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Does Accurate Data, Identifying Obese Patients Impact Nurse Safety and Hospital Finances?

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Submitted in total fulfilment of the requirements of the degree of

Doctor of Philosophy

26 July 2021
School of Medical and Health Sciences
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ABSTRACT

Healthcare staff who manage obese patients are at increased risk of sustaining patient handling injuries, and this risk is anticipated to intensify as projected Australian obesity rates increase to 42% by the year 2035 and obese patients admitted to hospitals also increase. High cost burdens to healthcare organisations will result due to increased funding requirements for bariatric risk management solutions and growing costs of workers’ compensation claims of injured staff. Five (5) studies explored if identification of obese patients impacts the safety of nurses and other healthcare staff who manage obese patients and investigated the accuracy of obesity data recorded in hospital data systems. Additionally, financial impacts to hospitals relating to obesity data accuracy was also examined. Very little research currently exists on these risks.

A literature review was conducted which investigated risks to healthcare staff and organisations that manage obese patients. Availability of obesity data to mitigate risks was also explored. Thirty (30) studies were included in the review, which identified high risks of injury to healthcare staff and high liability and financial risks to healthcare organisations. Availability of obesity data within clinically captured information was also verified.

A pilot study successfully investigated accuracy of obesity data in the Western Australian Country Health Service (WACHS), and factors potentially impacting completeness of obesity data recording and accuracy of obesity coding. The methodology and data used in the pilot study was expanded to examine 590 patient records, and poor completeness of obesity data recording and coding accuracy was determined.

Financial implications to hospitals due to inaccurate obesity data were also examined. Eighty five (85) records of inaccurate obesity data were identified and corrected, and adjusted Diagnosis Related Groups, National Weighted Activity Units and Activity Based Funding were examined. Estimated annual lost funding opportunities of A$2.23 million due to obesity coding inaccuracy was calculated.

Finally, an intervention to improve completeness of obesity recording and data accuracy was conducted at a WACHS hospital site over a 1 year timeframe. The intervention outcomes demonstrated improved obesity recording and coding, including increases in weight and height recording, BMI recording, obesity coding, and sensitivity.
The 5 completed studies illustrate the risks to healthcare staff and organisations that manage obese patients, and the ability to use accurate obesity data to mitigate risks and improve hospital finances. Obesity data recording and coding has been demonstrated to be inaccurate, however improvement programs will enhance obesity data recording and accuracy which will positively impact safety of hospital workers and hospital finances.
Declaration of Original Authorship

I, Kim McClean, certify that this thesis does not, to the best of my knowledge and belief:

(i) incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education;
(ii) contain any material previously published or written by another person except where due reference is made in the text; or
(iii) contain any defamatory material.
(iv) I also grant permission for the Library at Edith Cowan University to make duplicate copies of my thesis as required.

26/07/21
Acknowledgements

My sincere gratitude and appreciation is extended to the many people who have made this thesis possible. Firstly, to my supervisors Dr. Martyn Cross and Associate Professor Sue Reed, both of whom have generously offered their time, expertise, and guidance despite significant workloads. Thank you for providing me with advice and support throughout my PhD, for making yourselves available to meet with me and for patiently reviewing drafts of my work. I am also grateful for advice, assistance and support provided by the broader Occupational Safety and Health team at Edith Cowan University, particularly by Professor Jacques Oosthuizen, Dr. Marcus Cattani and Mrs. Sally-Anne Doherty.

Heartfelt thanks to my parents, Heather and Robert, who have always believed in me. Thank you for your ongoing support, assistance and encouragement especially in the hard times. A special thank you to my daughter Mia for her patience and acceptance when I have been engaged in my studies. I am also grateful to my other family members and friends who have supported me along the way.

A special thank you to Meegan Kidd, Program Officer Clinical Coding at the Western Australian Country Health Service (WACHS). Your contribution to study design concepts and arranging access to patient data and coding staff is sincerely appreciated. Thank you also to WACHS Executives and staff, particularly South West Regional Director Kerry Windsor, WACHS Clinical Coding staff and the hospitals and staff who participated in the studies.
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Author’s Contribution


The first article is a review of literature on risks to hospitals, nurses and other healthcare staff who manage obese patients, and use of obese patient admission data to inform risk reduction strategies. Work on the review commenced with an initial meeting in 2018 between Kim McClean, Martyn Cross and Sue Reed to discuss the literature keywords and review methodology. A second meeting occurred in 2018 between McClean and ECU librarian Pam Thornton to further define the review methodology and databases to be examined. McClean conducted the first literature search in 2018, and updated the literature review in 2019 and 2020. The literature review analysis and compilation of the draft journal article was conducted by McClean, and the draft article was edited and revised by Cross and Reed.


The second article is a result of a preliminary data collection and analysis of obese patient admission data at two sites belonging to the Western Australian Country Health Service (WACHS). The data collection and analysis methodology was developed by Kim McClean, Martyn Cross and Sue Reed, with expert advice from the WACHS Program Officer Clinical Coding, Ms. Meegan Kidd. McClean conducted the data collection and statistical analysis of the coding accuracy results, and wrote the draft article literature review, introduction, results and discussion. The draft article was edited and revised by Cross and Reed.


The third article is a result of the successful preliminary data collection and analysis of obese patient admission data at two WACHS sites. The data collection and analysis was extended to include four sites. The same methodology as the second article was utilised which was
developed by Kim McClean, Martyn Cross and Sue Reed, with expert advice from the WACHS Program Officer Clinical Coding, Ms. Meegan Kidd. McClean conducted the data collection and statistical analysis of the coding accuracy results, and wrote the draft article literature review, introduction, results and discussion. The draft article was edited and revised by Cross and Reed.


The fourth article examined the financial implications of data inaccuracy identified in study three. The data collection and analysis methodology was developed by Kim McClean, Martyn Cross and Sue Reed, and McClean conducted the data collection and statistical analysis of the financial implications. McClean wrote the draft article literature review, introduction, results and discussion. The draft article was edited and revised by Cross and Reed.


The fifth article is a result of an intervention to improve obesity data recording and coding accuracy, and a re-audit and comparison of results recorded in the second article. The data collection and analysis methodology was developed by Kim McClean, Martyn Cross and Sue Reed, with expert advice from the WACHS Program Officer Clinical Coding, Ms. Meegan Kidd. McClean conducted the data collection and statistical analysis of the coding accuracy results, with technical advice provided by Cross. McClean wrote the draft article literature review, introduction, results and discussion. The draft article was then edited and revised by Cross and Reed.

To Whom It May Concern,

I, Kim McClean, contributed to the five publications in the manner detailed above.

26/07/21
I, as a Co-Author of the papers listed, endorse that the level of contribution by the Candidate indicated is correct.

Dr. Martyn Cross
School of Medical and Health Sciences, Edith Cowan University. 26/07/21

Associate Professor Sue Reed
School of Medical and Health Sciences, Edith Cowan University. 26/07/21
Research Profile

This thesis will be presented with publications. Three of the studies within the thesis have been published in Australian and International Journals, one of the studies is currently accepted for publication in an International journal and one of the studies is under review in an International journal. Two conference presentations were conducted arising from studies in this thesis. The references for the papers and conference presentations resulting from this thesis are outlined below:

Published Journal Papers

   https://doi.org/10.2147/JMDH.S289676


   https://doi.org/10.37464/2020.381.99


Presentations Arising from Studies in this Thesis


Thesis Overview

This thesis examines patient obesity risks to healthcare organisations and staff, interrogates the accuracy of obesity data recorded in hospital patient admission systems, and demonstrates that data inaccuracies impact the safety of nurses and other healthcare staff required to manage obese patients. Methods to improve obesity data recording and coding are proposed, and a trial intervention is conducted to evaluate if the enhancements are successful in increasing obesity data recording and coding accuracy. The impact on hospital finances due to inaccurate obesity recording and coding is also explored. Accurate hospital funding can be used to implement staff safety enhancements such as appropriate staff resourcing to manage obese patients and increased allocation of bariatric wheelchairs and hoists. Given the current lack of awareness of obese patient data accuracy within Australian healthcare organisations, it is likely that there is a corresponding lack of awareness of the financial impact of inaccurate obese patient admission data.

This thesis comprises of 4 main elements:

- An introduction of the obesity condition and the impacts to healthcare organisations and staff (Chapter 1).
- A narrative literature review of international studies related to risks to hospitals, nurses and other healthcare staff who manage obese patients (Chapter 2).
- 4 exploratory case studies (Chapters 3 to 5).
- A discussion of the results, industry implications and recommendations for improvement (Chapters 6 to 7).

Chapter 1

Chapter 1 introduces the background and motivation of this thesis. The obesity condition is defined and impacts on healthcare workers and organisations who manage obese (bariatric) patients are presented, such as health and safety risks. The thesis approach, aim and objectives are included in this chapter, including use of a post-positivist critical analysis theoretical perspective. The novel content and contributions of Chapter 1 are:

- Examination of increasing obesity trends in the Australian population, future obesity predictions and correlations to increasing hospital admissions of obese patients.
- Identification of safety impacts to healthcare workers who care for obese patients and financial impacts to hospitals who manage obese patients.
• Examination of legal requirements to manage risks to healthcare staff that care for obese patients and review of risk management principles.
• Identification of methods of clinical recording of obesity data in health records and requirements for obesity data analysis.

Chapter 2

A narrative literature review is presented in Chapter 2 which examines Australian and International studies that focuses on risks to healthcare organisations and staff who manage patients with obesity and explores the ability to identify and quantify bariatric risks by using available data. The novel content and contributions of Chapter 2 are:

• Identification of risks to staff and organisations who manage obese patients.
• Examination of methods of obesity recording and requirements for obesity data analysis to inform risk management strategies.


Chapter 3

Chapter 3 includes two studies which examine obesity recording and data accuracy at Western Australian regional hospitals between 2015 and 2017. Manual reviews of obesity data recorded in patient files is conducted and compared to electronically coded obesity data. The novel content and contributions of Chapter 3 are:

• Identification and utilisation of fourteen indicators of obesity recording and coding accuracy to determine obesity accuracy and inter-rater reliability.
• Determination of the impacts on completeness of obesity recording and accuracy.
• Methods to improve obesity data recording and accuracy are recommended.

A pilot study to verify analysis methodology in Australian healthcare environments has been published in the Journal of Health, Safety and Environment (Impact factor: 0.08, Journal Ranking: Q4 (Medicine, Public Health, Environmental and Occupational Health)). The reference for this manuscript is: McClean, K., Cross, M. & Reed, S. (2019). Accuracy of Obese Patient Admission Data

The successful pilot study was expanded by analysing obesity recording and coding at four hospital sites and has been accepted for publication in *AJAN - The Australian Journal of Advanced Nursing* (Impact factor: 1.02, Journal Ranking: Q2 (Nursing)). The reference for this manuscript is: McClean, K., Cross, M. & Reed, S. (2021). An audit of obesity data and concordance with diagnostic coding for patients admitted to Western Australian Country Health Service hospitals. *AJAN - The Australian Journal of Advanced Nursing*, 38(1), 45-52.

**Chapter 4**

Chapter 4 builds on the findings of the two obesity data accuracy studies and examines financial impacts to hospitals due to inaccurate obesity data. Records of inaccurate obesity data identified in the obesity data accuracy studies are adjusted to determine correct obesity code and financial variations are determined. The novel content and contributions of Chapter 4 are:

- Identification of financial impacts and lost funding opportunities due to inaccurate obesity data.
- Examination of factors that may affect obesity data recording accuracy.


**Chapter 5**

Chapter 5 explores methods to improve obesity data recording and coding accuracy by implementing a trial intervention at a Western Australian country hospital that was also examined in the obesity data accuracy studies. A variety of obesity recording and coding improvements are implemented over a 12 month timeframe. Fourteen obesity recording and coding indicators are analysed and compared to results in the previous obesity data accuracy study. A hospital site not involved in the intervention, or the previous studies is also measured as a control site. The novel content and contributions of Chapter 5 are:

- Design of an intervention to enhance obesity data recording and coding accuracy.
The study has been submitted to *The Journal of Multidisciplinary Healthcare* (*Impact factor: 2.31, Journal Ranking: Q1 (Nursing)*) and is currently under review.


**Chapter 6**

The overall outcomes and findings of the studies included in this thesis are discussed in Chapter 6. A summary of the novel outcomes and findings in Chapter 6 are:

- Caring for obese patients presents high risks of injury to healthcare staff and high legal and financial risks to healthcare organisations
- Hospitals are receiving significantly inaccurate Activity Based Funding (ABF) reimbursements for the care of obese patients.
- Obesity data recording by clinicians can be improved with recording system enhancements and increased organisational commitment
- Improved obesity recording can be used to inform bariatric risk management approaches, plan for future increases in obese patient admissions and ensure accurate reimbursement of Activity Based Funding (ABF) to hospitals.

**Chapter 7**

Chapter 7 discusses substantive conclusions, practical recommendations and implications for future practices based on the results of all studies within the thesis.

The thesis structure is illustrated in Figure A.
| Study 1: A literature review of risks to healthcare organisations and staff who manage obese (bariatric) patients and use of obesity data to mitigate risks. |
| Study 2: A preliminary examination of the utilisation and accuracy of the obese patient admission data recorded by WACHS. |
| Study 3: An expanded examination of the utilisation and accuracy of the obese patient admission data recorded by WACHS. |
| Study 4: An examination of the financial impact of obese patient coding accuracy to hospitals. |
| Study 5: An implementation and measurement of enhanced obesity coding measures to increase obesity coding accuracy. |

The dissertation objective is to determine if obese patient admission data provides sufficient accuracy to be used to implement risk mitigation strategies. The dissertation examines two key areas: Obese patient data accuracy and Financial impacts on hospitals relating to obese data.

Does Accurate Data, Identifying Obese Patients Impact Nurse Safety and Hospital Finances?

Figure A. Thesis Outline.
## Definitions and Abbreviations

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<td>ABF</td>
<td>Activity Based Funding – an Australian Government funding system to calculate hospital reimbursements for the number of patients treated, the type of patient care required, hospital workload and associated costs incurred by the hospital.</td>
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<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<td>ACCD</td>
<td>Australian Consortium for Classification Development</td>
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<td>AIHW</td>
<td>Australian Institute of Health and Welfare</td>
</tr>
<tr>
<td>ANPHA</td>
<td>Australian National Preventative Health Agency</td>
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<tr>
<td>AS ISO</td>
<td>Australian Standards and International Organisation for Standardisation</td>
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<tr>
<td>Bariatric</td>
<td>The provision of clinical care for obese patients in hospitals</td>
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<tr>
<td>BMI</td>
<td>Body Mass Index - a person’s weight in kilograms divided by the square of the person’s height in metres (kg/m²)</td>
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<td>CDC</td>
<td>Centre for Disease Control</td>
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<td>CINAHL</td>
<td>Cumulative Index to Nursing and Allied Health Literature – a literature database of journal articles related to nursing and allied health.</td>
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<tr>
<td>Cohen’s Kappa Value</td>
<td>The measure of agreement between the patient admission data and the patient file data.</td>
</tr>
<tr>
<td>Consequence</td>
<td>A result of an action or situation, often one that is bad or not convenient.</td>
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<tr>
<td>Control measure</td>
<td>A way of eliminating or minimising risks to health and safety</td>
</tr>
<tr>
<td>COVID-19</td>
<td>A strain of coronavirus, formerly referred to as '2019 novel coronavirus'.</td>
</tr>
<tr>
<td>CT scan</td>
<td>Computed Tomography scan</td>
</tr>
<tr>
<td>DRG</td>
<td>Diagnosis Related Group</td>
</tr>
<tr>
<td>ECU</td>
<td>Edith Cowan University</td>
</tr>
<tr>
<td>False Negative</td>
<td>A result which wrongly indicates that a particular health condition is absent.</td>
</tr>
<tr>
<td>False Positive</td>
<td>A result which wrongly indicates that a particular health condition is present.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Hazard</td>
<td>A things that could cause harm, injury or ill health to a person.</td>
</tr>
<tr>
<td>HCARE</td>
<td>Health Care and Related Information System - A patient administrative</td>
</tr>
<tr>
<td></td>
<td>database used in Healthcare settings to record patient admissions.</td>
</tr>
<tr>
<td>HIM</td>
<td>Health Information Manager</td>
</tr>
<tr>
<td>Likelihood</td>
<td>The chance of something happening</td>
</tr>
<tr>
<td>MRI</td>
<td>Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>MBS</td>
<td>Medical Benefits Schedule</td>
</tr>
<tr>
<td>MEDLINE®</td>
<td>A database of journal citations and abstracts relating to biomedical</td>
</tr>
<tr>
<td></td>
<td>literature</td>
</tr>
<tr>
<td>MeSH</td>
<td>Medical Subject Headings</td>
</tr>
<tr>
<td>MSD</td>
<td>Musculoskeletal Disorder</td>
</tr>
<tr>
<td>NIH</td>
<td>National Institute of Health</td>
</tr>
<tr>
<td>NPV</td>
<td>Negative Predictive Value: a measure of the probability that patients</td>
</tr>
<tr>
<td></td>
<td>without a health condition code allocated truly don't have the condition</td>
</tr>
<tr>
<td>NWAU</td>
<td>National Weighted Activity Unit</td>
</tr>
<tr>
<td>OASCC</td>
<td>Office of the Australian Safety and Compensation Council (now referred to</td>
</tr>
<tr>
<td></td>
<td>as Safework Australia)</td>
</tr>
<tr>
<td>Obesity</td>
<td>Abnormal or excessive fat accumulation that may impair health</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>OSH</td>
<td>Occupational Safety and Health</td>
</tr>
<tr>
<td>Patient Handling</td>
<td>Movements involving lifting, turning and repositioning patients. Can</td>
</tr>
<tr>
<td></td>
<td>include bathing functions, making occupied beds, standing patients,</td>
</tr>
<tr>
<td></td>
<td>patient transfers, and changing dressings.</td>
</tr>
<tr>
<td>PBS</td>
<td>Pharmaceutical Benefits Scheme</td>
</tr>
<tr>
<td>PICoS</td>
<td>Population, phenomenon of Interest, Context, Study design – a literature</td>
</tr>
<tr>
<td></td>
<td>search strategy statement</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PPV</td>
<td>Positive Predictive Value: a measure of the probability that patients with a health condition coding truly have the condition</td>
</tr>
<tr>
<td>PRISMA</td>
<td>A literature review search strategy and synthesis</td>
</tr>
<tr>
<td>Risk</td>
<td>The effect of uncertainty on objectives and can be expressed as potential events and their consequences and likelihood</td>
</tr>
<tr>
<td>Risk Management</td>
<td>Coordinated activities to manage and control risks</td>
</tr>
<tr>
<td>SALSA</td>
<td>Search, Appraisal, Synthesis and Analysis – a literature review analytical framework</td>
</tr>
<tr>
<td>Scopus</td>
<td>A database of abstract and citation peer-reviewed literature relating to science, technology, medicine, social sciences and arts and humanities fields.</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>The degree of health condition recording in the patent admission data when it is first present in the patient files</td>
</tr>
<tr>
<td>Specificity</td>
<td>The absence of health conditions in the patient admission data if the condition is first absent in the patient files</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences – IBM data analysis tool</td>
</tr>
<tr>
<td>TOPAS</td>
<td>The Open Patient Administration System - A patient administrative database used in Healthcare settings to record patient admissions</td>
</tr>
<tr>
<td>VTE</td>
<td>Venous thromboembolism</td>
</tr>
<tr>
<td>WACHS</td>
<td>Western Australia Country Health Service</td>
</tr>
<tr>
<td>WC</td>
<td>Waist circumference</td>
</tr>
<tr>
<td>Web of Science</td>
<td>A database that provides a comprehensive citation search of scientific literature</td>
</tr>
<tr>
<td>WebPAS</td>
<td>A patient administrative database used in Healthcare settings to record patient admissions</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>WHR</td>
<td>Waist to hip ratio</td>
</tr>
<tr>
<td>WHS</td>
<td>Work, Health and Safety</td>
</tr>
</tbody>
</table>
Chapter 1 Introduction

1.1 Risks of Musculoskeletal Disorders to Healthcare Workers

Healthcare workers experience a high risk of musculoskeletal disorder (MSDs) injuries and MSD injuries to healthcare workers are recorded at greater rates than workers in construction, mining, and manufacturing industries (Abedinia et al., 2013). Within the category of healthcare workers, nurses are exposed to higher risks of MSDs and 20% of nurses experience work-related pain on any given day (Gallagher, 2011). Nurses report a 30–60% prevalence of back pain and a 43–53% rate of shoulder disorders due to conducting nursing tasks (Nuikka, 2002; Smith et al., 2003). Furthermore, 46% of nursing assistants reporting sustaining an injury while lifting, moving or helping a patient and 40% reporting a back injury due to conducting these tasks (Graham & Daugherty, 2012; Randall et al., 2009). MSD risks may affect an organisation’s ability to attract and retain staff as fear of sustaining injuries when moving obese patients is a major concern of nurses. 50% of staff consider leaving nursing because of the physical stress and injury involved (Gallagher, 2011; Walden et al., 2013).

MSD risks are often associated with patient handling tasks which are generally conducted by nurses and patient care staff. Patient handling tasks include lifting, turning and repositioning patients, bathing functions, making occupied beds, standing patients and patient transfers, and changing dressings (Muir & Archer-Heese, 2009). These tasks often cannot be conducted using standard manual handling practices as the patient’s weight is not evenly distributed, can be bulky or asymmetrical and cannot be held close to the nurse/patient care staff (Nelson, 2003). In order to manage the risks of these tasks, many hospitals have implemented “no lift” policies, however patient handling-related injuries continue to occur. Impacts on risks of injuries to healthcare staff include patient handling requirements in emergency situations, limitations of regional hospitals, when patient handling equipment is unavailable or lack of adequate staff. Additionally, each patient handling risk will vary for healthcare workers due to the unpredictable nature of the patient’s ability to assist with movements, patient uncooperative behaviour, sudden loss of balance by the patient and the healthcare worker’s individual health status.

Increasing risk of patient handling injuries to healthcare workers has been recognised both internationally and in Australia over the last decade. Healthcare organisations also face challenges to manage related issues such as aging workforces, high turnover of staff, high rates of musculoskeletal injuries to staff, high rates of staff absenteeism, high insurance premiums and increased demands to improve staff safety. Although there has been important awareness as to general patient handling
risks and injuries, there has been relatively little consideration to the patient handling subset of risks relating to the management of obese patients. Patient handling risks increase significantly when handling obese patients (Choi & Brings, 2016).

1.2 Obesity and Bariatrics

The term obesity is defined by the World Health Organisation (WHO) as abnormal or excessive fat accumulation that may impair health (WHO, 2021). Obesity is a chronic condition which is preventable and is generally caused by imbalances between calories consumed and calories expended which creates an energy imbalance resulting in excessive fat stored on the body (WHO, 2021). The obesity condition results in social, financial and health impacts on individuals. There are an excess of 30 illnesses and medical conditions associated with obesity including type 2 diabetes, coronary heart disease, respiratory conditions, stroke, hypertension and cancer (American Society for Metabolic and Bariatric Surgery, 2010). The Australian Safety and Compensation Council (ASCC) (now Safe Work Australia) affirms that severely obese patients are six times more likely to suffer from heart disease, and ten times more likely to have diabetes and kidney failure (Cowley & Leggett, 2009). The ASCC further states that 75% of morbidly obese individuals have at least one co-morbid condition and in many situations, obese patient hospitalisations can be linked to these associated health implications (Cowley & Leggett, 2009). Obese patients are more likely to require hospitalisation due to these associated co-morbidity conditions, which in turn indicates that a broad variety of hospital departments are required to manage obese patients.

Bariatric is a term used in healthcare environments to define the provision of clinical care for obese patients. The word bariatric is derived from the Greek work “barros” which means weight (Muir & Haney, 2004). There is international inconsistency with the definition of the term ‘bariatric’, however the use of Body Mass Index (BMI) has been the most accepted and consistent method for identifying and categorising both obesity and bariatric patients. The WHO has defined the BMI calculation methodology as a person’s weight in kilograms divided by the square of the person’s height in metres (kg/m²) (WHO, 2000). International debate has also occurred surrounding the use of BMI to measure obesity, with a view that BMI measurements may not always be an appropriate method of determining obesity. Examples where BMI categories may be inaccurate include athletes with high muscle mass, people with skeletal deformities and the elderly where body height shortens due to aging factors (Rush, 2002). Similarly, Healthdirect Australia (2014) and the Organisation for Economic Co-operation and Development (OECD) (2013) have identified that BMI is unreliable when measuring pregnant women, people with physical disabilities, people of some ethnic groups, people with eating disorders and people under 18 years of age. Furthermore, research examining waist size
measurements has also found that BMI may underestimate the incidence of obesity (Fife et al., 2007).

Although there are varying international views surrounding the use of BMI, organisations such as the WHO, the National Institute of Health (NIH) and the Centre for Disease Control (CDC) have determined that the use of BMI to measure obesity is reliable, inexpensive and efficient (Lemay et al., 2004). Additionally, the American Medical Association recognises the importance of BMI calculations by stating that it is the first step to diagnosing overweight and obesity (Kushner, 2003). Both the Western Australian Department of Health and the Australian Consortium for Classification Development (ACCD) use the BMI definitions displayed in Table 1.1.

**Table 1.1: Classification of adults according to BMI**

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
</tr>
<tr>
<td>Healthy Weight</td>
<td>18.5 – 24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0 – 29.9</td>
</tr>
<tr>
<td>Obese Class I</td>
<td>30.0 – 34.9</td>
</tr>
<tr>
<td>Obese Class II</td>
<td>35.0 – 39.9</td>
</tr>
<tr>
<td>Obese Class III</td>
<td>≥ 40.0</td>
</tr>
</tbody>
</table>

(Western Australia Department of Health, 2012, p.16)

Methods of determining patient weight must include physically weighing patient on scales or on equipment with scales embedded in them such as hoists or chairs. BMI scores determined from self-reported weight should be avoided as it has been well documented that patients either consciously or subconsciously under-estimate their weight (Shapiro & Anderson, 2003; White et al., 2007). The occurrence of incorrect volunteered weight measurements will be higher in certain patient groups such as females and obese patients, and some research has found that greater reporting errors of weight is strongly associated with increasing BMI measurements (Jeffery, 1996; Villanueva, 2001; White et al., 2007).
There is also international variation of obesity measurement and definition as demonstrated in Cowley & Leggett’s 2011 study which presented examples of one organisation using BMI calculations of over 30kg/m² to define obesity, and a second organisation using BMI calculations of over 40kg/m² to define obesity. The Western Australia Department of Health uses the WHO definition of obese, however also assert that additional measures of fat distribution such as waist circumference (WC) and waist to hip ratio (WHR) should be considered as measurable indicators of obesity (2008). Muir & Archer-Heese (2009) and New South Wales Health (2005) identify bariatric patients as obese patients who have weight distribution difficulties within the healthcare environment. Finally, Hahler (2002) defines bariatric patients as patients greater than 136 kilograms (300 pounds) or alternatively overweight by more than 45 to 90 kilograms (100 to 200 pounds).

In addition to the variation in obesity definition, there are also discrepancies within international clinical terminology. The term ‘morbid obesity’ is currently used in Australian guidelines however Access Economics use the terminology ‘clinically severe obesity’ in their Medical Benefits Schedule (MBS) reports. The United States National Institutes of Health also uses the term ‘clinically severe obesity’. Finally, the use of the term ‘extreme obesity’ and ‘morbid obesity’ is interchangeable as both relate to BMI measurements ≥40kg/m².

1.3 Worldwide Obesity Trends and Projections

The WHO has defined the worldwide obesity problem as one of the world’s most significant health problems and report that worldwide obesity has almost tripled since 1975. (WHO, 2000, 2021). Worldwide over 52% of the population were either overweight or obese in 2016, with 650 million people being obese (WHO, 2021). Australian obesity trends mirror the worldwide increase in obesity, with 67% of Australian adults being overweight or obese in 2017-18 (12.5 million people), comprising of 31.3% obese (5.8 million people) and 35.7% overweight (6.6 million people) (Australian Bureau of Statistics [ABS], 2018). This is an increase in Australians being overweight or obese from 56.3% in 1995, 62.8% in 2011-12 to 63.4% in 2014-15 (Australian Bureau of Statistics [ABS], 2017, 2018). The Australian National Preventative Health Agency (ANPHA) has identified that the average weight increase of Australian adults over the last 20 years is between 0.5 kilogram to 1 kilogram every year (2014). Muir et al. (2007) also found that obesity rates are rising across both genders, all age groups, races and education levels. Obesity projections forecast ongoing increases in obesity within the Australian population and predict that in 2035, 35% of the population will be overweight (11.2 million people) and 42% of the population (13.4 million people) will be obese (Infrastructure Australia, 2015; Walls et al., 2012).
1.4 Obesity Trends and Projections in Australian Healthcare

Capturing data to measure and determine obese patients being treated in Australian hospitals can be problematic due to variations in bariatric definitions, completeness of clinical record keeping and practices of clinical coding of obesity. Bariatric patients are recognised as having an increased likelihood of requiring medical intervention than patients who are within healthy weight ranges and Pieracci et al.’s 2006 research has determined that increases in obese patients requiring hospital admission matches increases in population obesity rates (ANPHA, 2014; Galinsky et al., 2010; Muir et al., 2007). These findings indicate that hospital admissions of obese patients will continue to be considerable and will increase in the future. A 2018 review of obese patients admitted to a Western Australian hospital supports this view by determining 55% of the hospital population during the study were either overweight or obese, with 23% being obese (Dennis et al., 2018). Given the Australian obesity trends and predictions and correlations to high amounts of obese patients admitted to Australian hospitals, future risks to healthcare organisations and workers who manage obese patients will be substantial.

1.5 The Cost of Obesity to the Australian Community

In addition to the direct health impacts of obesity and occurrence of comorbidities, obesity may also affect an individual’s mental wellbeing, employment and education, all of which can have adversely affect an individual’s personal finances and result in direct and indirect cost impacts to the community (World Obesity Federation, 2017). The estimated worldwide financial impact of the obesity condition is AUD$1.31 trillion per year, the equivalent of 13% of all healthcare expenditure (World Obesity Federation, 2017). Obesity cost the Australian economy $8.6 billion in 2011/12 in direct and indirect costs, and anticipated obesity-related costs are expected to rise by $87.7 billion between 2015 to 2025 if no public health action is taken to curb obesity (Department of Health Australia, 2013).

1.6 Cost Impacts of Obesity to Hospitals

Increasing obese patient admissions result from increasing obesity in the community and increasing trends of bariatric surgery for weight loss purposes. Bariatric surgery includes gastric band surgery (also called lap banding), gastric bypass and gastric sleeve surgery, and is deemed to be the only medical treatment that produces substantial and sustainable long-term weight loss (Colquitt et al., 2009; Picot et al., 2009). Bariatric surgery has become the most rapidly growing surgical practice in Australia, with the total number of Australian weight loss surgeries more than doubling from approximately 9,300 in 2005–06 to approximately 22,700 in 2014–15 (Australian Institute of Health and Welfare, 2017; O’Brien et al., 2004). Caring for obese patients is more labour intensive and
requires more time, increased staff and specialist patient handing skills and solutions than managing normal-weighted patients, all of which can be problematic in time-poor and resource-poor hospitals (Muir et al., 2007; Todd et al., 2014).

Increases of obese patients result in increased requirements for hospital staff to conduct safe patient handling, increased need for bariatric equipment and increased requirements for bariatric rooms including bariatric beds, chairs and toilets. These increased bariatric requirements result in increased cost implications to hospitals which are often not considered in budget forecasting, and result in costs associated with obesity being funded directly from hospital operating budgets. Additionally, increased recruitment costs, use of agency nursing staff to address increasing resourcing needs and ongoing increased nursing workloads also negatively impact hospital budgets. Increased admissions of obese patients also requires increased resourcing needs for dieticians, social workers and other allied health workers to assess obesity-related issues such as mobility, which again negatively affects hospital budgets.

1.6.1 Hospital Funding Model: Activity Based Funding
Healthcare organisations receive Activity Based Funding (ABF) which provides reimbursement of costs relating to the type of patient care delivered and the resources required for the patient treatment. ABF was enacted in 2011 as a result of the National Health Reform Agreement with the aim of increasing transparency of how funds are allocated to hospitals and to give hospitals incentives to use funding more efficiently (Solomon, 2014). Patient care requirements and treatment is recorded and coded through a series of calculations that result in allocation of ABF to the hospital for the patient treatment. It is essential that accurate recording and coding of clinical care requirements of obese patients occurs in order for hospitals to be allocated ABF correctly.

1.7 Increased Obesity in Australian Rural Communities
The risks of patient handling injuries to staff employed by regional health services will also be higher than staff providing healthcare in metropolitan hospitals due to obesity being more frequent in rural and remote areas compared to urban areas (ABS, 2008). Increased regional obesity rates are predominantly due to higher concentrations of communities of both lower socioeconomic categories and Aboriginal and Torres Strait Islanders residing in these locations (ANPHA, 2014). Lower incomes correlate with a higher likelihood of obesity and Indigenous populations are 1.3 times more likely to be overweight or obese than non-Indigenous populations (ABS, 2012; WA Department of Health, 2008). Given the Australian obesity projections, the correlation to increases in obese patient hospital admissions, and further increased rates of obesity in regional locations, healthcare staff working in rural hospitals who manage obese patients will be at significant risk of injury in the future. Regional
hospitals will require increased bariatric risk management approaches to reduce organisational liability risks, which will likely result in increased costs.

1.8 Legal Requirements to Reduce Risks to Staff that Manage Obese Patients

Australia currently has either Work, Health and Safety (WHS) or Occupational Safety and Health (OSH) legislation enacted across its states, all of which contain duty of care provisions which are designed to ensure staff are protected as far as practicable in workplaces. The Western Australian Occupational Safety and Health Act 1984 applies to sites studied in this thesis, a summary of the duty of care provisions of employers are below.

Provision and maintenance of a working environment where employees are not exposed to hazards, particularly:

I. Provide and maintain workplaces, plant, and systems of work such that, so far as is practicable, the employees are not exposed to hazards; and

II. Provide information, instruction, training and supervision of the employees as is necessary to enable them to perform their work so that they are not exposed to hazards; and

III. Consult and cooperate with safety and health representatives, if any, and other employees at the workplace, regarding OSH at the workplace; and

IV. Provide employees with adequate personal protective clothing and equipment as is practicable to protect them against hazards, without any cost to the employees; and

V. Ensure, so far as is practicable, the safe use, cleaning, maintenance, transportation and disposal of plant; and the safe use, handling, processing, storage, transportation and disposal of substances. (Department of Commerce, 1984).

As the hazards to staff who manage obese patients in hospitals are well documented, employers are legally required to adopt risk management and reduction approaches as far as is practicable. Improvement actions by healthcare organisations can be formally required by state safety regulators if hazards are not addressed. Prosecution action may result if related serious injuries occur or if healthcare organisations demonstrate ongoing non-compliance with the duties of the relevant safety legislation.

1.9 Obesity Risk Management in Healthcare

Due to obligations to treat obese patients, risks cannot be eliminated, however healthcare organisations can control and reduce risks when managing the obese patient cohort using risk management principles. In the Australian Standards and International Organisation for Standardisation AS ISO 31000:2018 Risk Management Guidelines, risk management is defined as
coordinated activities to manage and control risks in an organisation. The term ‘risk’ is defined as the effect of uncertainty on objectives and can be expressed as potential events and their consequences and likelihood (Standards Australia, 2018). Risk can be also be defined in layman’s terms as specific hazardous events and their consequences, which will have a frequency or probability of occurring (Leppälä, 2016). Risk management principles can be used by organisations and their staff to manage risk, make decisions, set and achieve objectives and improve performance (Standards Australia, 2018). The risk management process includes analysing the context, identifying risks, analysing risks, evaluating risks and implementing risk treatment and is displayed in Figure 1.1

![Risk Management Process Diagram](image)

**Figure 1.1 The main activities in the risk management process (AS ISO 31000:2018, p. 9)**

The first phase involves defining the scope and context which enables effective risk assessment and appropriate risk treatment (AS ISO 31000:2018). The context analysis includes examination of the objectives, expected outcomes, specific inclusions and exclusions, risk assessment techniques and tools, resources required and responsibilities. The risk assessment phases include identification and analysis of risk, considering the likelihood of events and the nature and magnitude of consequences. Risk matrices are common tools used to determine ratings of risk events by merging likelihood and consequence assessments, an example risk matrix is displayed in Table 1.2.
The risk treatment phase involves mitigating risks by implementing control measures that will eliminate or reduce the risk. Risk treatment involves selecting risk treatment options, planning and implementing the controls measures, assessing the effectiveness of the controls and determining if the remaining risk is acceptable. Risk treatment options can be assessed by utilising the hierarchy of controls, which ranks risk controls from the highest level of protection and reliability through to the lowest and least reliable protection (Worksafe Victoria, 2020). The hierarchy of controls is displayed in Figure 1.2 includes elimination of risk, substitution, isolation, engineering controls, administrative controls and use of personal protective equipment.
Healthcare organisations have both moral and legal obligations to manage obesity risks to their employees and patients. Risk identification is one of the first principles of risk management, and obesity identification is a key factor to managing risks to healthcare organisations, staff and obese patients’ themselves (Irwin, 2010). Having a comprehensive understanding of organisational risks relating to managing obese patients is warranted to improve safety outcomes for staff and patients.

The risk of obesity-related injury to nurses and patient care staff is presently difficult to manage due to discrepancies between current obese patient admission data and expected obese patient admission models. Some health Executives and Managers have acknowledged anecdotal awareness that obese patient admissions are increasing, however there is currently inadequate data to quantify obese patient treatment or admissions (Hahler, 2002; Kirk et al., 2010). The true number of obese patients being managed in Australian hospitals and healthcare sites is currently unknown, and the ability of health service providers to manage the risk of injury to nurses and other patient care workers who manage obese patients is limited. Given the documented obese management risks and injury rates to nurses, healthcare organisations cannot effectively manage these obese patient handling risks without the use of accurate data to quantifiably identify the risks in an evidence-based approach. Understanding bariatric patient handling risks will help organisations to identify deficiencies in risk management systems and focus interventions and resources more precisely (Randall et al., 2009). Furthermore, awareness of obese patient admission trends and increasing obesity projections will allow healthcare organisations to plan for future demands relating to obese patients and submit budgets for increasing obese patient requirements and staff safety initiatives.

1.10 Clinical Recording of Obesity Data

In hospital environments, anthropometric data including height, weight, BMI measurements and/or notations of obesity are routinely captured for many healthcare requirements and are recorded in patient files. This data collected during the patient’s care can be used to determine BMI and obesity (Noël et al., 2010). Many Australian healthcare organisations are currently transitioning to the adoption of electronic health records however a variety of methods of recording patient information are currently being used including the use of manual patient files, electronic records or hybrid models that involve manual files being scanned into patient admission databases.

When patients are discharged from hospital, their admission records are analysed by clinical coding staff who examine the notes within the manual patient files and assign up to 50 diagnosis codes to the patient electronic record which represent the treatment(s) provided. Obesity is coded when the condition is clinically observed and impacts the patient’s management during their hospital admission. The obesity condition may impact the healthcare provided during the patient’s
admission by requiring the commencement, alteration or adjustment of therapeutic treatment, requiring additional diagnostic procedures and/or requiring increased clinical care and/or monitoring.

The diagnosis coding is undertaken according to the Australian Coding Standards 9th Edition (2015) as defined by the ACCD. The Australian Coding Standards is a tool used by clinical coding staff that standardises code definitions and is used to ensure data consistency and integrity across all Australian health service providers. The diagnosis code(s) are further classified and used to calculate ABF reimbursements to hospitals for the patient care provided.

1.11 Data Examination of Obese Patient Risks

To understand the extent of the patient obesity risks and implications to organisations, staff and patients, a risk-based approach is required. Seigel & Ruoff (2015) state that data holds the key to risk reduction and the identification of trends may provide valuable insight that results in the development of strategic direction and action plans to meet organisational needs. The requirement for data examination and analysis by healthcare organisations is also addressed by Stanfill et al. (2010), highlight that the need for data and data analysis in healthcare has never been bigger, and accurate coding and reporting of health diagnosis and conditions has become more crucial. Directly relating to patient obesity risks, Grant and Lipscomb (2008) assert that until the extent of the obesity problem is known, it cannot be managed effectively. Organisational ability to predict risks and adopt risk management strategies will be dependent on opportunities to leverage relevant data.

Healthcare organisations may have difficulties in designing and implementing evidence-based proactive risk management approaches due to lack of relevant obesity data. Absence of obesity data may cause either ignorance of the risk or cause organisations to rely on anecdotal awareness of the risks. Many risk management approaches adopted to increase staff safety when managing obese patients result in operational funding impacts, such as increased staffing, and the purchase of equipment such as hoists, bariatric wheelchairs and bariatric beds. Accurate healthcare data is also essential to ensure accuracy of ABF and appropriate reimbursement of costs incurred by healthcare organisations that manage obese patients.

Injuries to healthcare workers resulting from bariatric patient handling may also be difficult to measure if there is a lack of patient obesity recording (Cowley & Leggett, 2011; Galinsky et al., 2010; Hahler, 2002; Muir et al., 2007). Similarly, lack of obesity recording may also result in difficulties in measuring outcomes of targeted bariatric interventions (Arzouman et al., 2006). Increased ability to
identify and record obesity will be crucial in informing, measuring and evaluating risk management strategies such as increased resourcing, bariatric equipment use and targeted interventions.

While recording and measuring obese patients requiring healthcare services is important from a staff safety perspective, it is also important for public health information which may inform obesity-related education and targeted treatment campaigns. As demonstrated above, the impact of obesity to the Australian economy is significant and measurement of both obesity healthcare requirements and admission trends may assist to inform community programs to reduce obesity.

1.12 Gaps in Research

This thesis examines patient obesity risks to healthcare organisations and staff, interrogates the accuracy of obesity data recorded in hospital patient admission systems, and builds an argument that data inaccuracies impact the safety of nurses and other healthcare staff required to manage obese patients. Furthermore, the research proposes improvements to data collection and/or recording methods to enhance data accuracy and a trial intervention to measure obese patient data recording and coding improvements is conducted. Additionally, financial impacts of obese patient data inaccuracies to hospitals is explored to examine the possibility of hospital funding being negatively impacted by data inaccuracy. Sound hospital funding could be used to implement nurse safety enhancements such as appropriate staff resourcing to manage obese patients and increased allocation of appropriate bariatric wheelchairs and hoists. Given the current lack of awareness of obese patient data accuracy within Australian healthcare organisations, it is likely that there is a corresponding lack of awareness of the financial impact of inaccurate obese patient admission data.

It is clear from the available literature that Australian population obesity rates are increasing and there are confirmed positive correlations between population obesity rates and hospital admissions of obese patients. Increased bariatric patient handling tasks will be required to be conducted in the future which poses significant risks to nursing and healthcare staff. While there have been advancements in the healthcare industry of increased bariatric patient handling policies and procedures, there is a lack of Australian research into the accuracy of obese patient admission data and methods to improve accuracy of obese patient admission data. More research is required to reduce obesity-related handling risks to healthcare organisations, staff and patients.

1.13 Research Approach

This thesis is exploratory in nature and is not bound by preconceived theories or conceptual frameworks. A post-positivist critical analysis theoretical perspective is adopted to guide the inductive research, which is concerned with exposing conditions of constraints, injustices or errors to
generate critical knowledge in order to provide knowledge growth and advancement. This research examines the validity of obesity data recorded in hospital patient admission data and builds an argument that data inaccuracies impact both financial measures relating to obese patients and safety of nurses and other healthcare staff required to manage obese patients.

The theoretical perspective used will support the comparison of data sources to identify data deficiencies and provide an implicit argument that the patient admission data coding methods require both further examination and improvement in order to deliver accurate data. While this theoretical perspective directs analysis and comparison between data, there is an assumption that the obesity data sets themselves are valid as the gold standard.

1.14 Research Aim

This project aims to determine if obese patient admission data provides sufficient accuracy to be used to implement risk mitigation strategies which will support workplace health and safety approaches for nurses and other healthcare staff. Additionally, the financial impact to healthcare organisations due to inaccurate obese patient admission data is also examined.

1.15 Research Objectives

To meet the research aim, the thesis includes the following objectives:

- Determine what is known about obesity risks to healthcare staff and organisations that manage and care for obese (bariatric) patients.
- Examine the utilisation and accuracy of obesity data and its impact on the health and safety of nurses and other healthcare staff; and provide recommendations for improvement to obesity data collection practices if required.
- Examine the financial impact to hospitals due to obese patient coding inaccuracy; and
- Develop, implement and measure intervention strategies to enhance obesity recording and coding measures to improve obesity coding accuracy.

1.16 Research Approvals

All studies within this thesis are approved by the Edith Cowan University (ECU) Human Research Ethics Committee, the WACHS Human Research Ethics Committee, the WACHS Research Governance Office and the WACHS Chief Executive. A waiver of consent under section 2.3.10 of the National Statement National Statement on Ethical Conduct in Human Research (Australia) is also approved by the Edith
Cowan University Human Research Ethics Committee and the WA Country Health Service Human Research Ethics Committee.
Chapter 2 Literature Review: Risks to Healthcare Organisations and Staff Who Manage Obese (Bariatric) Patients and Use of Obesity Data to Mitigate Risks.

This chapter is presented as the author-accepted manuscript of a peer-reviewed article published in the *Journal of Multidisciplinary Healthcare* (2021; 14(1)).

2.1 General Overview

There is growing awareness of risks associated with bariatric patient management however Australian research in this area is lacking. Further investigation is required to inform the development of preventative risk management approaches to increase staff safety and lessen other impacts of obesity management. This literature review examines current knowledge surrounding risks to healthcare staff and organisations who care for obese patients and use of obesity data to identify bariatric patients and qualify associated risks. This review approach is unique and not available in current literature. Increased knowledge of risks to healthcare staff and organisations who care for obese patients is required due to Australian population obesity rate projections increasing from 31% in 2018 to 42% by the year 2035, which will result in projected increases of hospital admissions of obese patients.

2.2 Search and Synthesis Methodology

A systematic literature search and review is conducted to synthesize Australian and International literature related to risks to hospitals, nurses and other healthcare staff who manage obese patients. Use of obese patient admission data is also examined as a potential method to inform obese patient risk mitigation strategies and potentially reduce risks related to management of obese patients. A PICoS statement is developed to inform the literature review search strategy and a Search, Appraisal, Synthesis and Analysis (SALSA) analytical framework is developed relevant to the study topic. The PICoS statement and SALSA framework are displayed in tables 2.1 and 2.2 respectively.

Table 2.1 PICoS Search Statement

<table>
<thead>
<tr>
<th>P (population)</th>
<th>Nurses, healthcare workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (phenomenon of interest)</td>
<td>Obesity risks</td>
</tr>
<tr>
<td>Co (context)</td>
<td>Hospitals</td>
</tr>
<tr>
<td>S (study Design)</td>
<td>qualitative, quantitative and mixed method</td>
</tr>
</tbody>
</table>
Table 2.2 Medical Subject Heading (MeSH) and Keyword Terms for Literature Search

<table>
<thead>
<tr>
<th>Search category</th>
<th>Search terms used</th>
</tr>
</thead>
<tbody>
<tr>
<td>healthcare staff AND</td>
<td>nurs* OR “healthcare staff”</td>
</tr>
<tr>
<td>obesity AND</td>
<td>bariatric OR obes* OR weight OR overweight OR BMI or “body mass index”</td>
</tr>
<tr>
<td>patient handling OR</td>
<td>“patient handling” OR lifting OR transfer OR “manual handling” OR “patient care”</td>
</tr>
<tr>
<td>injuries OR</td>
<td>injur*</td>
</tr>
<tr>
<td>Data</td>
<td>Data</td>
</tr>
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</table>

The literature search examines qualitative, quantitative and mixed-method literature published between 1999 to 2019 in four research databases, being the Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE, Scopus, and Web of Science. Inclusion criteria for journal papers includes:

(i) must include obesity risks in a healthcare environment,
(ii) must reference at least one obesity-related risk such as patient handling or injuries or reference use of obesity-related data; and
(iii) must be published in English in a peer-reviewed journal.

Grey literature and papers that relate to obese healthcare staff or paediatric obesity are excluded. A PRISMA search strategy and synthesis is utilised, which involves initial screening of potential papers by examining the article title. Papers that are not relevant to the topic are excluded and relevant papers are then reviewed in more detail by screening the abstract. Eligible papers are then assessed in full for consideration of inclusion in the review and relevant study particulars are then extracted from the reviewed papers.

2.3 Literature Review Results

The search strategy initially produced 3181 compiled results. Exclusion criteria was applied, and further reviews were conducted to ensure relevance and compliance with study protocols. A review of the limiters and duplicated records excluded 2193 records from the study. The study exclusion criteria was then applied and titles are screened for relevance, resulting in 822 records being excluded. A further review of abstracts was conducted to refine the results and a total of 92 studies did not meet the study protocols and were removed. Finally, the 74 remaining studies are further
scrutinised against the inclusion criteria and 44 studies were removed due to low relevance. After the application of all inclusion and exclusion criteria, a total of 30 studies remain to inform the literature review. Figure 2.1 demonstrates the PRISMA search strategy and synthesis.

![Figure 2.1 PRISMA study flow diagram.](image)

Of the 30 eligible studies, 27 studies examine risks of musculoskeletal disease (MSD) or injury to healthcare workers who manage patients with obesity. Thirteen (13) studies document potential medicolegal risks for healthcare organisations who treat obese patients. Seven (7) studies met the criteria for exploring the requirement for, or use of, data to quantify obese patient admission risks. Many papers identified multiple risk themes and each study included in the literature review is summarised in Table 2.3.
<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Risk</th>
<th>Key Findings and Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hahler (2002)</td>
<td>Data, Medicolegal Risk, MSD injury risks to staff.</td>
<td>Obesity increases morbidity and mortality and causes numerous care challenges however there is no data that quantifies the extent of this problem and the effects of targeted interventions. <strong>Recommendation:</strong> Research priorities are identification of patients with obesity and measuring interventions.</td>
</tr>
<tr>
<td>Davidson et al. (2003)</td>
<td>Medicolegal Risks, MSD injury risks to staff.</td>
<td>Medicolegal risks are high when treating patients with morbid obesity morbidly due to size and weight difficulties. Organisational risks include patient handling risks, environmental modifications, and increased staff workloads and injury risks. <strong>Recommendation:</strong> Planning to equip hospitals with resources to decrease body strain will result in injury reduction.</td>
</tr>
<tr>
<td>Edlich et al. (2005)</td>
<td>MSD injury risks to staff.</td>
<td>Nursing is a high-risk occupation for back injuries, primarily from lifting patients. Body mechanics training is ineffective for safe patient handling, and 'no lift' approaches are required. <strong>Recommendation:</strong> Increased use of bariatric lifting equipment is required. Medicare systems must be updated to reimburse costs of hospital lifting equipment.</td>
</tr>
<tr>
<td>Gallagher (2005)</td>
<td>Medicolegal Risk, MSD injury risks to staff.</td>
<td>Equipment for patients with obesity can improve quality of care, reduce length of stay and be safer for staff to care for patients. Hospitals are at increased legal risk when managing patients with obesity. <strong>Recommendation:</strong> Examine costs of staff injuries and prolonged patient hospitalisation to economically justify purchasing bariatric equipment. Staff education, pre-planning, proper equipment and awareness of legal implications will improve clinical and cost outcomes when managing patients with obesity.</td>
</tr>
<tr>
<td>Arzouman et al. (2006)</td>
<td>Medicolegal Risks, MSD injury risks to staff.</td>
<td>Physical injury may result when moving heavy patients, particularly to older nurses. Inability to treat patients with obesity due to lack of bariatric equipment may create legal issues. <strong>Recommendation:</strong> Nurses must be proactive in providing safe care to the obese population. A bariatric protocol was successful which includes an interdisciplinary approach, dissemination of information and staff training.</td>
</tr>
<tr>
<td>Wilson &amp; Tyler (2006)</td>
<td>MSD injury risks to staff.</td>
<td>The use of bariatric equipment, processes, training and work practices can reduce staff injuries and improve patient care outcomes. <strong>Recommendation:</strong> A multidisciplinary approach that includes policies, implementation responsibilities, compliance accountability and equipment.</td>
</tr>
<tr>
<td>Chappell (2007)</td>
<td>Medicolegal Risk</td>
<td>Claim increases relating to clinical negligence claims and staff injuries may occur if obesity risk management is not implemented. <strong>Recommendation:</strong> Investment in clinical and patient handling equipment, and patient handling training is required.</td>
</tr>
<tr>
<td>Authors</td>
<td>Data</td>
<td>Manual patient handling of patients with obesity is unsafe and risks MSD injuries to nurses. <strong>Recommendation:</strong> Organisations should provide safe working environments through ergonomic research, no-lift policies and education.</td>
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<tr>
<td>Muir et al. (2007)</td>
<td>Data, MSD injury risks to staff.</td>
<td>Lack of data measuring bariatric patients and patient handling risks. Enhanced bariatric patient process included staff training, equipment and patient handling policy. <strong>Recommendation:</strong> Hospitals should assess bariatric equipment based on patient fit not weight limits. Regular training and policies are required. Bariatric learnings and improvements to be shared between hospitals.</td>
</tr>
<tr>
<td>Vieira (2007)</td>
<td>MSD injury risks to staff.</td>
<td>Transferring, turning and repositioning patients in bed are high risk tasks to nurses. risks are magnified when managing patients with obesity. <strong>Recommendation:</strong> Fitness for work, job modifications and training programs can reduce MSD risks to nurses.</td>
</tr>
<tr>
<td>Muir &amp; Heese (2008)</td>
<td>MSD injury risks to staff.</td>
<td>Staff safety decisions should be based on bariatric guidelines and patient handling algorithms. <strong>Recommendation:</strong> Further research into bariatric patient handling tools and algorithms is required. Successful bariatric patient systems and improved use of bariatric equipment should be shared amongst organisations.</td>
</tr>
<tr>
<td>Whipple (2008)</td>
<td>MSD injury risks to staff.</td>
<td>Underutilisation of bariatric equipment occurs despite awareness of increased staff safety. Barriers to improving equipment use include commitment to traditional practices, lack of staff training on equipment use and patient rehabilitation concerns. <strong>Recommendation:</strong> Increased bariatric patient admissions will require improved bariatric patient handling, including use of bariatric equipment.</td>
</tr>
<tr>
<td>Muir &amp; Archer-Heese (2009)</td>
<td>Medicolegal Risk, MSD injury risks to staff.</td>
<td>An effective bariatric patient handling program includes operational procedures, patient assessment tools, communication tools, patient handling algorithms, space and environment considerations, equipment needs, training and evaluation. <strong>Recommendation:</strong> Timely procedure updating which incorporates ongoing bariatric patient handling research findings to ensure procedures are evidence-based and reflect best practice.</td>
</tr>
<tr>
<td>Randall et al. (2009)</td>
<td>MSD injury risks to staff.</td>
<td>Patients with obesity account for &lt;10% of patients, however 30% of staff injuries occurred when caring for a patient with obesity, mostly due to patient handling tasks. <strong>Recommendation:</strong> Proven and effective bariatric patient handling systems should be implemented to protect staff.</td>
</tr>
<tr>
<td>Todd (2009)</td>
<td>MSD injury risks to staff.</td>
<td>Patients with morbid obesity incur 81% more healthcare costs than normal weighted patients. Treating patients with obesity results in increased workload, resource requirements, and staff safety issues. <strong>Recommendation:</strong> Hospitals must adapt to accommodate patients with obesity.</td>
</tr>
<tr>
<td>Cowley &amp; Leggett (2010)</td>
<td>Data, MSD injury risks to staff.</td>
<td>Staff manual handling risks are significant but not quantifiable. Risk is influenced by environmental design, equipment limitations, training provision and use of written procedures. <strong>Recommendation:</strong> Standardised definition of &quot;bariatric&quot;. Increase research to quantify bariatric patient movement in hospitals, funeral homes and emergency services.</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Data, Description</td>
<td>Summary</td>
</tr>
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<tr>
<td>Galinsky, Hudock &amp; Streit (2010)</td>
<td>Data, MSD injury risks to staff.</td>
<td>Increasing overweight/obese patients are resulting in increased injuries to staff conducting patient handling. Patients with obesity require more frequent and extensive care, which involves increased time and physical exertion by staff. Incomplete recording of bariatric patient handling injuries occurs. <strong>Recommendation:</strong> Research is needed to quantify bariatric patient handling hazards/injuries, and assessment of ergonomic interventions.</td>
</tr>
<tr>
<td>Irwin (2010)</td>
<td>Data, Medicolegal Risk</td>
<td>Identifying and managing risks of obese pregnant patients is challenging, there are no national guidelines to direct policy development. <strong>Recommendation:</strong> Risk management approaches should be developed to safely manage obesity in pregnancy and improve outcomes. Ongoing identification of maternal obesity and analysis of risk is required.</td>
</tr>
<tr>
<td>Kirk et al. (2010)</td>
<td>Data, Medicolegal Risk, MSD injury risks to staff.</td>
<td>Height and pre-pregnancy weight is recorded however maternal obesity is not regularly captured. Maternal obesity impacts clinical complications and staff injuries. <strong>Recommendation:</strong> Formal recording of BMI/maternal obesity will improve understanding of patient and staff needs, including tracking of interventions. Lack of obesity data justified use of self-reported data but not ideal.</td>
</tr>
<tr>
<td>Noel et al. (2010)</td>
<td>Data</td>
<td>Anthropometric data (height, weight, BMI) are important and generally reliable sources of obesity data. <strong>Recommendation:</strong> Anthropometric data can inform research and development of obesity practices. Data completeness and quality can be improved by Managers and Policy Makers.</td>
</tr>
<tr>
<td>Swann (2010)</td>
<td>MSD injury risks to staff.</td>
<td>Risk assessments prior to patient admission should be conducted on obese patient handling and equipment needs. Training, equipment and sufficient working space is required. <strong>Recommendation:</strong> Bariatric equipment must be suitable for patient size/weight, staff to be trained in equipment use and patient handling procedures.</td>
</tr>
<tr>
<td>Cowley &amp; Leggett (2011)</td>
<td>Data, MSD injury risks to staff.</td>
<td>Lack of understanding of bariatric risks across the patient care journey. Lack of a standardized 'bariatric' definition including varied measurement of obesity. <strong>Recommendation:</strong> Improved collaboration between patient industries to improve risk reduction interventions. Standardised definition of 'bariatric' and improved data collections to quantify bariatric frequency.</td>
</tr>
<tr>
<td>Gallagher (2011) USA</td>
<td>Medicolegal Risk, MSD injury risks to staff.</td>
<td>Obesity may affect preventative care outcomes, delays in diagnosis and interventions. Increasing numbers of patients with obesity will increase risk of injuries to staff. <strong>Recommendation:</strong> Enhanced care for the obese includes use of equipment, staff training, size-appropriate rooms and increased staffing. Implementing no-lift strategies or lift teams increases staff safety.</td>
</tr>
<tr>
<td>Authors</td>
<td>Topic</td>
<td>Findings</td>
</tr>
<tr>
<td>--------------------------</td>
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<tr>
<td>Walden et al. (2013)</td>
<td>Medicolegal Risk, MSD injury</td>
<td>Lift teams resulted in decreased patient handling injuries to staff by 38%, increased staff perception of safety, reduced patient pressure ulcers by 43% and reduced care costs by $495,293. <strong>Recommendation:</strong> Consider linking programs that improve staff safety with enhanced patient care outcomes.</td>
</tr>
<tr>
<td></td>
<td>risks to staff.</td>
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</tr>
<tr>
<td>Choi &amp; Brings (2016)</td>
<td>MSD injury risks to staff.</td>
<td>MSD risks to staff increased when conducting patient handling tasks on patients that are overweight/obese. <strong>Recommendation:</strong> Patient handling controls are required such as lifting/transfer equipment, ergonomic assessments, no-lift policies and staff training.</td>
</tr>
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</tr>
<tr>
<td>Labreche, Tucker &amp; Kleinclauss (2017)</td>
<td>Medicolegal Risk, MSD injury risks to staff.</td>
<td>Reductions in length of stay, case costs and patient/staff risks can result from use of correct equipment, motivated patients with obesity and consistent and creative rehabilitation teams. <strong>Recommendation:</strong> Bariatric cases reviews considering improvement opportunities such as equipment and technology gaps. Knee pain management should be considered for bariatric cases.</td>
</tr>
<tr>
<td>Richardson. &amp; Harris (2018)</td>
<td>Medicolegal Risk, MSD injury risks to staff.</td>
<td>Patients with obesity are more likely to attend Emergency Department and have higher health risks due to comorbidities. Challenges of treating patients with obesity include difficulties with patient airways, circulation, radiographic imaging and medication administration. <strong>Recommendation:</strong> Ongoing obesity management training, including review of best practices, and patient handling.</td>
</tr>
<tr>
<td>Van Wicklin (2018)</td>
<td>Medicolegal Risk, MSD injury</td>
<td>Risks to patients with obesity and staff are present in operating rooms, including increased risk of pressure injuries, venous thromboembolism (VTE), surgical antisepsis, surgical positioning/movement and equipment. <strong>Recommendation:</strong> Identify risks when moving patients and perioperative care. Implement interventions to reduce pressure/positioning injuries and VTE, ensure supply of equipment and personnel to move patients, and adhere to professional guidelines for safe surgical positioning of patients with obesity.</td>
</tr>
<tr>
<td></td>
<td>risks to staff.</td>
<td></td>
</tr>
<tr>
<td>Morley (2019)</td>
<td>MSD injury risks to staff.</td>
<td>Increasing patients with obesity translates to increased obese deceased patients. There is a lack of literature on safe management of deceased patients with obesity, and patients are being manually handled post-death. <strong>Recommendation:</strong> Development of a Deceased Bariatric Pack to reduce manual handling of deceased obese patients.</td>
</tr>
</tbody>
</table>
2.4 Discussion of Literature Review Findings

Risks to both healthcare organisations and staff who provide care to obese patients were observed throughout the literature. High risks of musculoskeletal disorders (MSD) and injuries were experienced by nurses and other healthcare staff due to managing excessive weights and forces when conducting patient handling tasks. Compounding these risks is increased workload and time requirements to care for obese patients. Staff shortages are common in both nursing roles and hospitals generally, and workload pressures may affect staff ability to conduct nursing tasks safely. While ‘no lift’ approaches may reduce risks in some cases, lack of appropriate staffing levels and bariatric equipment in regional hospitals that manage obese patient care are barriers to implementing safety improvements. These issues are health system challenges to regional hospitals that require attention given that obesity rates are higher in regional locations (ABS, 2008). Due to the comorbidities associated with the obesity condition and the clinical testing and procedures often required, the healthcare journey of obese patients is varied and complex. Many hospital departments and staff may be required to manage obese patients which increases the breadth of exposure to bariatric risks across many different occupation groups and locations.

Organisational risks due to caring for bariatric patients was also demonstrated in the literature, including financial risks, cultural risks, recruiting and staffing risks and medical liability risks. Increased direct costs to hospitals may occur due to impacts on insurance premiums relating to workers’ compensation claims and/or common law claims of staff injured when conducting bariatric patient handling tasks. Additionally, hospitals experience significant costs when purchasing required bariatric equipment such as hoists, bariatric beds and wheelchairs and modifying hospital rooms to include additional space and bariatric toilets. Indirect costs and management workload implications may be experienced by hospitals with injured staff such as hiring and training of replacement staff and temporary reduced efficiencies. Difficulties in maintaining a positive staff culture and attracting and retaining skilled staff may also present in organisations with poor bariatric patient management approaches. Finally, increased medical liability risks may occur due to challenges in the delivery of clinical care due to the obesity condition, such as difficulties in determining clinical care requirements due to skin folds and increased body density, medication issues due to increased body fat compositions and high-risk bariatric pregnancies. Medical negligence claims may occur which can be costly and impact both an organisation’s finances and reputation.

To develop and implement plans to reduce obesity-related risks to healthcare staff and organisations, accurate obesity data is required that can be used to measure current obese patient admissions, requirements for bariatric equipment and additional staff and to forecast future obesity
trends and bariatric requirements for hospitals. The review of the literature confirms the ability to capture weight, height and BMI within patient files however identifies challenges to quantify obese patient admissions or treatment. Under-reporting of hazards and injuries experienced by healthcare staff relating to bariatric patient handing tasks is recognised which results in poor data collection. Improvements in data recording are required to improve organisational awareness of the bariatric risks and impacts on staff and enhance an organisation’s ability to target and measure bariatric patient handing risk reduction activities.

Sections 2.4.1 through to 2.4.3 further discuss obesity-related risks to healthcare staff and organisations and availability of obesity data in patient records identified and examined within the literature review.

2.4.1 Patient Obesity Risks to Healthcare Staff

Nursing is one of the leading professions who experience musculoskeletal injuries and disorders, with nurses reporting a 30–60% prevalence of back pain, and a 43–53% rate of shoulder disorders (Nuikka, 2002; Smith et al., 2003). Furthermore, 20% of nurses experience work-related pain on any given day, and 50% of staff consider leaving nursing because of the physical stress and injury involved (Gallagher, 2011). Conducting patient handling tasks on patients within healthy weight ranges presents high risks to healthcare workers, confirmed by a 2006 study that determined 68% of sprains and strains suffered by nurses were directly attributed to patient handling tasks (Nelson, 2006). Conducting patient handling tasks is physically demanding and healthcare staff are at high risk of injury due to many of the patient handling tasks exceeding safe working loads (Muir & Archer-Heese, 2009).

These high patient handling risks are further increased when managing obese patients. Injuries to backs, wrists, knees and shoulders have been demonstrated to increase when conducting bariatric patient handling tasks (Choi & Brings, 2016; Walden et al., 2013). Nurses and other staff who care for obese patients are at a higher risk of injury due to the substantial weight involved and awkward postures (Hignett et al., 2007). For example, simple tasks such as supporting an obese patient’s leg during a dressing change can result in increased risk of injury to healthcare staff. Sturman-Floyd (2013) has determined that a person’s leg weighs approximately 15% of total body weight, which when managing an obese patient weighing 190 kilograms could result in a nursing requirement to support the leg weight of almost 30 kilograms for a sustained time period. Bariatric patient handling tasks present unique challenges and increased risks to carers as patient bodies are not uniform, body shape and weight is unevenly distributed and there are no convenient handholds to grasp (Galinsky
et al., 2010). Additional patient challenges that increase risks to caregivers include patient pain levels, immobility, levels of sedation and lack of cooperation (Gallagher, 2011).

Managing obese patients results in increased physical workloads for carers with high percentages of obese patients requiring assistance with bathing, toileting, repositioning and getting out of bed (Muir & Heese, 2008). Bariatric patients require more frequent repositioning that normal weighted patients to prevent pressure ulcers, avoid respiratory issues and to assist with wound healing (Galinsky et al., 2010). Several studies support that the exertion, awkward postures and spinal loads experienced by carers who conduct these tasks result in high risk of injuries, which is further exacerbated by increased patient weight (Galinsky et al., 2010; Muir & Heese, 2008; Randall, 2009). The morbidly obese can also have significant width, causing carer injuries due to over-reaching.

Caring for obese patients is more labour intensive and requires more time, staff and specialist patient handing skills and solutions than when managing normal weighted patients (Muir et al, 2007; Todd et al, 2014). An additional 1.5 hours of care per day can be required when managing unconscious obese patients or obese patients requiring full care compared to normal weighted patients. Caregiver fatigue relating to increased workloads and low recovery time between tasks may contribute to injuries (Davidson et al., 2003; Randall et al., 2009). An unconscious obese patient may require up to 5 staff to safely lift or reposition them and lack of staff availability in busy wards or smaller hospitals, during lunch breaks, shift changeovers or emergencies may also result in unsafe patient handling occurring (Davidson et al., 2003; Muir & Archer-Heese, 2009; Van Wicklin, 2018).

A further indication of high risks that bariatric patient handling tasks present to healthcare staff is demonstrated in a 2007 American study that determined over a 12-month period obese patients represented less than 10% of all patients however 30% of all carer injuries were due to bariatric patient handling (Randall et al., 2009). This over-representation of injuries to patient carers should be a concern to hospital managers given that patient obesity in known to be under-reported in hospital data sets and patient handling injuries are known to be cumulative in nature. The true risk of handling obese patients is likely to be higher than reported and requires further investigation to better inform risk management initiatives to reduce bariatric risks to staff.

Reducing risks to healthcare staff who perform bariatric patient handling tasks can be complex. Typical patient handling techniques have historically adopted manual handling principles such as good body mechanics and lifting practices, however the Australian Safety and Compensation Council (now Safe Work Australia) assert that tradition and personal experience often influence the design of patient handling training rather than scientific evidence (2009). This view is supported by the
findings of several studies that determined generic patient handling training to be ineffective when lifting obese patients, even when conducting two-person lifts (Edlich et al.; 2005; Humphreys, 2007; Whipple, 2008; Wilson & Tyler, 2006). Risk reduction measures such as the implementation of 'lift teams' to move obese patients have, however, been successful in decreasing carer injuries by 38%, reducing workers’ compensation claims by 62% and increasing staff job satisfaction and perceptions of organisational safety commitment (Humphreys, 2007; Walden et al., 2013).

Some healthcare organisations can demonstrate recognition of patient handling risks to carers by the implementation of bariatric equipment and ‘no lift’ policies which mandate staff to use equipment to lift and reposition patients. However, risks remain when conducting many bariatric tasks such as wound dressings, conducting physical therapy, surgical repositioning and bracing patient legs in maternity wards during birthing. Successful reduction in staff injuries has resulted from the mandated use of equipment and implementation of documented bariatric handling policies. Difficulties have been reported, however, relating to the supply of bariatric equipment, lack of training in equipment use, lack of awareness of equipment availability, perceptions that equipment is cumbersome or inconvenient, inability to locate equipment, time constraints and concerns that the equipment may not accommodate weight or size requirements (Cowley & Leggett, 2011; Edlich et al., 2005; Van Wicklin, 2018). It is also possible that regional hospitals and smaller nursing posts/clinics may not have the equipment or staff available to comply with no-lift policies or implement the use of lift-teams.

2.4.2 Patient Obesity Risks to Healthcare Organisations

Obesity not only impacts the health of the individual and presents risks to healthcare staff, but it also results in high risks to healthcare organisations. Due to high clinical risks of obesity and the variety of testing and clinical procedures required, considered management of obese patients is required throughout the entire hospital journey from emergency departments, wards, radiography, theatres, physiotherapy and potentially the morgue. Due to the challenging and high-risk nursing tasks involved in the management of obese patients, there are high liability risks to healthcare organisations who must care for and compensate injured staff. Organisations are impacted by the direct financial impact of workers’ compensation costs and the human toll to injured staff that may include loss of physical function, loss of both short and long-term income and risks to emotional health (Edlich et al., 2005; Walden et al., 2013). Carers who have substantial and life altering injuries may also initiate common law claims that could be very costly to the organisation. Hidden organisational indirect impacts to finances, resourcing and workloads also include increased workload to conduct injury investigations, increased overtime, hiring and training of replacement
staff, replacement of staff wages, reduced efficiencies and increased management time requirements (Edlich et al., 2005; Hahler, 2002).

Risks relating to poor bariatric patient management may also impact an organisation’s culture and ability to retain staff. Healthcare workers report anxiety and safety concerns when managing obese patients and organisations may experience difficulties in recruiting and retaining staff in positions that include patient handling tasks (Hahler, 2002; Van Wicklin, 2018; Vieira, 2007; Walden et al., 2013). Choi & Brings (2016) and Edlich (2005) also assert that patient handling injuries are a major contributing factor to why nurses are leaving the profession, and that nursing workforce shortages have intensified due to occupational injuries. The increasing age of nurses, corresponding reduction in employee functional fitness and increasing obese patients may all contribute to high risks of bariatric patient handling injuries to staff (Arzouman et al., 2006). Increased longevity of nursing careers is common which results in an older workforce and may result in reduced employee functional fitness to manage obese patients. Interventions examining and enhancing staff ability to conduct work tasks safely or role modifications may be required to reduce bariatric risks for both carers and organisations (Vieira, 2007).

In addition to patient handling risks, obesity also poses significant clinical care challenges when conducting physical assessments, calculating drug doses and accessing appropriate and safe equipment for diagnosis and treatment (Kirk et al., 2010). A clinician’s ability to physically assess and diagnose obese patients may be ineffective or inadequate due to increased skin folds obscuring affected areas, large abdomens, inability to locate anatomical landmarks and difficulties in moving larger, heavier body parts (Hahler, 2002; Muir & Archer-Heese, 2009; Richardson & Harris, 2018). Obesity also affects outcomes of standard procedures such as blood pressure assessments in that extreme size cuffs may be difficult to locate. X-rays and medical imaging such as magnetic resonance imaging (MRI) and computed tomography (CT) scans may be impaired due to decreased image contrasts relating to obesity and the equipment’s ability to accommodate the patient’s size and weight (Gallagher, 2011; Richardson & Harris, 2018). Medication overdose or sub-therapeutic doses can also occur to obese patients due to high body fat compositions and changes in metabolism due to the obesity condition (Richardson & Harris, 2018). Medical errors and misdiagnosis may occur due to difficulties associated with the obesity condition, and healthcare organisations may be liable for medical negligence claims.

Increased breadth of hospital treatments, medical complications and longer hospital stays often result in increases to clinical workloads and hospital finances. Delayed recovery of obese patients and additional healthcare treatments required due to comorbidities associated with obesity also
results in increased hospital treatment costs. Obesity complications can include slower wound healing, increased risks of infection, loss of skin integrity, skin breakdown, development of pneumonia and development of pressure ulcers (Galinsky, Hudock & Streit, 2010; Kirk et al., 2010; Randall et al., 2009). These challenges can result in increased risks of sub-optimal care or adverse outcomes for patients which may also result in medical negligence cases (Chappell, 2007). Clinical risks relating to maternal obesity and childbirth outcomes are often high risks cases to both patients and healthcare staff and represent a significant portion of overall negligence claims (Irwin, 2010). An organisation’s inability to care for obese patients due to lack of bariatric equipment or facilities may also create legal risks and may be increasingly supported by legal arguments advocating for the same standards of care regardless of body size (Arzouman, 2006; Gallagher, 2011).

The ability for hospitals to diagnose and treat obese patients also presents potential legal risks. Supplies of appropriate equipment and room to accommodate both a patient’s weight and size when providing clinical care will be increasingly required and inability to provide care due to lack of facilities for the obese may result in discrimination complaints and legal action. Although there may be high financial outlay to healthcare organisations to purchase the required equipment, implement bariatric risk management programs and ensure adequate medical facilities, without the required risk approaches organisations will be exposed to potentially significant adverse financial outcomes that include workers’ compensation claims, common law claims and medical negligence claims. While financial and legal risks are important considerations for organisations, the primary motivation for enhanced management of obese patients should be improved clinical care and staff safety, not protection from liability claims.

2.4.3 Use of Data to Identify Patient Obesity and Quantify Associated Risks

Accurately identifying obese patients and the requirements to safely manage their clinical needs forms part of a bariatric hazard identification process. Obesity identification is a key factor to manage risks to healthcare organisations, staff and the obese patients themselves (Irwin, 2010). Anthropometric data including height and weight measurements are routinely collected during the patient’s care and can be used to determine BMI and obesity (Noel et al., 2010). Although hospital Managers and staff anecdotally recognise increasing bariatric patients receiving healthcare, there is currently inadequate data to measure obese patient treatment or admissions (Hahler, 2002; Kirk et al., 2010). Lack of obesity data recording and use often results in under-diagnosis of obesity; if obesity is not identified the patient is assumed to be of ‘normal’ weight (Noel et al. 2010).

Injuries to healthcare workers resulting from bariatric patient handling are also difficult to measure due to lack of patient obesity recording (Cowley & Leggett, 2011; Galinsky et al., 2010; Hahler, 2002;
Muir et al., 2007). Similarly, lack of obesity recording results in difficulties to measure outcomes of targeted bariatric interventions (Hahler, 2002). Hahler states the use of bariatric techniques and equipment are assumed to be effective, however these assumptions are supported by anecdotal reporting and tradition (Hahler, 2002). Increased patient obesity identification and recording will inform, measure and evaluate risk management strategies such as increased resourcing of staff, increased bariatric equipment use and targeted interventions and allow hospitals to build business cases for funding of these safety interventions.

Challenges relating to obesity data recording are recognised, specifically lack of height recording which makes BMI calculations unattainable. Failure to record height is attributed to lack of measurement equipment, low perceived importance, time constraints, competing clinical demands and difficulties in measuring patients who are bed or wheelchair-bound or amputees (Noel et al. 2010). Issues with obesity data accuracy can also occur such as recording errors when obtaining measurements, during data entry or during data transfers between systems (Noel et al., 2010). Electronic data cleansing solutions can be utilised to identify data outliers and some inaccuracies, which will improve obesity data accuracy.

Despite known obesity data errors, organisations should consider the advantages of using anthropometric data if the errors are determined to be minimal and random. Evidence gained from the use of this available data will be cost and time effective and may outweigh the weaknesses in data accuracy (Noel, 2010). Increased support by healthcare managers and policy makers will be required for improved obesity data recording. Improvements can include mandatory height and weight fields within electronic health records, clinical reminders for obesity recording and/or development and implementation of obesity recording performance measures.

2.5 Implications of findings

It is clear from the literature reviewed that the Australian population obesity rates are increasing and there are confirmed positive correlations between population obesity rates and hospital admissions of obese patients. The projected increase in obese patients indicates significant risks to healthcare staff and organisations who provide care for this patient cohort. While there have been bariatric-related advancements in the healthcare environment such as increased development of policies and procedures relating to handling obese patients and increased use of bariatric equipment, there is a lack of Australian research into the accuracy of obese patient admission data and methods of improving accurate obese patient admission data. This shows that more research and increased development of bariatric patient handling risk management approaches needs to be conducted to reduce obesity-related handling risks to healthcare organisations, staff and patients.
Chapter 3 Audits of Obesity Data and Concordance with Diagnostic Coding or Patients Admitted to Western Australian Country Health Service Hospitals (WACHS).


3.1 General Overview

Increasing risk management approaches to protect health care workers from patient handling issues have been examined and implemented by Australian health care organisations in an attempt to manage related challenges such as high rates of musculoskeletal injuries to staff, aging workforces, high insurance premiums and increased demands to improve staff safety. In some healthcare organisations, however, designing and implementing proactive risk management approaches have been difficult due to lack of healthcare data, causing organisations to rely on anecdotal awareness of patient handling risks.

In hospital environments, weight, BMI scores and/or notations of obesity are routinely captured for many clinical requirements and are either manually or electronically recorded in patient files. Many Australian healthcare organisations are currently transitioning to the adoption of electronic health records, however a variety of methods of recording patient information is currently being used including the use of manual patient files, electronic records or hybrid models that involve manual files being scanned into patient admission databases. When patients are discharged from hospital, their admission records are analysed by clinical coding staff who assign up to 50 diagnosis codes to the patient electronic record. Obesity is coded when the condition is clinically observed and impacts the patient’s management during their hospital stay by requiring the commencement, alteration or adjustment of therapeutic treatment; requiring additional diagnostic procedures and/or requiring increased clinical care and/or monitoring. Diagnosis coding is undertaken according to the Australian Coding Standards 9th Edition as defined by the ACCD (ACCD, 2015). The Australian Coding Standards is a tool used by clinical coding staff that standardises code definitions and is used to ensure data consistency and integrity across all Australian health service providers.

To identify the risks of managing obese patients in regional locations within Western Australia, an examination of obesity data accuracy is required. The accuracy of clinical coding of obesity has been examined in several international studies such as Martin et al.’s and Quan et al.’s studies which assessed variability between obesity coding and manual chart reviews (Martin et al., 2014; Quan et
al., 2008). Both studies found a large variance between the chart review results and clinical coding data. It is believed that prior to the studies discussed in this chapter, there has been no evidence-based examination of obese patient admission data by any Australian health service.

Bariatric patient handling risks to healthcare staff are likely to be higher in Australian regional hospitals than metropolitan hospitals due to documented increased population obesity rates in rural locations compared to metropolitan locations (ABS, 2008). The Western Australian Country Health Service (WACHS) was selected for this study as it is the largest regional health system in Australia, which provides an extensive range of health services across an area of 2.53 million square kilometres for an estimated population of 531,000 people (WACHS, n.d.)

3.2 Pilot Study: Obesity Data Recording and Accuracy at Two Western Australian Country Health Service (WACHS) Sites

The pilot study was designed to compare electronic patient admission data against manual patient records and investigate accuracy of obesity recording and clinical coding. The central aims of this study include:

- To determine methods to measure obesity recording of patients and clinical coding accuracy.
- To measure current levels of patient obesity recording and clinical coding accuracy in hospital environments.
- To examine impacts on healthcare workers that affect obesity recording and coding accuracy.

3.2.1 Methodology for the Determination of Obese Patient Recording Completeness and Coding Accuracy

The pilot study employed a quantitative comparative analysis of electronic patient admission data and data obtained within a manual examination of patient records. The pilot study included 2 WACHS hospitals, Northam Hospital and Busselton Health Campus, and examined the inclusion or absence of manual obesity notations, electronic obesity codes, weight, height and Body Mass Index (BMI) recording. BMI has been utilised in this study as it is the most commonly accepted and consistent method for identifying and categorising obesity. The World Health Organisation (WHO) has defined the BMI calculation methodology as a person’s weight in kilograms divided by the square of the person’s height in metres (kg/m²) (WHO, 2000). Although there are varying international views surrounding the use of BMI to measure obesity, it has been deemed a reliable, inexpensive and efficient method of measurement (Lemay et al., 2004). This study includes the
definition of obesity as patients with a BMI equal to, or more than 30 kg/m², which is in agreement with previous literature examining bariatric coding and aligns with Australian clinical coding obesity classifications as defined by the ACCD (ACCD, 2016; Galinsky et al., 2010; Grant & Lipscomb, 2008; Martin et al., 2014).

3.2.1.1 Patient admission data
De-identified patient admission data was obtained from 3 patient administrations systems, namely WebPAS®, TOPAS® and HCARE®, and was provided to the researchers by a WACHS Health Information Manager (HIM). The patient admission data inclusion criteria comprises of patients who were admitted to hospital for 5 days or greater and discharged between 1 July 2015 and 30 June 2017, patients who were over the age of 18 at the time of hospital admission, and who had principal or additional diagnosis of “diabetes mellitus”, otherwise known as diabetes type 2. Diagnoses of diabetes type 2 is selected as an inclusion criterion as there are confirmed links between obesity and 30 illnesses and medical conditions, including type 2 diabetes (American Society for Metabolic and Bariatric Surgery, 2010). Research by the Medical Research Council United Kingdom also showed that the obese population have a risk of diabetes 80 times higher than that of the normal weighted population, which categorically connects obesity and diabetes type 2 (Medical Research Council United Kingdom, 2015).

The data excludes patient boarder care types such as palliative care, and patients who utilise other health service use such as outpatient treatments. Patients who have diagnosis terms of Type 1 Diabetes Mellitus, Family history of diabetes mellitus, Pre-existing diabetes mellitus, Type 1, or ‘in pregnancy’ were also excluded from the data. The exclusions were selected due to palliative care and outpatient services not conforming to the research focus of examining patient admission to hospitals, lack of confirmed links between obesity and Type 1 diabetes and pregnancy-related diabetes being a potentially temporary condition.

Examination of obesity coding is conducted by identification of obesity codes within the selected patient records that met the inclusion criteria. The principal and additional diagnosis codes relating to obesity as defined by the Australian Coding Standards 9th Edition (ACCD, 2015) are:

E66 – Obesity;
E66.0 – Obesity due to excess calories;
E66.1 – Drug induced obesity;
E66.2 - Extreme obesity with alveolar hypoventilation;
E66.8 – Other obesity;
E66.9 – Obesity, unspecified; and
U78.1 - Endocrine, nutritional and metabolic diseases – obesity
3.2.1.2 Patient File Examination

WACHS HIMs determined patients and their corresponding episodes (admission and discharge dates) that fell within the pilot study inclusion criteria. The relevant patient identifier number and episode number were provided to clinical coding staff who extracted the physical patient files in preparation for examination. A manual examination of the patient files was then conducted to examine the inclusion or absence of obesity recording, including recording of weight, height and BMI. The principal researcher undertook training on patient file examination techniques prior to the manual file examination to ensure sound data extraction methods were met.

3.2.1.3 Data Analysis

A comparative assessment was conducted against the patient file data and the occurrence of principal and additional diagnosis codes relating to obesity, being the E66 coding suite and U78.1 additional diagnosis code. Seven (7) quantitative techniques were utilised to examine the accuracy of the patient admission data compared with manual patient clinical file reviews: sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), false negative rates, false positive rates and Cohen's Kappa values. This analysis methodology is commonly used in clinical examinations of interventions and comparisons, and is supported by several clinical research projects, including Ho et al.’s and Lee et al.’s studies (Ho et al., 2012; Lee et al., 2013). Five (5) additional methods of quantitative analysis of obesity recording are also applied: prevalence coded as obese, weight recorded, height recorded, BMI recorded and height and weight recorded with no BMI. The results of the 7 quantitative accuracy measures were calculated using IBM®’s Statistical Package for the Social Sciences (SPSS®).

Measuring sensitivity determines the degree of obesity recording in the patient admission data when it is first present in the patient files, while specificity measures the absence of obesity conditions in the patient admission data if the condition is absent in the patient files. Accuracy of the clinical coding of obesity-related conditions is examined by the analysis of positive predictive values (PPV) and negative predictive values (NPV). Negative predictive value firstly examines the absence of obesity coding and then examines the absence of obesity notations in patient files, conversely positive predictive value firstly examines the cases that were coded as obese and then examines the occurrences of obesity notations in patient files. Cohen’s Kappa values determine the agreement between the patient admission data and the patient file data.

3.2.2 Obese Patient Recording Completeness and Coding Accuracy Results

The pilot study was conducted to confirm the research methodology used to determine accuracy of obese patient admission data. Accuracy of obesity data is central to identifying and measuring risks
to healthcare staff who manage bariatric patients. Three hundred and twenty four (324) records were examined belonging to 165 males (51%) and 159 females (49%) aged between 25 and 98 years. Obesity was coded in 9.3% of all patients, with weight recorded in 59.8% of all patients and height recorded in 15.7% of patients. BMI is recorded in 8.9% of all patients, and of the patients that had height and weight recorded, 45.1% of patients did not have BMI recorded. A summary of the statistical analysis of the obesity recording and data accuracy indicators used in the pilot study is included in Table 3.1.

**Table 3.1 Pilot Study: WACHS Obese patient admissions accuracy analysis**

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>Busselton</th>
<th>Northam</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>324</td>
<td>165</td>
<td>159</td>
<td>166</td>
<td>158</td>
</tr>
<tr>
<td>Prevalence coded as obese (n, %)</td>
<td>30 (9.3)</td>
<td>15 (9.1)</td>
<td>15 (9.4)</td>
<td>14 (8.4)</td>
<td>16 (10.1)</td>
</tr>
<tr>
<td>Weight Recorded (n, %)</td>
<td>194 (59.8)</td>
<td>95 (57.6)</td>
<td>99 (62.3)</td>
<td>94 (56.6)</td>
<td>100 (63.3)</td>
</tr>
<tr>
<td>Height Recorded (n, %)</td>
<td>54 (15.7)</td>
<td>23 (13.9)</td>
<td>31 (19.5)</td>
<td>21 (12.6)</td>
<td>33 (20.1)</td>
</tr>
<tr>
<td>BMI Recorded (n, %)</td>
<td>29 (8.9)</td>
<td>12 (7.3)</td>
<td>17 (10.7)</td>
<td>10 (6.0)</td>
<td>19 (12.0)</td>
</tr>
<tr>
<td>Height and Weight Recorded, no BMI (n, %)</td>
<td>23 (45.1)</td>
<td>11 (52.4)</td>
<td>12 (41.4)</td>
<td>10 (52.6)</td>
<td>13 (40.6)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>41.0%</td>
<td>44.4%</td>
<td>38.2%</td>
<td>48.1%</td>
<td>35.3%</td>
</tr>
<tr>
<td>Specificity</td>
<td>98.1%</td>
<td>97.8%</td>
<td>98.4%</td>
<td>99.3%</td>
<td>96.8%</td>
</tr>
<tr>
<td>NPV</td>
<td>87.7%</td>
<td>90.0%</td>
<td>85.4%</td>
<td>90.8%</td>
<td>84.5%</td>
</tr>
<tr>
<td>PPV</td>
<td>83.3%</td>
<td>80.0%</td>
<td>86.6%</td>
<td>92.9%</td>
<td>75.0%</td>
</tr>
<tr>
<td>False Positive</td>
<td>1.9%</td>
<td>2.2%</td>
<td>1.6%</td>
<td>0.7%</td>
<td>3.2%</td>
</tr>
<tr>
<td>False Negative</td>
<td>59.0%</td>
<td>55.6%</td>
<td>61.8%</td>
<td>51.9%</td>
<td>64.7%</td>
</tr>
</tbody>
</table>

Average sensitivity and specificity between obesity coding and obesity recordings in patient files is calculated as 41% and 98.1% respectively. The average negative predictive value is 87.7% and the average positive predictive value is 83.3%. The average false positive outcome is 1.9%, while the average false negative outcome is 59%. The average Cohen’s Kappa value is 0.48. The comparative data analysis of obese patient coding and obesity recording in patient files demonstrates generally poor accuracy of the obese patient admission data. Figure 3.1 displays the sensitivity and specificity results and includes an aspirational specificity and sensitivity target established at 100% in order to support enhanced obesity coding accuracy.
Figure 3.1 Pilot Study: WACHS obesity data sensitivity and specificity


**3.3 Overview of Broader Study: Obesity Data Recording and Accuracy at Four Western Australian Country Health Service (WACHS) Sites**

As the pilot study was assessed to be successful, the study was expanded to include a quantitative analysis of obesity-related data accuracy at 4 WACHS sites. Factors that affect obesity recording and data accuracy are also examined, and a series of recommendations have been developed that will likely increase obesity data recording and accuracy. The central aims of this study are:

- To measure current levels of patient obesity recording and clinical coding accuracy in WACHS hospitals.
- To determine if obese patient admission data recorded by WACHS provides sufficient accuracy to be used to implement risk mitigation strategies for nurses and other healthcare staff performing obese patient handling tasks.
- To examine impacts on healthcare workers that affect obesity recording and coding accuracy.
3.3.1 Methodology for the Determination of Obese Patient Recording Completeness and Coding Accuracy

This study employed a retrospective audit of WACHS Patient Admission data and a manual examination of patient medical records at 4 WACHS regional hospitals (Sites A, B, C and D). The hospitals are selected as they are larger health campuses in 4 different regional regions of Western Australia and therefore are more likely to capture variations in rural obesity rates. The study examines the inclusion or absence of manual obesity notations, electronic obesity codes, weight, height and BMI recording.

3.3.1.1 Patient Characteristics and Data Analysis

To ensure research cohesion with the pilot study, identical recording of obesity data, BMI measurements and study inclusion and exclusion criteria are applied in this study. Components of patient medical files examined to obtain obesity data include but are not limited to Emergency Department notes, nursing admission screening tools, handover/interim care plans, progress notes, medication charts, anaesthetic records, insulin charts, malnutrition screening tools, dietetics assessments, fluid balance charts, perioperative pathway forms and discharge summaries. Common study methodologies are also applied between the pilot study and this study, including the 7 quantitative techniques to determine obesity data accuracy. This study did however expand obesity recording analysis from 5 to 7 indicators by also measuring occurrences of obesity/BMI notations recorded and records of obesity/BMI despite no height and weight measurements recorded. These additional 2 obesity recording indicators were able to be retrospectively applied to the pilot study data set.

3.3.2 Obese Patient Recording Completeness and Coding Accuracy Results

This broader study included reviewing 590 records belonging to 297 males (50.3%) and 293 females (49.7%) aged between 18 and 98 years. Obesity was coded in 10.8% of all patients, with weight recorded in 67.3% of all patients and height recorded in 24.1% of patients. BMI was calculated in 10.8% of all patients, and of the patients who had height and weight recorded, 62% of patients do not have BMI recorded. Obesity or BMI notations were recorded in 19.4% of all patients, however 9.3% of obesity or BMI notations were not supported by height or weight records. A summary of the results of the statistical analysis of the 7 data accuracy indicators used in this study are shown in Table 3.2.
Table 3.2 WACHS patient admission obesity accuracy and inter-rater reliability analysis

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>Site A</th>
<th>Site B</th>
<th>Site C</th>
<th>Site D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Records within research criteria</td>
<td>847</td>
<td>422</td>
<td>425</td>
<td>209</td>
<td>199</td>
<td>219</td>
<td>220</td>
</tr>
<tr>
<td>Records audited</td>
<td>590</td>
<td>297</td>
<td>293</td>
<td>166</td>
<td>100</td>
<td>158</td>
<td>166</td>
</tr>
<tr>
<td>Coded as obese (n, %)</td>
<td>64</td>
<td>31</td>
<td>33</td>
<td>14</td>
<td>3</td>
<td>16</td>
<td>31</td>
</tr>
<tr>
<td>Weight Recorded</td>
<td>397</td>
<td>190</td>
<td>207</td>
<td>94</td>
<td>70</td>
<td>100</td>
<td>133</td>
</tr>
<tr>
<td>Height Recorded</td>
<td>142</td>
<td>63</td>
<td>79</td>
<td>21</td>
<td>9</td>
<td>33</td>
<td>79</td>
</tr>
<tr>
<td>BMI Calculated</td>
<td>64</td>
<td>20</td>
<td>44</td>
<td>10</td>
<td>7</td>
<td>19</td>
<td>28</td>
</tr>
<tr>
<td>Height and Weight Recorded, no BMI</td>
<td>88</td>
<td>44</td>
<td>44</td>
<td>12</td>
<td>8</td>
<td>14</td>
<td>54</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded</td>
<td>115</td>
<td>47</td>
<td>68</td>
<td>27</td>
<td>12</td>
<td>34</td>
<td>42</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded but Height and Weight not recorded</td>
<td>55</td>
<td>23</td>
<td>32</td>
<td>21</td>
<td>11</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>40.0%</td>
<td>42.6%</td>
<td>38.2%</td>
<td>48.1%</td>
<td>8.3%</td>
<td>35.3%</td>
<td>47.6%</td>
</tr>
<tr>
<td>Specificity</td>
<td>96.2%</td>
<td>95.6%</td>
<td>96.9%</td>
<td>99.3%</td>
<td>97.7%</td>
<td>96.8%</td>
<td>91.1%</td>
</tr>
<tr>
<td>NPV</td>
<td>86.9%</td>
<td>89.9%</td>
<td>83.9%</td>
<td>90.8%</td>
<td>88.6%</td>
<td>84.5%</td>
<td>83.7%</td>
</tr>
<tr>
<td>PPV</td>
<td>71.8%</td>
<td>64.5%</td>
<td>78.8%</td>
<td>92.9%</td>
<td>33.3%</td>
<td>75.0%</td>
<td>64.5%</td>
</tr>
<tr>
<td>False Positive</td>
<td>3.8%</td>
<td>4.4%</td>
<td>3.1%</td>
<td>0.7%</td>
<td>2.3%</td>
<td>3.2%</td>
<td>8.9%</td>
</tr>
<tr>
<td>False Negative</td>
<td>60.0%</td>
<td>57.4%</td>
<td>61.8%</td>
<td>51.9%</td>
<td>91.7%</td>
<td>64.7%</td>
<td>52.4%</td>
</tr>
<tr>
<td>Kappa</td>
<td>0.44</td>
<td>0.44</td>
<td>0.43</td>
<td>0.59</td>
<td>0.09</td>
<td>0.40</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Average sensitivity and specificity between obesity coding and obesity records in patient files is calculated as 40% and 96.2% respectively. The average negative predictive value is 86.9% and the average positive predictive value is 71.8%. The average false positive outcome is 3.8%, while the average false negative outcome is 60%. The average Cohen’s Kappa value is 0.44. Poor obesity accuracy of the patient admission data is demonstrated in the comparative data analysis of obese patient coding and obesity recordings in medical files. Figure 3.2 displays the sensitivity and
specificity results of this study and includes an aspirational specificity and sensitivity target established at 100% in order to support enhanced obesity coding accuracy.

Figure 3.2 WACHS obesity data sensitivity and specificity

The outcomes of this study are published in the peer reviewed Australian Journal of Advanced Nursing (2021; 38(1):45-52).

3.4 Discussion of Obesity Data Completeness, Accuracy and Impacting Factors.

Both the pilot study and broader study demonstrate generally poor obesity accuracy in the comparative analysis between the obese patient admission coded data and the obesity recordings in medical files. The pilot study demonstrated low average sensitivity results (41%), high average false negative results (59%) and a Cohen’s Kappa value of 0.48, which supports the findings of poor accuracy of the obese patient admission data. Similarly, the broader study demonstrates low average sensitivity results (40%), high average false negative results (60%) and a Cohen’s Kappa value of 0.44 which also supports findings of poor accuracy of the obese patient admission data. The sensitivity result within the broader study demonstrates that, where obesity is recorded in patient files, only 40% is coded as obese. Similarly, the average false negative result of 60% demonstrates that of all cases that should have been coded as obese due to the inclusion of obesity calculations or notations in the medical files, 60% of these cases are incorrectly coded as ‘normal weighted’. A Cohen’s Kappa value demonstrates correlation between occurrences of coded obesity and the recorded obese patient notations in the medical files. A larger Cohen’s Kappa value demonstrates a higher agreement between coded obesity data and obesity recording in medical files. The average
Cohen's Kappa value result of 0.44 demonstrates only moderate agreement. The positive predictive value of 71.8% does however demonstrate moderate levels of accuracy when clinical coding staff are coding obesity and there is evidence of obesity in the clinical file records.

Conversely, high accuracy of coding non-obese patients is demonstrated in the pilot study by the high average specificity result (98%) and high average negative predictive value (87%). The broader study also results in high average specificity (96.2%) and high average negative predictive value (86.9%). Specificity in the broader study demonstrates that where there are no obesity notations recorded, clinical coders are correctly coding these patients as normal weighted in 96.2% of all occurrences. Similarly, the average negative predictive value result of 86.9% demonstrates that of all ‘normal weighted’ coded patients, 86.9% of these patients do not have obesity notations recorded in medical files.

There is poor completeness of weight, height and BMI measurement data in patient files (59%, 15% and 8% respectively in the pilot study and 67%, 24% and 10.8% respectively in the broader study). While scales to measure patient weight are commonly available in hospitals, equipment to measure patient height is often lacking which could contribute to the low recording of patient height. Inadequate equipment to measure patient height will negatively impact a clinician’s ability to calculate BMI. Wall mounted and calibrated height measurement tools should be readily available in hospital wards to measure patient height. For patients who are mobility impaired, bed-ridden or unable to stand due to their health conditions, healthcare workers may be unable to measure height using standard measurement techniques and should be trained in the use of alternate height measurement techniques. Several evidence-based methods of obtaining reliable height measurements from bone measurements are available, such as the Ulnar length method, Demi-span method or knee height method. These methods provide accurate estimates of stature in normally proportioned adults (Han & Lean, 1996; Hickson & Frost, 2003; Jarzem & Gledhill, 1993).

Poor completeness of weight, height and BMI data may also be a result of time demands and workload of clinicians, breadth of total clinical recording requirements, and lack of organisational direction for the need of this data. Galinsky et al. (2010) highlight that approximately 75% of morbidly obese patients have at least one co-morbid condition. The immediate focus of both doctors and nurses is the treatment of the condition causing the patient to be admitted. This concentrated focus on the health condition(s) causing hospital admission is also mirrored in coding practices, where primary health conditions are coded in the first instance, as they are important indicators for health condition data and funding provision by the Western Australian government.
Stanfill et al. (2010) assert that data recording and analysis in healthcare has increased substantially over time and high data collection requirements of clinicians may affect their prioritisation of obesity data recording. In addition to competing data priorities, lack of clinician awareness of the importance and use of obesity data for clinical, safety and funding purposes are likely contributors to the absence of obesity data and notations in files of obese patients. Insufficient organisational prioritisation of obesity data recording and use of the data itself, and related lack of auditing of the obesity data recording, may also be a factor that further influences low obesity data recording. As healthcare organisations progress to electronic patient records, consideration should be given to mandatory recording fields for patient height and weight, automated BMI calculations, and indicators or ‘file flags’ for patients who are obese and require additional patient care measures.

Obesity codes are added to the coding data set in an ‘opt in’ approach, which is likely to be an additional contributing factor to inaccurate obesity coding. If obesity is not coded, the default data position indicates ‘normal weighted’. Another challenge to obesity data accuracy is requirements within the Australian Coding Standards 9th Edition for coders to only code patients as obese if a BMI score is provided or a clinical notation detailing patient obesity is explicitly recorded. Currently, if weight and height are available within the medical record, coders are not able to calculate and code BMI. In practice, however, weight, height and BMI recording itself is low. Even when weight and height is recorded in the broader study, in 62% of these instances the measurements are not translated to a BMI calculation by the clinician.

Furthermore, clinical notes which indicate a high BMI has been observed (such as ↑BMI) are not deemed to be sufficient detail to be coded. While the data challenges do not impact the clinical treatment of obese patients, they do affect an organisation’s ability to proactively manage obese patient handling risks by the identification of current risks and predicting the extent of future risks. The ability for clinical coders to use height, weight and BMI scores to code obesity, and the resulting impact to improve obesity data accuracy should be explored further. With the adoption of electronic patient records, mandatory recording of height and weight, automated BMI calculations, and a check box field that indicates an impact to clinical care may also be worthy of further examination.

It appears that a degree of obesity notations by clinical staff are likely due to visible observations of obesity. Within the examined medical files, there are 115 instances of BMI or obesity notations recorded in the clinical notes, of which 55 records are not supported by a recorded patient weight or height. Of the 115 records with obesity notations, only 64 medical files contain BMI scores. Furthermore, a clinician’s ability to accurately visually identify obesity may be reduced due to obesity normalisation, a result of increased prevalence of obese patient presentations in hospitals.
and increased obesity in the community. As a result of continually rising prevalence of obesity in Australia, society's acceptance of heavier body weights as 'normal' is increasing, as described by Maynard and others (Maynard et al., 2006). Therefore, a clinician's visual assessment may underestimate BMI. While clinical notations of obesity are important, these are likely to be subjective observations and should be supported by measured weight, height and BMI data.

Although not captured in the data, the clinical recording of obesity could also be affected by the clinician's reluctance to record words similar to obese, obesity or overweight in the clinical notes to try to preserve patient dignity. Positive patient and clinician relationships are incredibly important and are guarded in the healthcare setting, and the clinician may be concerned about using these terms which are often subjective and used in a derogatory manner. This potential reluctance to record obesity can be rectified by recording of weight, height and BMI measurements, which are clinical measurements removed of emotion.

Finally, lack of obesity records and coded data has healthcare funding implications. All diagnosis codes are processed through a series of calculations including Diagnosis-related Groups (DRGs) and National Weighted Activity Units (NWAUs). DRGs and NWAUs result in allocation of Activity Based Funding (ABF), a funding system to hospitals for the patient care delivered. If treatment is provided for obese patients where patient care is affected by the obesity condition, lack of obesity recording and coding results in obesity not being included in the funding calculations. For example, this will mean that instances of change in patient care such as increased staffing requirements for lifting, turning or toileting of obese patients, use of bariatric equipment, increases in anaesthetic or medication doses, change in rehabilitation approaches, and change in clinical risk categories for obese maternity patients will not be included in the funding calculations. The impact on healthcare funding due to lack of obesity coding or coding inaccuracy should also be explored further.

3.5 Limitations

Examining the clinical methods of obtaining the obesity data contained within patient files and the accuracy of the obesity data is outside of the scope of the research study. The data within patient files is recorded by trained clinical staff and is considered to be the gold standard for analysis and comparison. Due to distances between WACHS hospitals and associated travel requirements for researchers to attend rural hospital locations and conduct manual file examinations, it is acknowledged that a limitation of this study is researcher availability. Travel restrictions during the COVID-19 pandemic were also potential barriers to researcher availability. While the data collection provided valid results, increased data collection may be required to inform future research which will require increased researcher availability. The ongoing adoption of electronic health records by
healthcare organisations will likely allow researchers to manually review patient files at central locations, which may reduce this limitation in the future. An additional limitation due to researcher availability was the inclusion of patients only with Type II Diabetes. As diabetes is strongly linked to obesity, rates of obesity coding in the patient administrative data may be higher than in the general population. Expanding the patient inclusion criteria will allow an examination of obesity recording accuracy of the general patient population.

3.6 Implications of findings

Enhanced methods to record BMI and obesity should be considered, including mandatory recording of weight and height and progressing organisational adoption of electronic healthcare records. Automated BMI calculations and user-friendly methods to indicate patient care impacts of obesity will assist clinicians to easily record obesity data and simplify obesity coding, which will increase obesity data accuracy. Until full adoption of electronic health records, healthcare organisations should promote the importance of obesity data and increase clinical staff awareness of the requirement for improved height, weight and BMI recording, and the potential use of this data for non-clinical uses such as obese patient handling risk mitigation. The impact of current obesity coding processes should be examined, particularly the absence of obesity recording resulting in the default data coding position indicating ‘normal weighted’. Furthermore, investigation of alternative coding methods to obtain obesity recordings should be conducted such as allowing clinical coders to calculate BMI if height and weight measurements are available in medical files.
Chapter 4 Financial Impact of Obese Patient Recording Completeness and Coding Accuracy

This chapter is presented as the author-accepted peer reviewed manuscript published in the Journal of Multidisciplinary Healthcare (2021; 14(1): 1–8).

4.1 General Overview

Although the Australian budget for healthcare services in hospitals is extensive at A$23.6 billion in 2020–21, this budget supports over 1300 public and private hospitals to provide care for the Australian community (Australian Institute of Health and Welfare [AIHW], 2020a; Hunt, 2020). Presentations of the ill or injured to hospitals has increased by 7% between 2015 and 2019 due to corresponding increases in the aging population and chronic disease (ABS, 2015; AIHW, 2020b). Increased hospital presentations and admissions results in requirements for increased hospital funding for resources such as workforce, equipment and infrastructure (Department of Health Australia, 2013).

Healthcare organisations receive Activity Based Funding (ABF) which provides reimbursement for costs relating to patient care delivered and the resources required for the patient treatment. Activity Based Funding (ABF) was enacted in 2011 as an outcome of the National Health Reform Agreement with the aim of increasing transparency of how funds are allocated to hospitals and to give hospitals incentives to use funding more efficiently (Solomon, 2014). The ABF is a payment for the number of patients treated and the type of care required and reflects workload and associated costs incurred by the hospital. Patient care and treatment is recorded and coded through a series of calculations that results in allocation of ABF to the hospital for the patient treatment. It is essential that accurate clinical recording of care and coding occurs in order for hospitals to be allocated ABF correctly.

Accurate obesity data is also essential to ensure accuracy of ABF reimbursement of costs to hospitals that manage obese patients. Managing obese patients results in operational funding requirements such as increased staffing and purchasing of equipment such as hoists, bariatric wheelchairs and bariatric beds, and hospitals must ensure these clinical requirements are documented accurately so that they can be reimbursed for these costs by way of ABF. Accuracy of clinical coding of obesity has been examined internationally and in Chapter 3, it showed that there are discrepancies between the manual patient files and coded data (Martin et al., 2014; McClean et al., 2020; Quan et al., 2008). The obesity recording and data accuracy study in Chapter 3 highlighted the need for an in-depth examination of the financial impact of inaccurate obesity data which may influence healthcare
organisations to improve methods of recording obesity data, improve obesity data accuracy and receive accurate ABF reimbursements.

This study examines, rectifies and extrapolates cases of inaccurate obesity recording and coding identified in Chapter 3 to determine the estimated annual financial impact of these inaccuracies to WACHS hospitals. The central aims of this study were:

- To determine if hospital finances are impacted by accuracy of obese patient admission data.
- If hospitals are impacted by accuracy of obese patient admission data, to measure the impacts on hospital funding due to inaccurate obesity recording and coding.

4.2 Methodology for the Determination of the Financial Impact of Obese Patient Recording

Completeness and Coding Accuracy

This study employs a quantitative analysis of 85 inaccurate obese patient admission data records identified in the study discussed in Chapter 3. Obesity-related information captured in this study such as patient weight, height and/or BMI is reapplied to the inaccurate patient data records to determine correct obesity diagnosis codes. The updated patient admission codes are then resubmitted to determine changes to Diagnosis-related Groups (DRGs) and National Weighted Activity Units (NWAUs), which are used to determine ABF allocated for the episode of patient care. ABF financial variations are calculated and extrapolated against WACHS obesity discrepancy rates, Australian population obesity data and WACHS annual patient admission data to calculate estimated annual obesity coding inaccuracies and related annual funding effects to WACHS.

The inclusion and exclusion criteria relating to assessed patient admission data records in this study is identical to criteria used in the previous studies presented in Chapter 3. Additionally, obesity diagnosis codes utilised in this study have been applied in the same manner as the previous studies. The use of the obesity codes aligns with the Australian Coding Standards Ninth Edition defined by the ACCD (ACCD, 2015). Patient admission data was supplied by a WACHS Health Information Manager, and WACHS patient admission projections were supplied by the WA Health Central Modelling Unit.

4.3 Results of Financial Implications of Inaccurate Obesity Data Coding

This study investigates the financial implications of inaccurate obesity data and factors that may affect obesity data recording accuracy. Eighty five (85) records of inaccurate obesity data identified in the previous studies include 38 records that were not coded as obese, despite weight and height measurements being documented which allowed BMI to be determined, and 47 records that include
clinical notations detailing obesity however obesity was not coded. When the 85 records were updated with corrected patient admission data, they were resubmitted to determine changes to DRGs, NWAUs and ABF. Eleven (11) cases resulted in DRG and/or NWAU changes that resulted in higher costs of care and 74 cases did not result in DRG, NWAU or financial changes. Table 4.1 displays the eleven cases where changes to DRGs, NWAUs and ABF outcomes occurred when the records were adjusted by entering correct obesity codes.

**Table 4.1: Variations of DRGs, NWAUs and ABF when accurate obesity codes are applied.**

<table>
<thead>
<tr>
<th>Case</th>
<th>Obesity Code Applied</th>
<th>Pre DRG</th>
<th>Post DRG</th>
<th>Pre NWAU</th>
<th>Post NWAU</th>
<th>Pre-Financial Costs (A$)</th>
<th>Post Financial Costs (A$)</th>
<th>ABF Increase (A$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E66.92</td>
<td>G70B</td>
<td>G70A</td>
<td>0.6612</td>
<td>1.3019</td>
<td>$3,313</td>
<td>$6,525</td>
<td>$3,212</td>
</tr>
<tr>
<td>2</td>
<td>E66.91</td>
<td>J64B</td>
<td>J64A</td>
<td>0.8232</td>
<td>1.4059</td>
<td>$4,125</td>
<td>$7,046</td>
<td>$2,921</td>
</tr>
<tr>
<td>3</td>
<td>E66.91</td>
<td>X63A</td>
<td>X63A</td>
<td>0.5</td>
<td>1.3492</td>
<td>$2,567</td>
<td>$6,926</td>
<td>$4,359</td>
</tr>
<tr>
<td>4</td>
<td>E66.91</td>
<td>J12B</td>
<td>J64A</td>
<td>0.8232</td>
<td>1.4059</td>
<td>$4,125</td>
<td>$7,046</td>
<td>$2,921</td>
</tr>
<tr>
<td>5</td>
<td>E66.93</td>
<td>J64A</td>
<td>J64A</td>
<td>0.8232</td>
<td>1.4059</td>
<td>$4,125</td>
<td>$7,046</td>
<td>$2,921</td>
</tr>
<tr>
<td>6</td>
<td>E66.92</td>
<td>G70B</td>
<td>G70A</td>
<td>0.6612</td>
<td>1.3019</td>
<td>$3,313</td>
<td>$6,525</td>
<td>$3,212</td>
</tr>
<tr>
<td>7</td>
<td>E66.91</td>
<td>O01B</td>
<td>O01A</td>
<td>2.2002</td>
<td>3.185</td>
<td>$11,027</td>
<td>$15,963</td>
<td>$4,936</td>
</tr>
<tr>
<td>8</td>
<td>E66.92</td>
<td>O60C</td>
<td>O60A</td>
<td>1.1219</td>
<td>1.6418</td>
<td>$5,622</td>
<td>$8,228</td>
<td>$2,606</td>
</tr>
<tr>
<td>9</td>
<td>E66.91</td>
<td>O01B</td>
<td>O01A</td>
<td>2.2002</td>
<td>3.185</td>
<td>$11,027</td>
<td>$15,963</td>
<td>$4,936</td>
</tr>
<tr>
<td>10</td>
<td>E66.93</td>
<td>J64B</td>
<td>J64A</td>
<td>0.8232</td>
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<td>$4,125</td>
<td>$7,046</td>
<td>$2,921</td>
</tr>
<tr>
<td>11</td>
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<td>O01B</td>
<td>O01A</td>
<td>2.2002</td>
<td>3.185</td>
<td>$11,027</td>
<td>$15,963</td>
<td>$4,936</td>
</tr>
</tbody>
</table>

Frequency of ABF increases when correcting obesity inaccuracy was measured and is displayed in Figure 4.1. The average ABF increase when correcting inaccurate obesity data is A$3625 per case.
Figure 4.1 Frequency Histogram displaying increases in ABF when accurate obesity codes are applied.

A financial variation case rate of 1.86% was calculated by dividing the total amount of financial variations in this study by the total cases examined. The financial variation rate was applied to the estimated obese patient admissions data to determine the number of estimated annual obesity coding discrepancies. Additionally, the average ABF increase when correcting obesity data inaccuracy was applied to determine related estimated annual ABF variations at WACHS. A summary of the statistical analysis conducted is presented in Table 4.2.

Table 4.2 WACHS estimated obese patient admissions, estimated obesity coding discrepancies and estimated ABF variation.

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Australian Obesity rate</th>
<th>WACHS Total admissions</th>
<th>Estimated obese patient admissions</th>
<th>Estimated WACHS obesity coding discrepancies</th>
<th>Estimated ABF Variation (A$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013/14</td>
<td>29.3%</td>
<td>105708</td>
<td>30972</td>
<td>577</td>
<td>$2,092,929</td>
</tr>
<tr>
<td>2014/15</td>
<td>29.8%</td>
<td>106074</td>
<td>31610</td>
<td>589</td>
<td>$2,136,015</td>
</tr>
<tr>
<td>2015/16</td>
<td>30.3%</td>
<td>107978</td>
<td>32717</td>
<td>610</td>
<td>$2,210,838</td>
</tr>
<tr>
<td>2016/17</td>
<td>30.8%</td>
<td>102391</td>
<td>31536</td>
<td>588</td>
<td>$2,131,040</td>
</tr>
<tr>
<td>2017/18</td>
<td>31.3%</td>
<td>103902</td>
<td>32521</td>
<td>606</td>
<td>$2,197,593</td>
</tr>
<tr>
<td>2018/19</td>
<td>31.9%</td>
<td>104956</td>
<td>33470</td>
<td>624</td>
<td>$2,261,731</td>
</tr>
<tr>
<td>2019/20 projected</td>
<td>32.4%</td>
<td>108061</td>
<td>35012</td>
<td>653</td>
<td>$2,365,882</td>
</tr>
<tr>
<td>2020/21 projected</td>
<td>33.1%</td>
<td>109844</td>
<td>36347</td>
<td>678</td>
<td>$2,456,135</td>
</tr>
<tr>
<td>Annual Average</td>
<td>31.1%</td>
<td>106114</td>
<td>33023</td>
<td>616</td>
<td>$2,231,520</td>
</tr>
</tbody>
</table>
The results show corresponding increases in obesity coding discrepancies, population obesity rates and obese patient admissions over the eight-year period analysed. Annual average cases of obesity inaccuracy are calculated to be 616 cases. Estimated ABF variations due to obesity coding inaccuracy during this timeframe range from A$2,092,929 to A$2,456,135, with an average of A$2,231,520 per financial year.

The outcomes of this study have been published in the *Journal of Multidisciplinary Healthcare* (2021; 14(1): 1–8).

**4.4 Discussion of Financial Implications of Obese Patient Coding Inaccuracy**

The data analysis of obese patient coding inaccuracy demonstrated substantial financial implications to WACHS funding. The application of Australian population obesity rates and the financial variation rate of 1.86% to WACHS admission data resulted in the finding that an average of 616 annual cases of obesity inaccuracy will occur if obesity data accuracy improvements are not implemented. The number of cases will likely be higher in WACHS regional and remote communities as obesity rates are higher in these areas, however no ABS obesity data for these communities is available for discrete examination (ABS, 2008). The cases of obesity data inaccuracy will result in lost ABF opportunities to WACHS estimated at A$2,231,520 each financial year. In the current fiscal environment where healthcare funding challenges are frequent, improving obesity clinical recording and coding accuracy to ensure ABF reflects the clinical impact of caring for obese patients should be a priority. Additionally, improvements to obese data collection will allow healthcare organisations to enhance obese patient handling safety strategies and reduce risks of injuries to nurses and other healthcare staff, which will also bring about financial benefits such as reduced workers’ compensation costs and reduced casual/agency staff costs incurred to replace injured workers.

Much of the current clinical and safety implications involved in caring for obese patients both at WACHS and generally in Australian hospitals is absorbed within hospital operational budgets. Additional staff are regularly required when managing morbidly obese patients to ensure safe patient handling practices by the staff involved. Lifting or maneuvering obese patients if mechanical means such as hoists are unavailable, which is common in smaller regional hospitals, will often involve 2 to 4 healthcare workers and can require more staff if managing morbidly obese patients. Changes in rehabilitation approaches commonly occur for morbidly obese patients as rehabilitation requirements are extended above the admission health issue to address patient general wellbeing concerns such as mobility.
Obese patients, particularly the morbidly obese, will require utilisation of bariatric equipment or furniture that have higher safe working load ratings such as hoists and slings, bariatric beds, bariatric wheelchairs, bariatric chairs, and bariatric toilets. Both obese patients themselves and the equipment/furniture requires additional hospital space, and therefore bariatric rooms require more hospital space per patient than normal weighted patients. It is common for health services to modify a 2-person patient room to a one-person bariatric patient room to ensure sufficient space is made available. Additional space requirements due to management of obese patients may reduce a hospital’s overall room or bed availability and therefore impact a hospital’s servicing ability to its community, which may in time impact on requirements to expand healthcare facilities. Costs for bariatric equipment and building modifications or extensions to accommodate obese patients can be expensive and is often funded out of a hospital’s operating budget. Additionally, costs to train staff to safely manage obese patients, particularly the morbidly obese, are often funded from a hospital’s operating budget rather than ABF. The financial impacts to healthcare organisations due to requirements to manage obesity is a hidden cost burden to hospitals. Given future projections of Australian obesity rates, increasing financial impacts to healthcare organisations, especially those in county and rural locations, will be significant and should be included in future financial models and budget submissions.

Financial implications relating to obese patients also includes increased medications in comparison to normal weighted patients, due to their higher percentage of adipose tissue and lower percentages of water and lean body mass (Hahler, 2002). Examples of these medications include but are not limited to lipophilic drugs, some chemotherapeutics and some anticoagulants such as Enoxaparin, unfractionated Heparin, Carvedilol, Apixaban, Ribavirin, Prasugrel and Cephazolin. These medications can be costly to both patients and the Australian Government by way of the Pharmaceutical Benefits Scheme (PBS) subsidies (Barras & Legg, 2017).

Obesity coding inaccuracies that result in lost funding opportunities are generally attributed to issues relating to recording of patient obesity by clinicians rather than coding practices itself. The recording issues can involve lack of data such as height, weight and/or BMI recording, lack of recording of obesity visually observed by clinicians and lack of recording of changes in patient care due to obesity. It has also been anecdotally reported that obesity recording by clinicians may be impacted by societal obesity normalisation and fear of stigmatising patients (Quan et al., 2008). Further examination is required to develop improvement opportunities that will enhance clinical recording and coding of patient obesity, which will result in reduced ABF variations and increased funding opportunities for hospitals. A manual examination of patient records determined between 6
to 9 locations within the manual patient files for weight, height and/or BMI to be recorded by clinicians (McClean et al., 2020). The multiple recording locations may confuse busy clinical staff and may result in low recording of obesity. As hospitals transition towards electronic health records, future opportunities may be available for mandatory recording of patient weight and height data by clinicians, which could then generate automated BMI calculations within the electronic record. Simplified methods for staff to record changes in clinical care due to the obesity condition should also be considered.

For healthcare organisations maintaining manual patient files, improvements to obesity recording will occur if clinicians are informed on the benefits of accurate obesity data. Education to clinicians should be delivered that links impacts of poor obesity data and potential effects of improved obesity data recording such as enhanced safety of staff who manage obese patients and additional opportunities for funding which could be used for increased resourcing, equipment or training. Additionally, strong management direction and policy regarding improved weight, height and BMI recording should be initiated, such as consideration of mandatory recording of obesity data. These improvements will influence a culture shift for improved obesity data recording, ensuring enhanced ability by healthcare organisations to increase safety approaches for staff managing obese patients and recoup finances for obesity related tasks.

4.5 Limitations

The inclusion criteria of patients only with Type 2 Diabetes is a recognised limitation of this study and it is acknowledged that recorded obesity rates in the patient files may differ from obesity rates in the general population. Expansion of the patient inclusion criteria should be considered for future research to allow a broader study of obesity recording accuracy. A second limitation to this study is the clinical accuracy of obesity-related measurements recorded in patient files, which exceeds the scope of this research study. All clinical data within patient files is recorded by trained staff and is considered to be the gold standard for analysis and comparison.

The number and location of rural hospitals in Australia, is though large in number, are spatially remote and WACHS has been selected as a case study. However, WACHS itself incorporates 94 sites regional health locations, and time and funding restraints warranted a sample of 4 sites to be included in the research studies. The 4 sites were selected as a representation of the vastness of WA regional locations and incorporated a variety of population obesity rates in rural and remote locations within Australia. A third limitation of this study was researcher availability to attend rural hospital locations to collect data. Travel restrictions during the COVID-19 pandemic were also potential barriers to researcher availability. While valid results were obtained in this study, future
research may require collection of larger data collections and increased researcher availability will require consideration, however future use of electronic health records by hospitals will potentially accommodate remote data collection by researchers, which could reduce this limitation in the future.

4.6 Implications of findings

Hospital administrators must ensure accurate clinical recording of obesity in order to obtain accurate ABF to fund treatment of obese patient admissions. Insufficient obesity data recording currently results in lost ABF reimbursement which is impacted by multiple recording locations of height, weight and BMI within patient files, lack of organisational communication regarding requirements for this data and competing clinical workload pressures. Improvement opportunities to increase obesity data recording should be examined such as streamlined data recording locations in both physical and electronic patient files, consideration of mandatory reporting of height and weight, and simplified methods to record changes in patient care due to obesity, such as ‘check boxes’ for clinical staff to easily indicate. Increased accuracy of obesity recording within clinical files of obese patients will ensure ABF will reflect the obesity conditions managed, and healthcare organisations will be funded appropriately for treatment of obese patients.
Chapter 5 Evaluating the Effectiveness of a Clinical Practice Intervention in Increasing Obesity Data Recording and Coding.

This chapter is presented as the manuscript submitted to, and currently under peer-review in the *Journal of Multidisciplinary Healthcare*.

5.1 General Overview

Pressure on Australia’s health care system is increasing annually partially due to increases in chronic diseases such as obesity. The literature review discussed in Chapter 2 highlights risks to healthcare staff and organisations that manage obese patients, including increased injuries to backs, wrists, knees and shoulders of nurses. Caring for obese patients is more labour intensive and requires more time, which can be problematic in time-poor and resource-poor hospitals. Increased staff and specialist patient handing skills and solutions is also required when caring for obese patients. Additionally, hospitals that treat obese patients were observed to experience high liability and financial risks due to workers’ compensation and common law claims by injured staff and potential medical negligence claims by patients with obesity. These risks to healthcare staff and organisations are going to increase as the Australian population rates of obesity increase, with obesity rates projected to be 42% by 2035 (Walls et al., 2012).

Work, Health and Safety (WHS) and Occupational Safety and Health (OSH) obligations require healthcare organisations to manage risks to their staff as far as practicable. In order to adopt sound risk management practices to protect staff managing obese patients, accurate obesity data is required. Inaccurate or unavailable patient obesity data may result in difficulties for healthcare organisations to design and implement evidence-based proactive risk management approaches. Additionally, absence of obesity data may result in either organisational ignorance of obesity risks or organisations to rely on anecdotal awareness of the risks. The literature review discussed in Chapter 2 and the study discussed in Chapter 3 identified that obesity data is recorded within clinical information which can be used to inform programs to reduce risks to staff and obese patients.

Recording and measuring obese patients requiring healthcare services is important from a staff safety perspective, however it is also important for public health information which may inform obesity-related education and targeted treatment campaigns. The obesity condition cost the Australian economy A$8.6 billion in 2011/12 in direct and indirect costs, and anticipated obesity-related costs are expected to rise by A$87.7 billion between 2015 to 2025 if no public health action is taken to curb obesity (AIHW, 2017). Increased measurement of obese patients admitted in hospitals will record increases for requirements of focussed obesity-related treatment such as
engagement of dieticians, social workers and other allied health workers. Conversely, increased weight, height and BMI recording will also identify patient malnutrition and inform engagement of similar hospital services to assess patient health requirements.

The study discussed in Chapter 3 examined accuracy of admission records of obese patients in 4 WACHS hospitals, which revealed poor recording of weight (67%), height (24%) and BMI when weight and height measurements were recorded (38%). Poor obesity data accuracy was also determined by low sensitivity results (40%) and high false negative results (60%). This analysis of obesity recording and accuracy revealed that improvement is required to accurately reflect the frequency of obese patients treated in WACHS hospitals and inform risk management strategies to protect staff from patient handling injuries when managing obese patients. To examine potential methods to enhance obesity recording and coding accuracy, an intervention was undertaken over 12 months to at 1 WACHS hospital. To assess whether the intervention makes any impact on obesity recording or data accuracy, a repeat audit of obese patient records was conducted and compared to the original audit.

5.2 Methodology to Determine Effectiveness of a Clinical Practice Intervention in Increasing Obesity Data Recording and Coding

5.2.1 Intervention Design

A hospital-wide intervention at Site A to improve obesity recording and coding was conducted over 12 months. Site A had participated in the preceding retrospective audit discussed in Chapter 3, which provided a baseline for this intervention. The intervention includes several approaches that aim to improve obesity data recording and coding which are:

i. Education sessions to medical, nursing staff and clinical coding staff to emphasise the importance of accurate obesity data recording for both clinical and safety decision making, identifying recording locations within medical charts for height, weight and BMI measurements and providing upskilling in use of evidence-based methods to measure height of patients who are bed-ridden or unable to stand due to their health conditions.

ii. Introduction of tape measures to nursing staff to undertake height measurements of bed-ridden patients.

iii. Introduction of obesity decision making tools such as BMI charts and measurement tools in Emergency Departments, Wards and Clinical Coding offices to allow easy identification of obesity.

iv. Recording of patient volunteered height measurements, if known, if patient height could not be measured in the hospital.
v. Education of the above obesity recording improvements for all newly employed clinical staff.
   vi. Regular email, newsletter and patient file reminders (flags) to clinical staff reinforcing the requirement for patient height, weight and BMI recording in medical charts.
   vii. Enhancements to clinical coding instructions to allow the determination of obesity by coding staff by calculating BMI if recorded height and weight measurements are available.

Patient volunteered height measurements was accepted if other methods could not be utilised to determine height. Volunteered height is demonstrated to be reliable for use in determining obesity (Hodge, 2020; Pasalich et al., 2014). The education sessions to medical, nursing staff and clinical coding staff occurred prior to the commencement of the intervention and involved 16 dedicated sessions with hospital leaders, ward staff, dieticians, allied health staff and coding staff. Following the education sessions, clinical shift co-ordinators conducted obesity recording reminders at shift changes. Manual BMI calculators and tape measures were distributed to nursing stations and allied health offices and education posters on obtaining height by using the Ulnar (forearm) length method were distributed in nursing stations, allied health offices and placed near all patient scales. 3 email reminders by hospital Executives were sent to all hospital staff quarterly prompting staff to record weight, height and BMI and included (i) justification why BMI recording was required, (ii) recording locations in medical charts and (iii) links to BMI online tools. Additional BMI-related information was included in a staff newsletter and manual reminder flags were placed in patient files.

5.2.2 Intervention Audits

Obesity recording and accuracy of coding was examined 2 months post the 12-month intervention timeframe to allow all records to be coded. Inclusion and exclusion criteria for the intervention was identical to the criteria of the original audit discussed in Chapter 3. Inclusion criteria comprised of records for patients who were admitted to hospital for 5 days or more between 17 February 2020 and 16 February 2021, patients who were over the age of 18 at the time of hospital admission, and who had principal or additional diagnosis of “diabetes mellitus”, which includes Type II diabetes. Diagnoses of Type II diabetes was selected as an inclusion criterion as it has a confirmed link with obesity (American Society for Metabolic and Bariatric Surgery, 2013; Medical Research Council United Kingdom, 2015). Records of patients who were admitted to hospital more than once in the audit period were included. Exclusion criteria included records of patient boarders such as palliative care, and patients who use other health services such as outpatient treatments, patients diagnosed with Type 1 Diabetes Mellitus, those with a family history of diabetes mellitus or pre-existing diabetes mellitus, and keywords relating to Type 1, or ‘in pregnancy’. Further details of data collection are reported in Chapter 3. Site E was nominated as a control site for this study due to no
involvement in the original audit or intervention and was also audited using the same criteria and methods.

WACHS Health Information Managers (HIMs) determined patients and their corresponding episodes that fell within the study inclusion criteria. A manual examination of the medical files was then conducted to examine the inclusion or absence of obesity recording, and weight, height and BMI recording. The principal researcher undertook training on medical file examination techniques prior to the original audit to ensure sound data extraction methods were met.

5.2.3 Data analysis
Statistical analysis, equivalent to the original audit in Chapter 3, was performed using Statistical Package for the Social Sciences (SPSS®) version 27, which is common methodology used in clinical examinations of interventions and comparisons. 7 quantitative obesity recording measures are examined:

i. Percentage coded as obese,
ii. Weight recorded,
iii. Height recorded,
iv. BMI calculated,
v. Height and weight recorded with no BMI,
vi. Obesity or BMI notations recorded, and
vii. Obesity or BMI notations recorded but Height and Weight not recorded.

Accuracy of clinical recording and coding of obesity-related conditions are examined by the analysis of 7 additional measures, being:

i. Sensitivity,
ii. Specificity,
iii. Positive predictive values (PPVs),
iv. Negative predictive values (NPVs),
v. False positives,
vi. False negatives, and
vii. Cohen’s Kappa values.

Sensitivity determined the degree of obesity recording in the patient admission data when it was first present in the medical files, while specificity measured the absence of obesity conditions in the patient admission data if the condition is absent in the medical files. PPVs examined cases that were coded as obese and then examined the occurrences of obesity notations in medical files, conversely
NPVs examined absence of obesity coding and then examined the absence of obesity notations in medical files. Analysis of false positives determined records coded as obese despite the obesity condition not recorded and analysis if false negatives determined records not coded as obese despite the obesity condition being recorded. Cohen’s kappa values determined the agreement between the patient admission data and the obesity data within clinical records.

5.3 Results Assessing the Effectiveness of a Clinical Practice Intervention

A total of 166 patient records met the inclusion criteria and were assessed in the pre-intervention audit in September 2017 and 166 records were similarly assessed in the post-intervention audit between March and April 2021. The pre-intervention audit included records consisting of 87 males (52%) and 79 females (48%) aged between 25 and 98 years. The post-intervention audit included records consisting of 76 males (46%) and 90 females (54%) aged between 19 and 96 years. A summary of the results of the statistical analysis of obesity data recording and accuracy is shown in Tables 5.1 and 5.2.
Table 5.1: WACHS patient admission obesity accuracy and inter-rater reliability analysis

<table>
<thead>
<tr>
<th></th>
<th>2017/18 Data Collection</th>
<th>2021 Intervention Site</th>
<th>2021 Control site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Site A</td>
<td>Site B</td>
</tr>
<tr>
<td>Records within research criteria</td>
<td>847</td>
<td>209</td>
<td>199</td>
</tr>
<tr>
<td>Records audited</td>
<td>590</td>
<td>166</td>
<td>100</td>
</tr>
<tr>
<td>Coded as obese (n, %)</td>
<td>64 (10.8%)</td>
<td>14 (8.4%)</td>
<td>3 (3.0%)</td>
</tr>
<tr>
<td>Weight recorded</td>
<td>397 (67.3%)</td>
<td>94 (56.6%)</td>
<td>70 (70.0%)</td>
</tr>
<tr>
<td>Height recorded</td>
<td>142 (24.1%)</td>
<td>21 (12.6%)</td>
<td>9 (9.0%)</td>
</tr>
<tr>
<td>BMI calculated</td>
<td>64 (10.8%)</td>
<td>10 (6.0%)</td>
<td>7 (7.0%)</td>
</tr>
<tr>
<td>Height and weight recorded, no BMI</td>
<td>88 (62.0%)</td>
<td>12 (57.1%)</td>
<td>8 (88.8%)</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded</td>
<td>115 (19.4%)</td>
<td>27 (16.2%)</td>
<td>12 (12.0%)</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded but height and weight not recorded</td>
<td>55 (9.3%)</td>
<td>21 (12.6%)</td>
<td>11 (11.0%)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>40.0%</td>
<td>48.1%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Specificity</td>
<td>96.2%</td>
<td>99.3%</td>
<td>97.7%</td>
</tr>
<tr>
<td>NPV</td>
<td>86.9%</td>
<td>90.8%</td>
<td>88.6%</td>
</tr>
<tr>
<td>PPV</td>
<td>71.8%</td>
<td>92.9%</td>
<td>33.3%</td>
</tr>
<tr>
<td>False positive</td>
<td>3.8%</td>
<td>0.7%</td>
<td>2.3%</td>
</tr>
<tr>
<td>False negative</td>
<td>60.0%</td>
<td>51.9%</td>
<td>91.7%</td>
</tr>
<tr>
<td>Kappa</td>
<td>0.44</td>
<td>0.59</td>
<td>0.09</td>
</tr>
</tbody>
</table>
Table 5.2: WACHS patient obesity recording characteristics and intervention outcomes

<table>
<thead>
<tr>
<th></th>
<th>Site A Pre-intervention</th>
<th>Site A – Intervention</th>
<th>Difference in proportions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Records within research criteria</td>
<td>209</td>
<td>220</td>
<td>11</td>
</tr>
<tr>
<td>Records audited</td>
<td>166</td>
<td>166</td>
<td>0</td>
</tr>
<tr>
<td>Coded as obese (n, %)</td>
<td>14 (8.4%)</td>
<td>17 (10.2%)</td>
<td>3 (1.8% ↑)</td>
</tr>
<tr>
<td>Weight Recorded</td>
<td>94 (56.6%)</td>
<td>96 (57.8%)</td>
<td>2 (1.2% ↑)</td>
</tr>
<tr>
<td>Height Recorded</td>
<td>21 (12.6%)</td>
<td>55 (33.1%)</td>
<td>34 (20.5% ↑)</td>
</tr>
<tr>
<td>BMI Calculated</td>
<td>10 (6.0%)</td>
<td>56 (33.7%)</td>
<td>46 (27.7% ↑)</td>
</tr>
<tr>
<td>Height and Weight Recorded, no BMI</td>
<td>12 (57.1%)</td>
<td>12 (21.8%)</td>
<td>0 (35.3% ↓)</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded</td>
<td>27 (16.2%)</td>
<td>22 (13.2%)</td>
<td>5 (3% ↓)</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded but Height and Weight not recorded</td>
<td>21 (12.6%)</td>
<td>14 (12.6%)</td>
<td>2 (stable)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>48.1%</td>
<td>59.1%</td>
<td>11% ↑</td>
</tr>
<tr>
<td>Specificity</td>
<td>99.3%</td>
<td>96.5%</td>
<td>2.8% ↓</td>
</tr>
<tr>
<td>NPV</td>
<td>90.8%</td>
<td>93.9%</td>
<td>3.1% ↑</td>
</tr>
<tr>
<td>PPV</td>
<td>92.9%</td>
<td>72.2%</td>
<td>20.7% ↓</td>
</tr>
<tr>
<td>False Positive</td>
<td>0.7%</td>
<td>3.5%</td>
<td>2.8% ↑</td>
</tr>
<tr>
<td>False Negative</td>
<td>51.9%</td>
<td>40.9%</td>
<td>11% ↓</td>
</tr>
<tr>
<td>Kappa</td>
<td>0.59</td>
<td>0.6%</td>
<td>0.01% ↑</td>
</tr>
</tbody>
</table>

5.3.1 Pre-Intervention Obesity Recording and Coding

Obesity was coded in 8.4% of all patients, with weight being recorded in 56.6% of all patients and height being recorded in 12.6% of patients. BMI was calculated in 6% of all patients, and of the patients who had height and weight recorded, 57.1% of patients did not have BMI recorded. Obesity or BMI notations were recorded in 16.2% of all patients, however 12.6% of obesity or BMI notations were not supported by height or weight records. Sensitivity and specificity between obesity coding and obesity recordings in medical files resulted in 48.1% and 99.3% respectively. Analysis of PPVs
and NPVs resulted in 92.9% and 90.8% respectively. Recorded false positives were 0.7%, while recorded false negatives were 51.9%. The Cohen's Kappa value was 0.59.

5.3.2 Post-Intervention Obesity Recording and Coding
In the post-intervention audit obesity was coded in 10.2% of all patients, with weight being recorded in 57.8% of all patients and height being recorded in 33.1% of patients. BMI was calculated in 33.7% of all patients, and of the patients who had height and weight recorded, 21.8% of patients did not have BMI recorded. Obesity or BMI notations were recorded in 13.2% of all patients, however 12.6% of obesity or BMI notations were not supported by height or weight records. Sensitivity and specificity between obesity coding and obesity recordings in medical files resulted in 59.1% and 96.5% respectively. Analysis of PPVs and NPVs resulted in 72.2% and 93.9% respectively. Recorded false positives were 3.5%, while recorded false negatives were 40.9%. The Cohen's kappa value was 0.6.

Figure 5.1 displays a histogram summary of the pre-intervention and post-intervention obesity recording results. Figure 5.2 displays the pre-intervention and post-intervention sensitivity and specificity results, including an aspirational specificity and sensitivity target established by the study authors of 100% in order to support enhanced obesity coding accuracy.

![Figure 5.1: WACHS Obesity Recording Pre and Post Intervention](image-url)
5.4 Discussion of Intervention Outcomes and Impacting Factors

Generally, the 12-month intervention at site A resulted in high improvements in recording of obesity-related measures and obesity data accuracy. An increase from 6% to 33% in patient BMI recordings resulted, impacted by an increase from 12% to 33% in patient height measurements and an increase from 56% to 58% in patient weight measurements being obtained. Completeness of BMI recording was also positively demonstrated by a 35% reduction in cases where BMI was achievable using weight and height measurements but was not recorded. Written notations in clinical files of obesity or BMI also reduced by 3%, indicating increased use of BMI measurements to indicate obesity by clinicians rather than visual observation of obesity. Increasing use of BMI data to indicate obesity was also demonstrated by a reduction of 7 cases where written notations in clinical files of obesity or BMI were recorded despite height and weight measurements not obtained.

Obesity accuracy results also generally increased due to the intervention, including sensitivity increases from 48% to 59%, NPV from 90% to 94% and reduction in false negatives from 52% to 41%. The Cohen’s kappa value also increased slightly by 0.01%. The sensitivity result demonstrates that, where obesity was recorded in patient files, 59% were coded as obese, similarly the NPV result of 94% demonstrated that of all ‘normal weighted’ coded patients, 94% of these patients did not have
obesity notations recorded in medical files. The slight increase in the Cohen’s Kappa value demonstrated moderate correlation between occurrences of coded obesity and the recorded obese patient notations in the medical files.

Conversely, the small reduction in specificity from 99% to 96% reduction resulted in a slight reduction in accuracy when coding non-obese patients as ‘normal weighted’. A specificity measurement of 96% does however demonstrate very good accuracy. Similar to the reduced specificity result, a reduction in PPV was recorded from 93% to 72%, which demonstrated a reduction in accuracy of the percentage of patients coded as obesity who actually were obese. PPV outcomes are influenced by the prevalence of obesity in the patient population, which is very low in both the pre-intervention and post-intervention results at 8% and 10% respectively. The 21% reduction in PPV was due to an increase of 4 cases of false positives, where patients have been incorrectly coded as obese despite no clinical recording of obesity in the patient files. Due to the low prevalence of 18 cases of obesity recording, a minor increase of 4 cases of false positives resulted in the large decrease in PPV.

Control site E was also analysed to determine if external factors impacted obesity recording and accuracy during the intervention timeframe. The control site was not included in the pre-intervention analysis and did not receive obesity-related coaching or information. Site E demonstrated generally high levels of obesity recording and accuracy, with 14% of patients coded as obese, 87% of patient weight recorded and 37% of patient height recorded. However, low translation to BMI measurements resulted with 10% of total cases having BMI measurements recorded and 74% of cases with height and weight measurements did not record BMI measurements. Sensitivity, specificity, NPV & PPV measurements were relatively high at 72%, 97%, 95% and 81% respectively. Both false positives and false negatives were relatively low at 3% and 28% respectively. The Cohen’s Kappa measurement was 0.7 which demonstrates good agreement between clinical files and coded obesity data. The control site obesity recording, and coding accuracy results demonstrates site variability in processes and methods of recording obesity, which can be affected by site leadership, occupation functions or internal training. Site E demonstrated strong allied health obesity recording, mostly by dieticians, occupational therapists or physiotherapists. These functions were represented at all other examined sites, however methods and levels of detail of recording differed and high levels of obesity recording appeared to be dependent on fastidious staff. While Site E demonstrates strong recording of obesity and coding accuracy, Table 5.1 shows fluctuations across the 5 sites, likely due to variability of local instructions, processes and individual recording practices of staff.
Instruction to staff by healthcare leaders on requirements for obesity recording and education for staff on methods/tools to measure obesity, how obesity is used and recording locations within clinical files is essential for improved recording and accuracy of obesity data. Depending on the clinical presentation of the patient, there may be up to 9 locations in patient files where obesity-related data can be captured. These multiple data recording locations can create confusion and reporting fatigue for staff. Staff may also not be aware of the importance of, and uses of obesity data, such as staff safety approaches, clinical malnutrition or ABF/financial implications. Staff may not be aware of locations of scales, particularly bariatric scales, or how to accurately measure height of bed-ridden patients using the Ulnar length method, Demi-span method or knee height method (Han & Lean, 1996; Hickson & Frost, 2003; Jarzem & Gledhill, 1993).

Organisational reinforcement of requirements for obesity recording is required and is demonstrated to successfully influence obesity recording improvements in this intervention. Education and emphasis of obesity recording requirements should be conducted at site inductions for new staff and on an ongoing schedule using a variety of methods to ensure clinical understanding and compliance. While the intervention resulted in a 27% increase in BMI recording which is a positive result, aspirational targets of 100% should be set by hospitals to support a mandatory reporting requirement. Quality improvement processes such as audits of clinical files to ensure accuracy and completeness of clinical data occurs within hospitals, these processes should be expanded to also include reviews of obesity recording. These improvement actions will increase obesity recording and coding in busy hospital environments where potential competing priorities such as immediate treatment needs, heavy workloads and lack of staff may be present.

In country hospitals where patients may be individually known to staff due to community interaction or repeated hospital admissions, a patient’s obesity status and history may be well known to staff however undocumented in patient files. This represents risks to both unfamiliar staff and the healthcare organisation. Furthermore, as obesity is higher in rural locations, country hospital staff are at risk of normalising obesity and accepting both visual and clinical indications of obesity as ‘normal’ and therefore underestimating BMI (ABS, 2008; Maynard et al., 2006). Indications of visual weight observations occurring was indicative in the intervention data with 12.5% of BMI recordings being in the obese category and 39% being in underweight or healthy weight categories. Under-reporting of obesity was also observed, predominantly in cases where patients were obese but able to move independently and obese patients admitted with mental health crises.

Although immediate improvement of obesity recording can be improved by implementing hospital education programs and auditing compliance, mandatory recording fields for patient height and
weight should be considered as Australian hospitals move towards adoption of electronic health records. Electronic fields for recording obesity data should be made available and be easily located by clinicians, which will reduce confusion around recording requirements and duplication. BMI calculations can be automated using the height and weight measurements, and indicators or a ‘check box’ should be designed to indicate when the obesity condition impacts the patient’s management during their hospital admission. This indicator will meet coding requirements for clinical coders to code the obesity condition. Studies in the United States have determined that identification of patient obesity has increased with adoption of electronic health records, along with the ability to record frequency of obese patient hospitalisations and obesity treatment provided (Mattar, 2017). This potential recording and coding improvement will also automate and address low BMI recording, where clinical coders currently are unable to code obesity if weight and height are available within the medical record but BMI is not calculated. Although the intervention improved clinical recording of BMI when weight and height measurements were obtained, 22% of records still did not record BMI despite availability of weight and height measurements.

Improved obesity data, including BMI recording, will indicate if both clinical risks and staff safety risks may be present and can inform Bariatric Risk Management plans. Requirements for mobility assistance, additional staff support and bariatric equipment can all be documented in 1 clinical location within the Bariatric Risk Management plan. During the pre and post intervention analysis, much of the clinical planning for bariatric support and required documentation/records were in a variety of locations in the patient file, including the general notes section. Risks can be present for staff, the patient and the organisation if the documented hazards and care plans are not easily located and understood by nursing staff.

Finally, improved obesity recording and coding will positively impact healthcare funding. Hospital funding is partially generated by the ABF system which provides payment for patient care, which can vary significantly due to the complexity of patient treatment and length of stay. In cases of obesity, if the patient treatment is affected by the obesity condition and poor obesity recording occurs, the hospital will not receive correct financing relating to the case. This can mean that clinical necessities such as increased staffing requirements for lifting, turning or toileting of obese patients, use of bariatric equipment, increases in anaesthetic or medication doses, change in rehabilitation approaches, and changes in clinical risk categories for obese maternity patients will not be included in ABF calculations. Further exploration of financial impacts to hospitals due to lack of obesity recording or inaccurate coding should also be considered.
5.4.1 Case studies of inaccurate obesity recording/coding.

The following 3 case studies are presented to demonstrate hospital treatment provided to obese patients that have required additional resources above standard requirements of ‘normal weighted’ patients. These cases include inaccurate obesity recording and coding, resulting in the hospital not being funded for the use of additional staff or equipment required for the safe healthcare treatment for the patient.

1. A 66 year old male admitted with an anal abscess for treatment. Patient weight recorded as 118 kilograms, no height, BMI or obesity notations recorded. One (1) or two (2) staff were required to assist for bed mobility tasks, sheet changes and washing of patient. Patient showered on trolley bath with 2 staff assisting. Patient transfers from bed using ceiling hoist and 3 staff to assist. Patient was also hoisted to wheelchair with 3 staff to assist. It was clinically noted that positioning patient in wheelchair is challenging due to his increased weight. Patient hoisted back to bed with 2 staff assisting and use of ceiling hoist. Obesity not coded by clinical coders.

2. A 79 year old female admitted with cellulitis of lower limb requiring treatment. Patient weight recorded as 134 kilograms, no height, BMI or obesity notations recorded. Patient required transfer from bed to toilet using 1 staff member to assist her and patient also required 1 staff member to assist her to lift legs back into bed. Patient was not able to turn herself in bed and required 2 staff to assist her with repositioning in bed. She also needed 2 staff to assist with 'sit to standing' movement. Use of a standing hoist and 2 staff was required to transfer the patient from the toilet back to bed. Obesity not coded by clinical coders.

3. A 82 year old female admitted with Motor Neuron Disease requiring treatment. Patient weight recorded as 90 kilograms, no height, BMI or obesity notations recorded. Patient presented with mobility issues and clinical notes stated 'heavy transfer, will need to be a full hoist'. Obesity not coded by clinical coders likely as insufficient obesity recording to code obesity.

5.5 Limitations

The obesity recording and coding intervention commenced in February 2020, 3 weeks after the first reported cases of COVID-19 in Australia and approximately a month prior to COVID-19 restrictions and impacts in Western Australia. During the entire 12 months of the intervention significant healthcare planning for COVID-19 patient surges occurred and staff anxiety relating to COVID-19 was high. While the intervention was successful, it is very likely that obesity recording compliance by some staff was affected by the impacts of COVID-19.

Similarly, competing priorities and constraints relating to increased clinical workload, resourcing limitations and hospital pressures were present during the intervention. WACHS, and many other
Western Australian hospitals experienced increased hospital admissions and Emergency Department presentations due to a variety of factors such as increased mental health cases linked to illicit substance abuse, compounded during the intervention due to delays in mental health treatment due to COVID-19 restrictions. Increased workload and pressures potentially affected completeness of obesity recording and accuracy of obesity coding at higher than normal occurrences.

An additional limitation of this study is the inclusion of patients only with Type II Diabetes. This health condition inclusion was selected as diabetes is strongly linked to obesity, and it is possible that rates of obesity recording in the data of patients with diabetes may be higher than in the general population. A broader examination of obesity recording accuracy of the general patient population may be available by expanding the patient inclusion criteria. The accuracy of clinical data within patient files is also outside of the scope of this study, this clinical data is recorded by trained clinical staff and is considered to be the gold standard for analysis and comparison.

Finally, researcher availability was also a limitation of this study. Sizable distances between WACHS hospitals and metropolitan locations impacted researcher ability to conduct manual file examinations. While the data collection and analysis demonstrated successful results, increased data collections and increased researcher availability should be considered for future similar research. The adoption of electronic health records by healthcare organisations will reduce this limitation by allowing researchers to examine patient files remotely.

**5.6 Implications of findings**

The identification of obese patients admitted to hospitals is important for management of patient treatment, management of staff safety and reduction of organisational risks (McClean et al., 2021). Methods to increase obesity recording by clinical staff and accuracy of obesity coding by clinical coders is demonstrated by the successful intervention, however more must be done to reduce risks to healthcare organisations, patients and staff. Due to clinical workloads and immediate treatment prioritisation of health conditions responsible for hospital attendance, methods of obesity recording are required to be simple and user-friendly. Organisational progression in adoption of electronic health records will assist to improve obesity recording, including consideration of mandatory recording of weight and height, automated BMI calculations and ‘check-boxes’ to indicate obesity impacts on patient care requirements. Simplified mandatory obesity recording and implementation of audit programs will ensure accurate coding. Until electronic health records are adopted by healthcare organisations, promotion of the importance of obesity data recording and programs to increase clinical staff awareness of the requirement for improved height, weight and BMI recording should occur, including potential uses of this data for non-clinical uses such as obese patient
handling risk mitigation and ABF reimbursements. Auditing of obesity recording should occur, which could inform training and improvement strategies. Finally, expansion of clinical coder availability to determine BMI/obesity categories if height and weight measurements are available in patient records should be explored. In addition to staff safety improvements, increased obesity recording and coding accuracy will also increase accuracy of funding allocations to hospitals and reduce requirements for hospitals to pay for costly obesity management requirements such as increased staffing and bariatric equipment out of operational hospital funds.
Chapter 6 General Discussion

6.1 General Introduction

The studies described in this thesis sought to examine health and safety, and financial risks to healthcare organisations and staff who care for obese patients, and the impact of accurate obesity recording and coding. The significance of these risks is underpinned by high Australian population obesity rates of 31.3% obese (5.8 million people) recorded in 2017-18 and Australian projected obesity rates increasing in 2035 to 42% of the population (13.4 million people) (ABS, 2018; Infrastructure Australia, 2015; Walls et al., 2012). Pieracci et al.’s (2006) study revealed a correlation between increases in population obesity and increases in bariatric patient admissions which indicates a high increased risk of injury to nurses, patients, and other healthcare staff in the future. Injuries sustained by nurses and other healthcare staff who care for obese patients have been reported in the literature and can result in varying impacts to both the individual staff member and to healthcare organisations. Given what is known about the hazards associated with bariatric patient handling, Work Health and Safety and Occupational Safety and Health legislation requires healthcare organisations to ensure programs are adopted to reduce risks to staff as far as is reasonably practicable.

Accurate recording and coding of patient obesity data is required to quantify bariatric patient handling risks and allow trending for healthcare organisations to understand future risks and plan bariatric risk mitigation programs appropriately. Although obesity data such as height, weight and BMI has been demonstrated to be recorded in patient files and available for healthcare analysis, international studies have previously determined high variability between obesity data recorded in patient files and coded obesity data (Martin et al., 2014; Quan et al., 2008). Inaccurate obesity data represents many barriers to implementing safety improvement programs for bariatric patient handling; without an ability to measure and trend obese patient admissions and requirements safe staffing levels, bariatric equipment requirements and staff training needs cannot be assured. As such, the requirement to determine obesity data accuracy is necessary.

The outcomes of the study described in Chapter 5 contributes to improved understanding of safety and financial risks to healthcare staff and organisations that care for obese patients, and availability of data to identify obese patients and quantify associated risks. High safety and financial risks are identified, and obesity data availability is confirmed within patient files, which, if accurate, can be utilised to reduce risks. Accuracy of obesity recording and coding is analysed in Chapter 3 and is determined to be poor. The inaccurate data is examined in Chapter 4, specifically the financial impacts of inaccurate obesity data and an argument is presented that hospitals are not receiving ABF
reimbursements relating to obesity care due to poor obesity recording and coding and are utilising operational budgets to fund much of the obesity requirements. The research outcomes presented in Chapters 2 to 4 resulted in the development of the intervention detailed in Chapter 5, which has been shown to successfully improve obesity data recording and coding. The research included in this thesis is novel and the primary objectives for the research project are achieved. It is believed that prior to this thesis to there has been no evidence-based examination of obese patient admission data accuracy and financial impacts by any Australian health service.

6.2 Obesity Risks to Healthcare Staff

Nurses and other healthcare staff who conduct patient handling tasks are at high risk of injury even when caring for ‘normal weighted’ patients due to the heavy spinal loads involved and awkward postures sustained. Unlike standard manual handling education, weight of patient bodies is not evenly distributed or uniform and there are no handholds easily located to assist with lifting or moving (Muir et al., 2007). 20% of nurses regularly experience work-related pain and 68% of sprains and strains suffered by nurses are directly attributed to patient handling tasks (Gallagher, 2011; Nelson, 2006). Patient handling risks to healthcare staff are magnified when caring for obese patients due to the increased patient weight and increased patient handling requirements such as increased repositioning to avoid pressure ulcers, respiratory complications and to assist with wound healing (Galinsky et al., 2010; Hignett et al., 2007).

High workloads and physical strain are experienced by nurses who care for obese patients, with 1.5 hours of additional care per day required when managing unconscious obese patients (Davidson et al., 2003; Randall et al., 2009). Given time pressures on nurses to complete ward tasks and ongoing nursing shortages making nursing resourcing difficult, caring for obese patients, likely places strain on healthcare staff and can contribute to unsafe patient handling. The manual handling risk for healthcare workers caring for obese patients is considered greater for regional locations due to higher obesity rates than metropolitan locations. Here the workload challenges are associated with smaller workforces such as reduced ability to safely conduct bariatric patient handling when staff are on lunch breaks, shift changeovers or during medical emergencies (ABS, 2008; Davidson et al., 2003; Muir & Archer-Heese, 2009; Van Wicklin, 2018). Additionally, regional hospitals are unlikely to receive the same financial support as metropolitan hospitals to purchase bariatric equipment such as ceiling mounted hoists and bariatric operating tables, beds, and wheelchairs.

Bariatric patient handling training has been demonstrated to be based on tradition and personal experience and evidence-based approaches, required to increase staff safety when conducting patient handling tasks. Introduction of ‘no lift’ approaches and ‘lift teams’ have been successful in
reducing injuries to staff and workers’ compensation claims, however challenges will again be experienced by some regional hospitals to implement these approaches due to small staff teams, competing clinical priorities and lack of bariatric patient handling equipment. Analysis of costs to supply bariatric patient handling equipment to smaller regional hospitals compared to clinical risks, staff safety risks, potential worker’s compensation claims and resulting staff shortages and culture implications should be undertaken. Additionally, safety legislation and duty of care requirements to staff should be considered by all hospitals that are likely to care for obese patients.

6.3 Obesity Risks to Healthcare Organisations

Healthcare organisations have a legal and moral obligation to protect staff in their workplaces as far as reasonably practicable. Obese patients present many staff health and safety challenges described in Section 6.2 which can result in workers’ compensation claims as well as very costly common law claims if serious injuries to staff occur. Additional costs to organisations include funding of worker’s compensation insurance premiums and staff, temporary and permanent, replacement costs. Workload increases to healthcare Managers also occurs to replace injured staff such as arranging recruitment processes, conducting interviews and training new staff members. Mental health and morale of the injured worker’s Manager and colleagues is also a potential workforce ‘cost’, as staff report increased anxiety and safety concerns when caring for obese patients.

Risks of increased medical liability and negligence claims may also occur when caring for obese patients. The obesity condition causes difficulties in scanning, diagnosis and clinical management of health conditions which may result in adverse patient health outcomes. Clinicians treating obese patients may experience complications in accessing or viewing areas of the obese body due to excess skin folds or inability to physically assess patients due to large abdomens, inability to locate anatomical landmarks and difficulties in moving larger, heavier body parts (Hahler, 2002; Muir & Archer-Heese, 2009; Richardson & Harris, 2018). Traditional clinical equipment may not physically fit the obese patient such as blood pressure cuffs and MRI/CT scanning tables. These challenges may result in increased claims of misdiagnosis, medical errors, and ultimately medical negligence.

Treatment of obese patients is also more complex than ‘normal weighted’ patients and increased risk of complications including infections, loss of skin integrity, development of pneumonia and pressure ulcers can slower recovery and lengthen hospital stay. (Galinsky et al., 2010; Kirk et al., 2010; Randall et al., 2009). Increased patient length of stay can contribute to hospital bed shortages, particularly if obese patients require more clinical space such as utilising a 2-bed room for single patient use. Morbidly (severely) obese patients are demonstrated to experience increased length of stays in hospital by up to 4 days than other patients (Hauck & Hollingsworth, 2010). This
increased length of stay contributes to increased hospital service provision and increased hospital costs.

Obesity in the Australian population is demonstrated to be increasing year on year and a future organisational risk is increasing legal action relating to equal opportunity and rights for obese patients. Community expectations for bariatric care in local hospitals will likely rise and a hospital’s inability to provide bariatric clinical care may give rise to legal action. Legal arguments may demonstrate known awareness of obesity increases including in hospitals and lack of planning to accommodate obese patient cohorts with appropriate infrastructure, equipment and healthcare staff. Identification, control and oversight of patient obesity risks, including sound risk management is required by hospitals that manage obese patients to meet safety regulatory compliance and reduce corporate risks. Increased patient obesity recording and accurate coding will improve an organisation’s ability to conduct these tasks. Implementing corporate governance models to address patient obesity risks will provide direction, authority and implementation of initiatives to mitigate and prevent staff safety risks and organisational risks (Sobel & Reding, 2004). Additionally, adopting an enterprise-wide risk management approach to include stakeholders at all levels of the organisation such as Executives, Managers, clinicians and orderlies will embed a safety culture where safe management of patient obesity risks is treated as part of every employee’s job (Beasley et al., 2005).

6.4 Availability and Accuracy of Obesity Data

The literature review presented in Chapter 2 confirmed the availability of anthropometric measurements such as height and weight measurements within patient files as this data is expected to be routinely collected for clinical purposes during the patient’s hospital journey (Noel et al., 2010). If recorded, these measurements can be used by clinicians and clinical coders to determine BMI and obesity by using the standardised BMI calculation and clinical coding methodology. The studies presented in Chapter 3, however, identified sub-optimal recording of weight, height and BMI, which impact on obesity data accuracy and a healthcare organisation’s ability to use obesity data to design risk management approaches, plan for future bariatric requirements and measure success of interventions or improvement programs.

6.4.1 Obesity Recording Completeness and Accuracy

Methodology to measure obesity data accuracy was successfully trialled in the pilot study examined in Chapter 3. Here sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), false negative rates, false positive rates and Cohen’s Kappa values are determined. Additionally, 5 indicators to demonstrate completeness of obesity data recording were successfully
triaged. These included prevalence coded as obese, weight recorded, height recorded, BMI recorded, and height and weight recorded with no BMI. The pilot study involving 2 hospitals resulted in findings of poor obesity accuracy and poor obesity data completeness. As the research pilot methodology is determined to be successful, the dataset has been expanded to include 4 hospitals. The patient files are compared to coded obesity data using the same 7 obesity data accuracy indicators. Additionally, the obesity recording indicators are expanded to include occurrences of obesity/BMI notations recorded, plus records of obesity/BMI despite no height and weight measurements recorded. These 2 additional indicators are also applied retrospectively to the pilot study data so that the cumulative data set are comparable. The extended study also concluded that there is poor obesity accuracy, and low obesity, recording in comparison with obese patient admission data, and obesity recording, in medical files.

Completeness in the recording of weight, height and BMI is generally low in the patient files, with weight recorded in 67% of patient files, height recorded in 24% in patient files, and BMI recorded in only 10.8% of patient files. Given that weight is generally required for medication and anaesthetic dosing calculations, weight is recorded at lower than anticipated levels (67%). Increased clinical understanding on requirements for weight recording and increased equipment availability to weigh patients such as availability of bariatric scales and chair scales may influence improvement in weight recording. Height recordings are low at 24% and can be attributed to lack of clinical understanding of both requirements for height recording, and lack of methods to measure height for patients who cannot stand or are bedridden. It is recommended that education on evidence-based methods to measure height of bed-ridden patients such as the ulnar method, demi-span method or knee height method should be provided to nurses to increase recording of patient height. Additionally, organisational acceptance of patient volunteered height should be considered if height measurements cannot be obtained, as volunteered height is demonstrated to be reliable for use in determining obesity and could be used for obesity-related management decisions (Hodge, 2020; Pasalich et al., 2014).

6.4.2 Methods to improve Obesity Recording Completeness and Accuracy

Improved patient height and weight recording will increase a clinician’s or clinical coder’s ability to calculate patient BMI and additional actions to increase BMI recording are required. It is strongly recommended that electronic medical records are adopted and utilised by healthcare organisations, and that mandatory recording of weight and height is required to enable automated BMI calculation. Simple electronic methods should be made available for clinical staff to identify that the obesity condition has altered, or that increased clinical care is required. This should include ‘check boxes’,
which will assist clinical coders to code obesity. The Australian Coding Standards (ACCD, 2015) requires that the clinical coding of obesity can only occur when the obesity condition has altered, or that there are increased clinical care requirements, and therefore the ‘check box’ system combined with an automated BMI measurement will meet the coding standard requirements. Generally, clinical coding of obesity is recorded for hospitals to gain ABF reimbursements, however the input of weight, height, and BMI into electronic patient records will allow obesity-related patient data to be easily analysed for hospital planning purposes, and importantly enable risk reduction programs for staff to be implemented.

Alternatively, if manual patient files continue to be utilised, healthcare organisations should also strongly consider mandating recording of weight, height and BMI and should also consider the ability for clinical coders to calculate BMI and code obesity from the BMI measurement. Auditing of manual patient records should also occur to ensure compliance with weight, height and BMI recording. In both instances, education of staff to ensure understanding for weight, height and BMI recording should be provided. Simple and cost-effective tools allowing the capture of height and BMI should be provided to clinicians such as tape measures and BMI matrices/wheels.

Lack of detail in patient files relating to provision of bariatric care reduces the ability for clinical coders to electronically code the obesity care provided. Current clinical coding practices can only code the obesity condition if it affects the clinical care provided above the requirements of ‘normal weighted’ patients which includes increased staff to conduct patient handling tasks and use of bariatric equipment such as hoists and bariatric beds. Typically, due to safe bariatric patient handling practices, most obese patients will require additional care services and should be coded as such. Clinicians often capture bariatric care information within the clinical notes of the patient file however the patient notes sections can be lengthy, and the recording of this information is not prominent for coding purposes. A simplified ‘checkbox’ to indicate that clinical care requirements have been altered due to the obesity condition would likely increase a clinical coder’s ability to correctly code obesity. Similarly, depending on the health condition of admitted patients, there can be up to 9 locations within patient files to record height, weight and/or BMI, which can result in recoding fatigue for clinical staff and impact completeness of obesity recording. Simplification of obesity recording including placement of weight, height and BMI recording at the commencement of the patient file should occur. The early placement of the obesity data within the patient files can align with organisational expectations of this information to be measured at the commencement of the patient’s hospital journey.
Clear organisational direction relating to obesity recording requirements and education to clinicians on how the data can be used to improve patient care, inform, and increase staff safety approaches and increase accuracy of hospital funding will improve obesity recording within patient files. It is observed that notations of obesity are recorded by clinicians without weight and height measurements obtained which indicates use of visual observations to determine obesity. Normalisation of obesity and visual estimation of obesity are also highly likely to impact inaccurate obesity recording (Husin et al., 2012; Maynard et al., 2006; Robinson, 2017). There is also current potential for clinicians to be reluctant to use words such as obese, obesity or overweight in the clinical notes to try to preserve patient dignity and retain relationships with patients and their families. Increased use of BMI and measured height and weight will reduce these challenges for clinicians and enhance accuracy of obesity recording.

6.5 Financial Implications of Inaccurate Obesity Data

Increased obese patient admissions to hospitals results in increased requirements for staff, increased use of bariatric equipment and increased bariatric infrastructure requirements, resulting in increased costs to hospitals. ABF is an Australian method for providing transparent funding to hospitals by way of reimbursement for healthcare services provided. This considers the number of patients treated and the type of care required. ABF is determined by a series of complex calculations that initially utilises clinical coding data that is translated into DRGs and NWAUs. Therefore, inaccurate obesity recording and coding results in inaccurate ABF reimbursements to hospitals. The study contained within Chapter 4 examined the financial impacts of inaccurate obesity data recorded at 4 WACHS sites.

Of the 590 patient records examined in the study discussed in Chapter 3, 14.4% (85) are identified as recording inaccurate obesity data. Inaccurate patient data is corrected by updating obesity coding determined by weight, height, BMI calculations and obesity notations recorded in the patient files. The updated patient coded records are then resubmitted to determine changes to DRGs, NWAUs and subsequent ABF. Eleven (11) records resulted in an average ABF increase of A$3625 per case. Extrapolation of known WACHS patient admission data, population obesity rates and projected increases in obesity allowed calculations of the estimated financial impacts due obesity coding inaccuracy to be calculated, resulting in an annual ABF lost opportunity of A$2,231,520. This calculation is likely to be an underestimation as obesity is demonstrated to be higher in regional locations than metropolitan locations. Unfortunately, obesity data for specific regional locations is not readily available (ABS, 2008).
Costs required by hospitals who provide care for obese patients are high. These costs include purchase of clinical equipment to diagnose and treat obese patients, much of which is required to physically fit the large body compositions. Such equipment can include bariatric scales, larger operating tables, larger diagnostic imaging systems such as CT or MRI scanning equipment, bariatric blood pressure cuffs, bariatric ceiling hoists, bariatric wheelchairs, bariatric mobility walkers and larger morgue tables. Additionally, infrastructure requirements include dedicated bariatric rooms with wider doors, bariatric equipment such as bariatric ceiling hoists, and sufficient space for the safe treatment of the obese patient and for the bariatric equipment to fit. Bariatric rooms also require bariatric furnishings to accommodate the obese patient or obese visitors and include bariatric chairs, toilets and grab rails. It is estimated that bariatric rooms are 2.3 times more expensive that standard patient rooms at an approximate cost of A$79,300 (The Advisory Board, 2014).

The most hidden cost to hospitals who provide care to obese patients is the cost of additional staff due to increased workloads required with bariatric care. Caring for an unconscious obese patients or obese patients requiring full care requires an estimated additional 1.5 hours of care per day compared to normal weighted patients (Davidson et al., 2003; Randall et al., 2009). An unconscious obese patient may also require up to 5 staff to safely conduct lifting or repositioning tasks (Van Wicklin; 2018). In busy hospitals often under budget pressures and staffing shortages, often do not have the appropriate staff resourcing to accommodate bariatric care needs. This will lead to staff fatigue due to increased workloads, and low recovery time between tasks increasing the risk of harm to staff and patients.

Healthcare costs for obese patients are associated with high patient handling requirements. This has to be funded from hospital operating budgets which is often not allocated through ABF mechanisms due to inaccurate obesity recording. The study discussed in Chapter 4 demonstrates significant lost ABF opportunities for hospital funding (A$2.23 million) due to inaccurate obesity recording and coding and provides a financial case for enhanced obesity recording to be implemented.

6.6 Intervention to Enhance Obesity Recording and Coding

Health and safety, and financial impacts of incomplete and inaccurate obesity recording and coding is demonstrated in Chapters 1 through 4, with the requirements for improved data recording and coding discussed. Chapter 5 examines an intervention to enhance recording and coding of obesity data over a 12-month timeframe at a WACHS hospital. The study design is a before (intervention) and after (intervention) study at a selected hospital. Chapter 3 provided the baseline data on which
recommendations are derived for the intervention to improve obesity recording and coding. These recommendations resulted in 5 actions that were introduced at the intervention site:

i. Education sessions were provided to clinical staff emphasising requirements for accurate obesity data recording, including recording locations within medical charts and evidence-based methods to measure height of patients who are bed-ridden,

ii. Introduction of tape measures and obesity decision-making tools to clinical staff,

iii. Recording of patient volunteered height, if required and known,

iv. Regular communication to staff on obesity recording requirements, and

v. Enhancements to clinical coding obesity instructions.

The outcomes of the intervention are determined by analysing obesity data within the patient files against the electronically coded obesity data. These are then compared with the baseline data prior to the intervention, as discussed in Chapter 3.

High levels of organisational commitment were required to promote and support the intervention actions over a 12-month timeframe. This intervention was endorsed by manager and executives. This promotional campaign included time off for staff to be educated, plus quarterly emails and internal site newsletters on the intervention requirements. Included in the staff education program are methods of BMI calculations, and the method using ulnar length to determine patient height. A nurse educator provided coaching to staff on obesity recording during auditing of patient files. Staff were highly supportive of this strategy seeing the benefits for their safety, along with resourcing and financial improvements that enhanced obesity data may inform.

6.6.1 Intervention Outcomes

The intervention is generally successful in improving obesity recording completeness and coding accuracy and resulted in significant increases in recording of height (20.5%) and BMI (27.7%). Furthermore, a 35.3% improvement in BMI recoding is achieved with weight and height measurement availability. Future improvements in recording of weight and height measurements will result in increased ability to calculate patient BMI greater than the 33% BMI recorded in the intervention study. A slight increase in obesity coding (1.8% increase) and weight recording (1.2%) also occurred, though further improvements are required. This could be achieved by mandatory reporting of weight, the inclusion of ‘check boxes’ to indicate increased bariatric care, but better still the adoption of electronic health recordings to include these requirements.

Sensitivity, specificity and predictive values used to screen the outcome of the intervention indicated improvements to obesity coding accuracy, with sensitivity increased by 11% and false negatives
reduced by 11%. There is a slight increase in false positives (2.8%) and a reduction in specificity (2.8%) which indicated a small positive bias to ensuring obesity recording occurs. These data results are likely affected by the increased education of the coding requirements to staff. This positive bias in obesity recording is demonstrated in 4 cases where obesity is recorded despite no clinical measurements or indications of obesity which resulted in a significant reduction in the positive predictive values (20.7%). This outcome is however affected by the very low prevalence of obesity cases in both the pre- and post-intervention studies, resulting in an exaggerated decrement despite actual low instances of obesity inaccuracy.

Poor obesity recording for obese mental health patients is identified during the intervention study. Mental health care workers may not recognise the importance of obesity data by focusing on the psychological injuries present during the admission. However bariatric equipment, rooms and patient handling skills may still be required and should be accounted for in the data. Mental health workers in hospitals maintain similar patient records as clinicians on wards and have capacity and patient file recording methods to enable obesity recording. Further education and upskilling of mental health workers on obesity data recording requirements may be required as it is likely that the obese patient has other health comorbidities that will require hospital treatment in the future.

For improvement in tracking the increasing number of obese patients requiring hospital treatment and to preventing manual handling injury to hospital staff, it is necessary to adopt the promotional and education program implemented in the intervention study. This will continue to require commitment by hospital staff, managers and Executives, in both medical and nursing occupation groups. Initial and ongoing education to clinical staff on the recording requirements, methods of obtaining obesity measurements and obesity recording locations will be required. For organisations that adopt the use of electronic patient records, mandatory weight and height recording is recommended, as are automated BMI calculations and reminder ‘flags’ if mandatory obesity data is not entered. Targets for obesity data recording compliance should be considered. Similarly, check boxes indicating obesity clinical care requirements will also be required. Hospitals continuing to use manual patient files will also be able to adopt some of the above actions, and a review and simplification of weight, height and BMI recording locations in patient files is recommended. Although the above actions to improve the obesity recording culture and practices for WACHS will require organisational effort, staff time and potentially increased resourcing, the positive impact of accurate data will forecast future patient obesity requirements, hospital staffing requirements and provide accurate ABF reimbursements. The benefits of accurate obesity recording to both healthcare organisations and staff will outweigh the requirements for these improvements.
Chapter 7 Conclusions, Industry Implications and Recommendations

7.1 Conclusions
There is growing awareness of high risks to healthcare staff, organisations and patients due to increasing Australian obesity population rates and high patient handling requirements when caring for obese patients. Risk management strategies are required to reduce these risks, which must be informed by accurate patient obesity data. There are 3 main areas of focus in this thesis:

i) to understand patient obesity risks, including financial risks, to healthcare organisations and staff;
ii) to determine the accuracy of obesity data recorded in hospital patient admission systems to explore if obesity data impacts the safety of nurses and other healthcare staff required to manage obese patients; and
iii) to develop improvements to obesity data recording and coding methods to enhance data accuracy.

The research aims and objectives are achieved through 4 primary studies.

7.1.1 Literature Review
A literature review of 30 obesity-related studies was conducted using the PRISMA search strategy and synthesis. This allowed identification of key obese patient management risks to healthcare staff and organisations. Availability of data within patient records to identify patient obesity and quantify associated risks was also identified. The key risks are categorised and synthesised in a novel approach not available in current literature and are discussed in Chapter 2. Obese patient management is determined to present high physical risks of injury to healthcare staff, especially for staff who work in regional hospitals. Similarly, obese patient management presents high risks to healthcare organisations by way of high liability risks, risks of medical negligence claims, high costs of obesity-related infrastructure and equipment and challenges to recruit and retain nurses and other staff.

7.1.2 Audit of Obesity Data Recording and Coding
Determining current accuracy of obesity data is required to inform bariatric patient handling risk strategies that will reduce risks of injury to healthcare staff. Accurate obesity data will also allow hospitals to plan for future obese patient management requirements such as infrastructure, bariatric equipment requirements and increasing requirements for staff. Methodology to audit obesity data recording and coding accuracy was developed and successfully trialled in the pilot study detailed in Chapter 3. The methodology was expanded in a second study also discussed in Chapter 3, which determined poor completeness of obesity recording and poor accuracy of obesity coding. Low
recording of height, weight and BMI was revealed. The study also focusses on work impacts on healthcare staff that affect obesity recording and coding accuracy. Low organisational prioritisation of obesity recording and lack of education to clinicians is identified as a major impact on low obesity recording. Education such as methods to measure height of bedridden patients, education on how obesity data is used and education on locations of obesity recording in patient files is discussed as methods to increase obesity recording.

### 7.1.3 Identification of Financial Impacts of Inaccurate Obesity Recording and Coding

The impact of inaccurate obesity recording and coding on Australian hospital funding was unknown and had not previously been explored in research literature. Increasing bariatric patient admissions will utilise increased hospital services, incur longer hospital stays due to comorbidities and obesity-related complications and result in increased costs to healthcare organisations. These costs are unable to be reimbursed by way of ABF if the obesity condition is not accurately recorded and coded. The study discussed in Chapter 4 identified cases of inaccurate obesity recording and coding and determined the average ABF increase when obesity cases were corrected as A$3625 per case. Additionally, the annual impact to WACHS due to inaccurate obesity recording and coding is calculated to be in excess of A$2.23 million in lost funding. Accurate recording and coding of obese patients will undoubtedly result in increased ABF for hospitals which could be utilised to fund bariatric risk management programs and equipment to reduce risks to healthcare staff, organisations and patients.

### 7.1.4 Intervention to Enhance Obesity Data Recording and Coding

The requirement to improve obesity recording and coding accuracy is identified in Chapter 3 and an intervention methodology to enhance obesity recording and coding was developed. The intervention including implementation of 7 novel initiatives was undertaken over 12 months at a WACHS hospital. To assess the impact of the intervention on obesity recording or data accuracy, a repeat audit of obese patient records was conducted and compared to a previous audit of the same hospital. The intervention generally results in improved recording of obesity-related measurements and obesity data accuracy. Patient BMI recording increased by 27%, patient height recording increased by 20%, sensitivity increased by 11% and false negative recording reduced by 11%. The intervention design and outcomes are discussed in detail in Chapter 5 of this thesis. Improved accuracy of patient obesity recording and coding will ensure the obesity data can accurately be used to reduce risks to healthcare staff, organisations and patients, and increase hospital funding for care provided to obese patients.
7.2 Industry Implications

Accurately recorded and coded patient obesity data can be used to reduce risks to healthcare staff, organisations and patients. Hospitals can use obese patient data to trend admissions and combine with population obesity projections to plan for future bariatric requirements. This can include infrastructure requirements, requirements for bariatric rooms, bariatric equipment requirements and additional resourcing of staff to accommodate increased workloads associated with bariatric patient care. Increased ability to diagnose bariatric patients using clinical equipment that accommodates larger sized patients will reduce potential for medical negligence claims. The ability to accurately measure and trend patient obesity data will allow hospitals to identify bariatric needs and build business cases for costly bariatric equipment.

Improved accuracy of obesity data can also inform Australian public health approaches to attempt to curb obesity such as provision of obesity-related education and targeted treatment campaigns. The increased use of obesity data to target public health strategies may ultimately result in long term reductions in the number of obese patients requiring hospital care. Increased recording and measurement of obese patient admitted in hospitals will increase focussed obesity-related treatment such as engagement of dieticians, social workers and other allied health workers. Conversely, increased recording of weight, height and BMI will also identify patient malnutrition and inform engagement of similar hospital services to assess patient health requirements.

Accurate patient obesity data will also improve awareness of frequency of bariatric care provision and can be linked to reports of injuries to nurses and other healthcare staff. Many hospitals are currently unable to record injuries and incidents to staff due to bariatric patient handling. Increasing a hospital’s recording of bariatric patient handling hazards and injuries will inform requirements for bariatric patient risk management programs. Increased bariatric patient handling training for staff who manage obese patients will reduce likelihood of injuries to nurses and other staff who care for obese patients. Bariatric patient handling training should be evidence-based and include training on using bariatric equipment in addition to bariatric patient handling skills. Reduced injuries to staff will have many positive impacts to healthcare organisations such as increased staff morale, increased ability to retain and recruit staff and reduced worker’s compensation costs. Reduced bariatric-related injuries to staff and enhanced bariatric risk management programs will evidence compliance by hospitals with duty of care responsibilities within safety legislation.

Many of the above requirements to provide safe bariatric patient care will result in costs incurred by hospitals. Much of the current bariatric care requirements are currently funded by hospital operating budgets due to inaccurate patient obesity data. These costs are significant and reduce
hospital budgets for other clinical care or staffing needs. Improved patient obesity recording, and coding will result in obesity correctly being reflected in ABF reimbursements to hospitals and will increase hospital budgets.

7.3 Recommendations

These studies increase awareness of obese patient risks to healthcare staff and organisations, identify current inaccuracy of patient obesity recording and coding and confirm methods to increase accuracy of obese patient data and coding. The following actions are recommended to improve recording and coding accuracy of patient obesity data.

7.3.1 Recommendations to Australian Healthcare Organisations

- Simplify weight, height and BMI recording fields within manual or electronic patient records. Consider placement of these fields on the first page of patient admission records.
- ‘Check boxes’, or similar, to be developed in patient records to identify cases where the obesity condition has altered or increased clinical care.
- Implementation of electronic health records, including development of mandatory recording fields for weight and height measurements that enable automated BMI calculations. Consider inclusion of electronic reminder ‘flags’ if mandatory obesity data is not entered.
- Consider acceptance of patient volunteered height measurements when height cannot be measured. Volunteered height is demonstrated to be reliable for determining obesity.
- Education of clinical staff on evidence-based methods to measure patient height when patients are mobility impaired, bed-ridden or unable to stand due to their health conditions. Evidence-based methods to measure patient height may include ulnar length method, demi-span method or knee height method.
- Tape measures and BMI wheels or similar BMI calculation tools to be provided to clinicians.
- Education to be provided to clinical staff on the requirement for, and use of, obesity data. Education to include location of weight, height and BMI recording fields and methods to calculate BMI using weight and height measurements. Education should also connect understanding of ABF reimbursements, use of obesity data in ABF calculations and potential for increased ABF to fund staff safety programs, increase resourcing of staff and fund other hospital priorities.
- Audits of obesity recording to be included in current clinical audit schedules.
- Healthcare organisations should seek flexibility to allow clinical coders to calculate BMI and code obesity from the BMI measurement if BMI is not recorded, changes to clinical care is indicated and weight and height measurements are available.
• Implementation of corporate governance models to address patient obesity risks by providing organisational direction, authority and implementing risk reduction initiatives. Stakeholders at all levels of the organisation to be included in the development of initiatives.

• Once patient obesity data has been assessed as accurate, consider use of Australian obesity projections and obese patient hospital admission rates to project future needs of bariatric patients, hospitals and healthcare staff.

7.3.2 Recommendations for Future Research

• The studies included in this thesis examined patient cases who had principal or additional diagnosis of ‘diabetes mellitus’, otherwise known as diabetes type 2. Diagnoses of diabetes type 2 is selected as an inclusion criterion as there are confirmed links between obesity and diabetes type 2. Future studies that include expanded patient profiles is recommended to allow an examination of obesity recording accuracy across the general patient population.

• It is unclear if increased ABF reimbursements due to accurate obesity coding adequately funds obesity-related costs. Studies within this thesis detail cases involving up to 4 nurses to conduct bariatric patient handling tasks and literature also details an estimated additional 1.5 hours of care per day is required to manage unconscious obese patients. Bariatric equipment such as beds, wheelchairs and hoists are very costly and equipment within bariatric rooms are 2.3 times more expensive that standard patient rooms. Further research is recommended to explore if ABF reimbursement for obese patient care is sufficient to reimburse bariatric costs to hospitals.

• Frequency and severity of bariatric injuries to healthcare staff is suspected to be under-reported. Enhanced methods to record bariatric injuries to healthcare staff, including linking obese patient details or flagging obese patient status is recommended for further exploration. Length of recovery of staff, including associated costs, should also be explored.
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Appendix A

Journal of Multidisciplinary Healthcare

Open Access Full Text Article

Risks to Healthcare Organizations and Staff Who Manage Obese (Bariatric) Patients and Use of Obesity Data to Mitigate Risks: A Literature Review

This article was published in the following Dove Press journal:
Journal of Multidisciplinary Healthcare

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Abstract: This literature review explores obesity risks to healthcare staff and organizations that manage and caring for obese (bariatric) patients. These risks are anticipated to increase due to Australian population obesity rate projections increasing from 31% in 2018 to 42% by the year 2035, which will result in increased hospital admissions of patients with obesity. Literature searches were conducted through the Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE, Scopus, and Web of Science. Thirty studies met the inclusion criteria and were tabulated and critiqued using appropriate appraisal techniques. High risk of injury to healthcare staff was identified relating to bariatric patient handling tasks. High liability and financial risks of organizations were also identified relating to workers’ compensation and common law claims by injured staff and medical negligence claims by patients with obesity. Availability of obesity data was identified within clinically captured information, which could be utilized to inform obesity risk management programs. Future research should focus on improving the use and quality of obesity data to better understand obesity risks to healthcare organizations and staff, including accurate identification of obese patient admissions, enhanced ability to measure bariatric patient handling hazards and related staff injuries and improved assessment of bariatric intervention effectiveness.

Keywords: hospital, patient handling, injury, risk management, body mass index, patient

Introduction

Staff employed in industries such as healthcare, aged care, emergency services and funeral homes may be at risk of injuries due to the impacts of obesity. Increasing population obesity is recognized worldwide, with the World Health Organization (WHO) defining obesity as one of the world’s most significant health problems.1 The Australian Bureau of Statistics’ (ABS) Australian Health Survey 2017–18 revealed that 67% of Australian adults were overweight or obese in 2017–18, comprising 30.8% obese and 35.6% overweight.2 This is an increase from 63.4% in 2014–15 and 62.8% in 2011–12. Worryingly, Australian obesity projections predict in 2035, 42% of the population will be obese and 35% will be overweight.3

Increases in population obesity rates correlate with increases in patients with obesity requiring care, and future risks of patient handling injuries to nurses and other healthcare staff will be considerable.4 A number of sources have also
demonstrated that patients with obesity have an increased likelihood of requiring medical intervention than patients who are within healthy weight ranges.\textsuperscript{5-8} Additionally, increasing trends of bariatric surgery for weight loss contribute to the increasing obese patient population in hospitals.

Staff working in hospitals, nursing homes, emergency services and funeral homes are required to handle and move clients or patients with obesity, also referred to as bariatric patients. In the aged care and hospital environments these tasks are generally conducted by nurses and patient care staff and include lifting, turning and repositioning patients, bathing tasks, making occupied beds, standing patients, conducting patient transfers, and changing dressings.\textsuperscript{9} These tasks often cannot be conducted using standard manual handling practices as the patient’s weight is unevenly distributed, can be bulky or asymmetrical and cannot be held close to the nurse/patient care staff.\textsuperscript{10} Additionally, the risks to carers will vary due to the patient’s mobility, uncooperative behavior or sudden loss of balance.

Healthcare workers experience one of the highest rates of musculoskeletal disorders (MSD) worldwide, with 46\% of nursing assistants reporting hurting themselves while lifting, moving or helping a patient and 40\% reporting a back injury due to conducting these tasks.\textsuperscript{11,12} Furthermore, 20\% of nurses experience work-related pain on any given day, and 50\% of staff consider leaving nursing because of the physical stress and injury involved.\textsuperscript{13} Fear of injuries when moving patients with obesity is also a major concern of nurses and may affect an organization’s ability to attract and retain staff.\textsuperscript{14} It is clear that increasing population obesity also increases risks of workplace injuries in healthcare environments due to more patients with obesity attending hospitals for treatment.

Healthcare organizations have both moral and legal obligations to manage obesity risks to their employees and patients. When risks are identified, risk management approaches including the use of available data must be adopted to decrease risks as far as reasonably practicable. A number of studies have independently identified increasing risks of obesity in the Australian population, obesity-related risks to healthcare workers conducting patient handling tasks, legal and workers’ compensation cases due to healthcare injuries and use of healthcare data to mitigate risks; however, there is a lack of understanding and connectivity to define the impact of obesity-related risks to healthcare organizations and staff. Consolidating resources and comprehensively understanding risks relating to the care of patients with obesity and the availability of obesity data to mitigate risks is warranted, particularly to improve safety outcomes for both healthcare workers and patients, and reducing risks for healthcare organizations. This literature review has examined worldwide studies that focus on risks to healthcare organizations and staff who manage patients with obesity and explores the ability to identify and quantify bariatric risks by using available data. The review includes an expansive and holistic examination of obesity-related risks and enhanced use of data to potentially reduce risks, which is a unique review approach not available in the current literature.

Materials and Methods

Data Sources and Search Strategies

A systematic search was conducted to synthesize the current literature on risks to hospitals, nurses and other healthcare staff who manage patients with obesity. Furthermore, risks involving patient handling tasks and the use of obese patient admission data as a potential method to inform risk mitigation strategies were examined. The PICoS statement in Table 1 was used to inform the search strategy.

The Search, AppraisAL, Synthesis and Analysis (SALSA) analytical framework was used to conduct the literature review, and searches were conducted for qualitative, quantitative and mixed-method literature published between 1999 and 2019 in the Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE, Scopus, and Web of Science. Database searches for potentially relevant articles included combinations of terms displayed in Table 2.

Inclusion and Exclusion Criteria

To be considered for full review, papers were required to meet the following inclusion criteria: (i) include obesity

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Search PICoS Statement</th>
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<tbody>
<tr>
<td>P (population)</td>
<td>Nurses, healthcare workers</td>
</tr>
<tr>
<td>I (phenomenon of interest)</td>
<td>Obesity risks</td>
</tr>
<tr>
<td>Co (context)</td>
<td>Hospitals</td>
</tr>
<tr>
<td>S (study design)</td>
<td>Qualitative, quantitative and mixed method</td>
</tr>
</tbody>
</table>
risks in a healthcare environment, (ii) reference at least one obesity-related risk such as patient handling or injuries or (iii) reference use of obesity-related data and (iv) be published in English in a peer-reviewed journal. Grey literature and papers that related to obese healthcare staff or pediatric obesity were excluded.

Identification of Relevant Studies and Data Extraction

The principal author undertook the paper screenings from January 2018 to September 2020. Potential papers were first identified by screening the title and then by screening the abstract. Eligible papers were then assessed in full for consideration of inclusion in the review, and then, study particulars were extracted from the reviewed papers. Figure 1 demonstrates the PRISMA search strategy and synthesis.

Outcomes of Literature Search

The initial literature queries in CINAHL, MEDLINE, Scopus, and Web of Science databases cross-referenced 15 Medical Subject Heading (MeSH) terms or keyword identifiers as displayed in Table 2 and produced 3181 compiled results. A review of the limiters and duplicated records excluded 2193 records from the study. The study exclusion criteria were applied, and titles were screened for relevance, resulting in 822 records being excluded. A further review of abstracts was conducted to refine the results, and a total of 92 did not meet the study protocols and were removed. Finally, the 74 remaining studies were further scrutinized against the review inclusion criteria and 44 were removed due to low relevance. A total of 30 studies remained for literature review examination.

Of the 30 studies selected, a total of 27 studies examined risks of musculoskeletal disease (MSD) or injury to healthcare workers who manage patients with obesity. 13 studies documented potential medicolegal risks for healthcare organizations who treat patients with obesity and require staff to care for patients with obesity. 7 studies met the criteria for exploring the requirement for, or use of, data to quantify obese patient admission risks. Many papers identified multiple risk themes and each study included in the literature review is summarized in Table 3.

Findings

Obesity not only impacts the health of the individual, but it also results in high risks to healthcare organizations and staff. Similar to global obesity increases, patients with obesity being admitted to hospitals and attending emergency departments have also increased.5,6,15–17 Hospitalization of patients with obesity occurs due to a variety of factors, including the effects of comorbidities such as cardiac disease, diabetes and respiratory problems, and bariatric surgery for weight loss. Due to high clinical risks of obesity and the variety of testing and clinical procedures required, considered management of patients with obesity is required throughout the hospital journey from emergency departments, wards, radiography, theatres, physiotherapy and potentially the morgue.

Bariatric Patient Handling Risks to Carers

Managing patients with obesity results in increased physical workloads for carers, with high percentages of patients with obesity requiring assistance with bathing, toileting, repositioning and getting out of bed.18 The exertion, awkward postures and spinal loads experienced by carers who conduct these tasks result in high risk of injuries, which is further exacerbated by increased patient weight.5,11,18 The morbidly obese can also have significant width, causing carer injuries due to over-reaching.

Bariatric patient handling tasks present unique challenges and increased risks to carers as patient bodies are not uniform, body shape and weight is unevenly distributed and there are no convenient handholds to grasp.5 Additional patient challenges that increase caregiver risks include pain levels, immobility, levels of sedation and lack of cooperation.13 Bariatric patients require more frequent repositioning than normal weighted patients to prevent

### Table 2 Medical Subject Heading (MeSH) and Keyword Terms for Literature Search

<table>
<thead>
<tr>
<th>Search Category</th>
<th>Search Terms Used</th>
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</thead>
<tbody>
<tr>
<td>Healthcare staff AND</td>
<td>Nurs* OR “healthcare staff”</td>
</tr>
<tr>
<td>Obesity AND</td>
<td>Bariatric OR obes* OR weight OR overweight OR BMI or “body mass index”</td>
</tr>
<tr>
<td>Patient handling OR</td>
<td>“Patient handling” OR lifting OR transfer OR “manual handling” OR “patient care”</td>
</tr>
<tr>
<td>Injuries OR</td>
<td>Injur*</td>
</tr>
<tr>
<td>Data</td>
<td>Data</td>
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**Note:** Refers to truncation searching, enabling expanded searches for different forms of the word.
pressure ulcers, avoid respiratory issues and assist wound healing.  

Caring for patients with obesity is more labor intensive and requires more time, staff and specialist patient-handling skills and solutions.  

An additional 1.5 hours of care per day can be required when managing unconscious obese patients or patients requiring full care compared to normal weighted patients, and caregiver fatigue
### Table 3 Summary of the Studies Included in the Literature Review

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Risk</th>
<th>Key Findings and Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Noel et al (2010)12</td>
<td>Data</td>
<td>Anthropometric data (height, weight, BMI) are important and generally reliable sources of obesity data. Recommendation: Anthropometric data can inform research and development of obesity practices. Data completeness and quality can be improved by Managers and Policy Makers.</td>
</tr>
<tr>
<td>2 Choi &amp; Brings (2016)16</td>
<td>MSD injury risks to staff.</td>
<td>MSD risks to staff increased when conducting patient handling tasks on patients that are overweight/obese. Recommendation: Patient-handling controls are required such as lifting/transfer equipment, ergonomic assessments, no-lift policies and staff training.</td>
</tr>
<tr>
<td>3 Chappell (2007)18</td>
<td>Medicolegal risk</td>
<td>Claim increases relating to clinical negligence claims and staff injuries may occur if obesity risk management is not implemented. Recommendation: Investment in clinical and patient-handling equipment, and patient-handling training is required.</td>
</tr>
<tr>
<td>4 Vieira (2007)17</td>
<td>MSD injury risks to staff.</td>
<td>Transferring, turning and repositioning patients in bed are high-risk tasks to nurses, and risks are magnified when managing patients with obesity. Recommendation: Fitness for work, job modifications and training programs can reduce MSD risks to nurses.</td>
</tr>
<tr>
<td>5 Cowley &amp; Leggett (2010)14</td>
<td>Data, MSD injury risks to staff.</td>
<td>Staff manual handling risks are significant but not quantifiable. Risk is influenced by environmental design, equipment limitations, training provision and use of written procedures. Recommendation: Standardized definition of “bariatric”. Increase research to quantify bariatric patient movement in hospitals, funeral homes and emergency services.</td>
</tr>
<tr>
<td>6 Davidson et al (2003)10</td>
<td>Medicolegal risks, MSD injury risks to staff.</td>
<td>Medicolegal risks are high when treating patients with morbid obesity morbidity due to size and weight difficulties. Organisational risks include patient-handling risks, environmental modifications, and increased staff workloads and injury risks. Recommendation: Planning to equip hospitals with resources to decrease body strain will result in injury reduction.</td>
</tr>
<tr>
<td>7 Arzouman et al (2006)18</td>
<td>Medicolegal risks, MSD injury risks to staff.</td>
<td>Physical injury may result when moving heavy patients, particularly to older nurses. Inability to treat patients with obesity due to lack of bariatric equipment may create legal issues. Recommendation: Nurses must be proactive in providing safe care to the obese population. A bariatric protocol was successful which includes an interdisciplinary approach, dissemination of information and staff training.</td>
</tr>
<tr>
<td>8 Galinsky, Hudock &amp; Streit (2010)5</td>
<td>Data, MSD injury risks to staff.</td>
<td>Increasing overweight/obese patients are resulting in increased injuries to staff conducting patient handling. Patients with obesity require more frequent and extensive care, which involves increased time and physical exertion by staff. Incomplete recording of bariatric patient handling injuries occurs. Recommendation: Research is needed to quantify bariatric patient-handling hazards/injuries and assessment of ergonomic interventions.</td>
</tr>
<tr>
<td>9 Morley (2019)15</td>
<td>MSD injury risks to staff.</td>
<td>Increasing patients with obesity translates to increased obese deceased patients. There is a lack of literature on safe management of deceased patients with obesity, and patients are being manually handled post-death. Recommendation: Development of a Deceased Bariatric Pack to reduce manual handling of deceased obese patients.</td>
</tr>
<tr>
<td>10 Labreche, Tucker &amp; Kleincauls. (2017)33</td>
<td>Medicolegal risk, MSD injury risks to staff.</td>
<td>Reductions in length of stay, case costs and patient/staff risks can result from use of correct equipment, motivated patients with obesity and consistent and creative rehabilitation teams. Recommendation: Bariatric cases reviews considering improvement opportunities such as equipment and technology gaps. Knee pain management should be considered for bariatric cases.</td>
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Table 3 (Continued).

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<tr>
<th>Author (Year)</th>
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<tbody>
<tr>
<td>11 Van Wicklin (2018)21</td>
<td>Medicolegal risk, MSD injury risks to staff.</td>
<td>Risks to patients with obesity and staff are present in operating rooms, including increased risk of pressure injuries, venous thromboembolism (VTE), surgical antisepsis, surgical positioning/movement and equipment. Recommendation: Identify risks when moving patients and perioperative care. Implement interventions to reduce pressure/positioning injuries and VTE, ensure supply of equipment and personnel to move patients, and adhere to professional guidelines for safe surgical positioning of patients with obesity.</td>
</tr>
<tr>
<td>12 Gallagher (2005)35</td>
<td>Medicolegal risk, MSD injury risks to staff.</td>
<td>Equipment for patients with obesity can improve quality of care, reduce length of stay and be safer for staff to care for patients. Hospitals are at increased legal risk when managing patients with obesity. Recommendation: Examine costs of staff injuries and prolonged patient hospitalization to economically justify purchasing bariatric equipment. Staff education, pre-planning, proper equipment and awareness of legal implications will improve clinical and cost outcomes when managing patients with obesity.</td>
</tr>
<tr>
<td>13 Muir et al (2007)4</td>
<td>Data, MSD injury risks to staff.</td>
<td>Lack of data measuring bariatric patients and patient-handling risks. Enhanced bariatric patient process included staff training, equipment and patient handling policy. Recommendation: Hospitals should assess bariatric equipment based on patient fit not weight limits. Regular training and policies are required. Bariatric learnings and improvements to be shared between hospitals.</td>
</tr>
<tr>
<td>15 Todd (2009)36</td>
<td>MSD injury risks to staff.</td>
<td>Patients with morbid obesity incur 81% more healthcare costs than normal weighted patients. Treating patients with obesity results in increased workload, resource requirements, and staff safety issues. Recommendation: Hospitals must adapt to accommodate patients with obesity.</td>
</tr>
<tr>
<td>16 Swann (2010)37</td>
<td>MSD injury risks to staff.</td>
<td>Risk assessments prior to patient admission should be conducted on obese patient-handling and equipment needs. Training, equipment and sufficient working space is required. Recommendation: Bariatric equipment must be suitable for patient size/weight, staff to be trained in equipment use and patient-handling procedures.</td>
</tr>
<tr>
<td>17 Richardson and Harris (2018)8</td>
<td>Medicolegal risk, MSD injury risks to staff.</td>
<td>Patients with obesity are more likely to attend Emergency Department and have higher health risks due to comorbidities. Challenges of treating patients with obesity include difficulties with patient airways, circulation, radiographic imaging and medication administration. Recommendation: Ongoing obesity management training, including review of best practices, and patient handling.</td>
</tr>
<tr>
<td>18 Whipple (2008)23</td>
<td>MSD injury risks to staff.</td>
<td>Underutilization of bariatric equipment occurs despite awareness of increased staff safety. Barriers to improving equipment use include commitment to traditional practices, lack of staff training on equipment use and patient rehabilitation concerns. Recommendation: Increased bariatric patient admissions will require improved bariatric patient handling, including use of bariatric equipment.</td>
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<tr>
<th>Author (Year)</th>
<th>Risk</th>
<th>Key Findings and Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 Gallagher (2011)</td>
<td>Medicolegal risk, MSD injury risks to staff.</td>
<td>Obesity may affect preventative care outcomes, delays in diagnosis and interventions. Increasing numbers of patients with obesity will increase risk of injuries to staff. Recommendation: Enhanced care for the obese includes use of equipment, staff training, size-appropriate rooms and increased staffing. Implementing no-lift strategies or lift teams increases staff safety.</td>
</tr>
<tr>
<td>20 Edlich et al (2005)</td>
<td>MSD injury risks to staff.</td>
<td>Nursing is a high-risk occupation for back injuries, primarily from lifting patients. Body mechanics training is ineffective for safe patient handling, and “no lift” approaches are required. Recommendation: Increased use of bariatric lifting equipment is required. Medicare systems must be updated to reimburse costs of hospital lifting equipment.</td>
</tr>
<tr>
<td>21 Walden et al (2013)</td>
<td>Medicolegal risk, MSD injury risks to staff.</td>
<td>Lift teams resulted in decreased patient-handling injuries to staff by 38%, increased staff perception of safety, reduced patient pressure ulcers by 43% and reduced care costs by $495,293. Recommendation: Consider linking programs that improve staff safety with enhanced patient care outcomes.</td>
</tr>
<tr>
<td>22 Randall et al (2009)</td>
<td>MSD injury risks to staff.</td>
<td>Patients with obesity account for &lt;10% of patients; however, 30% of staff injuries occurred when caring for a patient with obesity, mostly due to patient-handling tasks. Recommendation: Proven and effective bariatric patient-handling systems should be implemented to protect staff.</td>
</tr>
<tr>
<td>24 Wilson &amp; Tyler (2006)</td>
<td>MSD injury risks to staff.</td>
<td>The use of bariatric equipment, processes, training and work practices can reduce staff injuries and improve patient care outcomes. Recommendation: A multidisciplinary approach that includes policies, implementation responsibilities, compliance accountability and equipment.</td>
</tr>
<tr>
<td>25 Humphreys (2007)</td>
<td>MSD injury risks to staff.</td>
<td>Manual patient handling of patients with obesity is unsafe and risks MSD injuries to nurses. Recommendation: Organizations should provide safe working environments through ergonomic research, no-lift policies and education.</td>
</tr>
<tr>
<td>26 Muir &amp; Heese, (2008)</td>
<td>MSD injury risks to staff.</td>
<td>Staff safety decisions should be based on bariatric guidelines and patient-handling algorithms. Recommendation: Further research into bariatric patient-handling tools and algorithms is required. Successful bariatric patient systems and improved use of bariatric equipment should be shared amongst organizations.</td>
</tr>
<tr>
<td>27 Muir &amp; Archer-Heese (2009)</td>
<td>Medicolegal risk, MSD injury risks to staff.</td>
<td>An effective bariatric patient-handling program includes operational procedures, patient assessment tools, communication tools, patient-handling algorithms, space and environment considerations, equipment needs, training and evaluation. Recommendation: Timely procedure updating which incorporates ongoing bariatric patient-handling research findings to ensure procedures are evidence-based and reflect best practice.</td>
</tr>
<tr>
<td>28 Kirk et al (2010)</td>
<td>Data, medicolegal risk, MSD injury risks to staff.</td>
<td>Height and pre-pregnancy weight is recorded; however, maternal obesity is not regularly captured. Maternal obesity impacts clinical complications and staff injuries. Recommendation: Formal recording of BMI/Maternal obesity will improve understanding of patient and staff needs, including tracking of interventions. Lack of obesity data justified use of self-reported data but not ideal.</td>
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Table 3 (Continued).

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<th>Author (Year)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>29 Irwin (2010)</td>
<td>Data, medicolegal risk</td>
<td>Identifying and managing risks of obese pregnant patients is challenging; there are no national guidelines to direct policy development. Recommendation: Risk management approaches should be developed to safely manage obesity in pregnancy and improve outcomes. Ongoing identification of maternal obesity and analysis of risk is required.</td>
</tr>
<tr>
<td>30 Hahler (2002)</td>
<td>Data, medicolegal risk, MSD injury risks to staff.</td>
<td>Obesity increases morbidity and mortality and causes numerous care challenges; however, there are no data that quantify the extent of this problem and the effects of targeted interventions. Recommendation: Research priorities are identification of patients with obesity and measuring interventions.</td>
</tr>
</tbody>
</table>

relating to increased workloads and low recovery time between tasks may contribute to injuries.\textsuperscript{11,20} An unconscious patient with obesity may involve up to 5 staff to safely lift or reposition, and lack of staff availability in busy wards or smaller hospitals, during lunch breaks, shift changeovers or emergencies may also result in unsafe patient handling occurring.\textsuperscript{9,20,21} High risk of injury also occurs when conducting bariatric nursing tasks that exceed safe working load limits such as changing patient dressings which involves elevating and supporting limbs weighing approximately 16% of an obese patient’s total body weight.\textsuperscript{9} For a patient with obesity weighing 250 kilograms, changing a dressing may result in supporting 40 kilograms.

Nursing is one of the leading professions experiencing musculoskeletal injuries, and injuries to backs, wrists, knees and shoulders have increased when handling patients with obesity.\textsuperscript{14,16} A 2007 American study determined that during a 1-year period obese patients represented less than 10% of all patients however 30% of all carer injuries were due to bariatric patient handling.\textsuperscript{11} Patient obesity is known to be under-reported, and given the cumulative nature of patient handling injuries and community obesity increases, the true risk of handling patients with obesity is likely higher than reported and requires more investigation.

Managing patients with obesity while ensuring caregiver safety is a complex issue. Traditionally, patient handling techniques have been manual in nature and involved body mechanics and good lifting practices; however, a number of studies have found this training to be ineffective when lifting bariatric patients, even when conducting two-person lifts.\textsuperscript{22–25} Alternatively, implementation of “lift teams” to move patients with obesity has been successful, decreasing carer injuries by 38%, reducing workers’ compensation claims by 62% and increasing staff job satisfaction and perceptions of organizational safety commitment.\textsuperscript{14,24}

Although many healthcare organizations have implemented “no lift” policies that mandate staff to use equipment to lift and reposition patients, risks remain when conducting many bariatric tasks such as wound dressings, conducting physical therapy, surgical repositioning and bracing patient legs in maternity wards during birthing. Mandating the use of equipment and having a documented bariatric handling policy has reduced carer injuries.\textsuperscript{25,26} However, the supply of bariatric equipment alone presents challenges with staff reporting lack of training in equipment use, lack of awareness of equipment availability, perceptions that equipment is cumbersome or inconvenient, inability to locate equipment, time constraints and concerns that the equipment may not accommodate weight or size requirements.\textsuperscript{21,26}

Organizational Risks Relating to the Care of Obese Patients

The above nursing challenges result in high risk of injury to carers and high liability risks to healthcare organizations who must care for and compensate injured staff. Organizations should consider the direct financial impact of workers’ compensation costs and the human toll to staff that may include loss of physical function, loss of both short- and long-term income and risks to emotional health.\textsuperscript{14,25} Indirect organizational impacts to finances and resourcing also include injury investigations, increased overtime, hiring and training of replacement staff, replacement of staff wages, reduced efficiencies and increased management time requirements.\textsuperscript{25,27} Carers who have substantial injuries may also initiate common law claims that could be very costly to the organization.
Risks relating to poor bariatric patient management may also impact an organization’s culture and ability to retain staff. Healthcare workers report anxiety and safety concerns when managing patients with obesity, and organizations experience difficulties in recruiting and retaining staff in positions that include patient handling tasks. Edlich reports that back injuries may be the largest contributor to nursing shortages with 38% of nurses incurring back injuries during their career that required time off work and 12% of nurses resigning due to a back injury. Choi & Brings and Edlich also assert that patient handling injuries are a major contributing factor to why nurses are leaving the profession, and that nursing workforce shortages have intensified due to occupational injuries. The increasing age of nurses, reduced employee functional fitness and increasing patients with obesity may all contribute to bariatric patient handling injuries. Fitness for work interventions for carers or role modifications may be required to reduce risks for both carers and organisations.

Obesity also poses significant clinical care challenges when conducting physical assessments, positioning patients, drug dosing and accessing appropriate and safe equipment for diagnosis and treatment. A clinician’s ability to physically assess and diagnose patients with obesity may be ineffective or inadequate due to increased skin folds obscuring affected areas, large abdomens, inability to locate anatomical landmarks, and difficulties in moving larger, heavier body parts. Obesity also affects standard procedures such as blood pressure assessments in that extreme size cuffs may be difficult to locate. X-rays and MRIs may be impaired due to decreased image contrasts relating to obesity, and the equipment’s ability to accommodate the patient’s size and weight. Medication overdose or sub-therapeutic doses can also occur in obese patients due to body fat compositions and changes in metabolism.

Increased hospital treatments, medical complications and length of stays often result in increased clinical workloads and hospital finances. Wounds of obese patients are often slower to heal and are at higher risk of infection. Loss of skin integrity and breakdown and development of pneumonia and pressure ulcers by obese patients delay recovery and add to hospital treatment costs.

These challenges can result in increased risks of sub-optimal care or adverse outcomes for patients, which may result in medical negligence cases. Clinical risks relating to maternal obesity and childbirth outcomes should also be considered by hospitals as they represent a significant portion of overall negligence claims. An organization’s inability to care for patients with obesity due to lack of bariatric equipment or facilities may create legal risks that may be increasingly supported by legal arguments advocating for the same standards of care regardless of body size.

While financial and legal risks are important considerations for organizations, the primary motivation for enhanced management of patients with obesity should be improved clinical care and staff safety, not protection from liability claims.

Use of Data to Identify Patient Obesity and Quantify Associated Risks

Hazard identification is one of the first principles of risk management, and obesity identification is a key factor in managing risks to healthcare organizations, workers and patients with obesity themselves. Anthropometric data including height and weight measurements are routinely collected during the patient’s care and can be used to determine BMI and obesity. Although there is anecdotal recognition of increasing patients with obesity receiving healthcare, there are currently inadequate data to quantify obese patient treatment or admissions. Lack of obesity data recording and use often results in under-diagnosis of obesity; if obesity is not identified the patient is assumed to be of “normal” weight.

Injuries to healthcare workers resulting from bariatric patient handling are also difficult to measure due to lack of patient obesity recording. Similarly, lack of obesity recording results in difficulties to measure targeted bariatric interventions. Hahler states the use of bariatric techniques and equipment is assumed to be effective; however, these assumptions are supported by anecdotal reporting and tradition. Increased obesity identification and recording will inform, measure and evaluate risk management strategies such as increased resourcing, bariatric equipment use and targeted interventions.

Challenges relating to obesity data recording are recognized, specifically lack of height recording which makes BMI calculations unattainable. Failure to record height is attributed to lack of measurement equipment, low perceived importance, time constraints, competing clinical demands, and difficulties in measuring patient populations who are bed or wheelchair-bound or amputees. Issues with obesity data accuracy can also occur, such as recording errors when obtaining measurements, during data entry or during data transfers between systems.

Electronic data...
cleansing solutions can be utilized to identify data outliers and some inaccuracies, which will improve obesity data accuracy.

Despite known obesity data errors, organizations should consider the advantages of using anthropometric data if the errors are determined to be minimal and random. Evidence gained from the use of these available data will be cost and time effective and may outweigh the weaknesses in data accuracy.32 Increased support by healthcare managers and policymakers for improvements such as mandatory height and weight fields within electronic health records, clinical reminders and/or obesity recording performance measures will result in improved obesity data recording. Accurate identification of patients with obesity will also result in increased abilities to measure bariatric patient-handling hazards, related healthcare staff injuries and assess the effectiveness of bariatric interventions.5

Limitations
Although thorough search criteria were applied to the study reviews, there are limitations to this review that should be acknowledged. This review only included studies that were published in peer-reviewed journals in English. Therefore, some relevant literature in other languages or grey literature material has been excluded. Additionally, pediatric obesity was excluded from the search criteria; however, children with obesity are also recognized risk to healthcare staff, and more research on this topic is needed. Finally, risks of injuries due to bariatric patient handling and corresponding organizational risks are not limited to the healthcare industry. The identified risks should be considered by all industries that interact with people with obesity, such as aged care, funeral homes, ambulance services, and fire and emergency services.

Conclusion
This review examined risks to healthcare organizations and staff who manage patients with obesity and the use of data to identify and quantify obesity risks. Due to obligations to treat patients with obesity, risks cannot be eliminated however healthcare organizations can control risks when managing this patient cohort. The review resulted in recognition of increasing rates of patients with obesity requiring care however this appears to be anecdotal due to lack of obesity recording or use of available patient data. Similarly, hazards and injuries experienced by healthcare staff relating to bariatric patient-handling tasks are high and still under-reported and require data recording improvements to be implemented. Understanding bariatric patient-handling risks will help organizations to identify deficiencies in risk management systems and focus interventions and resources more precisely.11

Moving patients with obesity, particularly the morbidly obese, presents high risks of injury to carers. Support and recognition of increased staff workloads and resourcing requirements when managing these patients are required by hospitals. Diverse risk management programs should also be implemented to reduce risks to carers, including using bariatric patient handling equipment, providing education and training; use of written procedures, considering environmental design, and bariatric patient risk assessments and individual care plans.26,30 “Lift teams” have also significantly reduced carer injuries and increasing staff job satisfaction and perceptions of organizational commitment to safety.

Clinical diagnoses and treatment of patients with obesity also present potential legal risks to organizations. Supplies of appropriate equipment and room to accommodate both a patient’s weight and size to provide clinical care will be increasingly required, and the inability to provide care due to lack of facilities may result in discrimination complaints and legal action. While there may be high financial outlay to purchase the required equipment, implement bariatric risk management programs and ensure adequate medical facilities, without the right approaches, organizations are exposed to potentially significant adverse financial outcomes that include workers’ compensation claims, common law claims and medical negligence claims.

Knowledge gaps exist relating to quantifying the requirement for obese healthcare, risks or injuries experienced by hospital staff and outcomes of bariatric patient handling interventions, and all risk categories require further examination. There is also a lack of published literature on the management of deceased obese patients, which also presents high risks to healthcare staff. Australian obesity projections demonstrate future increases in patients with obesity and more needs to be done to reduce risks to healthcare organizations, staff and patients.

Disclosure
The authors report no conflicts of interest or competing interests in this work.

References


Accuracy of obese patient admission data recorded by the Western Australian Country Health Service: A pilot study

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Conflict of interest

The authors of this paper declare no conflict of interest.

Abstract

Accurate obese patient admission data can inform risk management strategies and assist in mitigating patient-handling risks to healthcare staff who manage obese patients. This pilot study investigates the accuracy of obesity coded data within the Western Australian Country Health Service (WACHS) patient admission data and examines factors potentially affecting obesity data accuracy. The examinations involved only patients with Type II Diabetes and comprised of a manual extraction and comparison of obesity-related data within patient records and electronic patient admission data to determine accuracy.

The results of the Type II Diabetes patient data examination demonstrated poor recording of weight (59%), height (15%) and BMI when weight and height measurements were recorded (8%). Poor obesity data accuracy was also determined by low sensitivity results (41%), high false negative results (59%) and a Cohen’s kappa value of 0.48. The sensitivity result demonstrates that only 41% of obese patients were coded as obese when obesity is recorded in their patient files and the false negative result demonstrates that where obesity notations were present in patient files, 59% of these cases were incorrectly coded as ‘normal weighted’. The Cohen’s kappa result demonstrated that there is only moderate agreement (0.48) between the occurrences of coded obesity and the recorded obese patient notations in the patient files. These results support the finding that further analysis is required to inform enhancements to

improve obesity recording and coding accuracy, which will enable the collection of reliable data that could be used to reduce obese patient handling risks to nurses and other healthcare staff.

Keywords: obesity, obese, patient handling, coding, administrative data.

**Introduction**

Increasing risk management approaches to protect healthcare workers from patient-handling issues have been examined and implemented by Australian healthcare organisations in an attempt to manage related challenges such as high rates of musculoskeletal injuries to staff, aging workforces, high insurance premiums and increased demands to improve staff safety. In some healthcare organisations, however, designing and implementing proactive risk management approaches have been difficult due to lack of healthcare data, causing organisations to rely on anecdotal awareness of patient-handling risks.

Patient handling is a subset of manual handling and includes tasks generally conducted by nurses and patient care staff such as lifting, turning and repositioning patients, bathing functions, making occupied beds, standing patients and patient transfers, and changing dressings (1). These tasks often cannot be conducted using standard manual handling practices as a patient’s weight is not evenly distributed, can be bulky or asymmetrical and cannot be held close to the nurse’s/patient care staff’s bodies (2). Although it is common for healthcare providers to adopt ‘no-lift’ policies and procedures, non-compliance of these processes can occur due to a variety of factors such as resourcing pressures, lack of equipment availability, awkward patient positioning and emergency situations requiring immediate patient treatment.

Patient-handling risks are well recognised in healthcare environments, however there are considerably fewer published risk management approaches regarding patient handling of obese patients, also referred to as bariatric patient handling. The World Health Organization (WHO) has defined the worldwide obesity problem as one of the world’s most significant health problems (3). The Australian Bureau of Statistics’ (ABS) Australian Health Survey 2011–13 (4) reveals that in 2011–12, 62.8% of Australians aged 18 years and over were overweight or obese, and Australian obesity projections are even more concerning with predictions that in 2035, 35% of the population will be overweight and 42% of the population will be obese (5). Given that research has demonstrated strong correlations between population obesity rate increases and increases in obese patients requiring hospital admissions, future risks of patient-handling injuries to healthcare workers will increase due to the corresponding increased requirement to manage ill and injured obese patients (6).

Patient-handling risks to nurses increase when managing heavier patients. Anecdotal awareness of increased obese patient admissions is often acknowledged, however in some healthcare organisations the risk of injury to nurses and patient care staff is presently difficult to manage due to issues relating to the ability to analyse obese patient admission data. The examination and analysis of data sources to address organisational risks is promoted by Seigal and Ruoff (7) who state “data holds the key to risk reduction . . . supports organisational decision making ability and may result in the development of strategic direction and action plans to meet organisational needs”. Stanfill et al., (8) further assert that the need for data and data analysis in
healthcare has never been bigger, and accurate coding and reporting of health diagnosis and conditions have become more crucial as healthcare data requirements have advanced.

In order to identify the risks of managing obese patients in country locations within Western Australia, an examination of obesity data accuracy is required. This pilot study will confirm research methodology used to determine accuracy of obese patient admission data within the Western Australian Country Health Service (WACHS) by examining two WACHS sites. A broader obesity data accuracy examination will occur if the pilot study is demonstrated to be successful. The accuracy of the clinical coding of obesity has been examined in several international studies such as Martin et al.’s (9) and Quan et al.’s (10) studies which assessed variability between obesity coding and manual chart reviews, and found a large variance between the chart review results and clinical coding data. It is believed that prior to this research there has been no evidence-based examination of obese patient admission data by any Australian health service.

This pilot study may inform further research which will interrogate the accuracy of obesity data recorded in hospital patient admission systems, and build an argument that data inaccuracies impact the safety of nurses and other healthcare staff required to manage obese patients. Furthermore, the broader research may propose improvements to data collection and/or recording methods to improve data accuracy which may then positively impact the safety of nurses and other healthcare staff.

WACHS is the largest country (rural) health system in Australia, which provides an extensive range of health services across an area of 2.53 million square kilometres for a combined estimated population of 2.69 million people. The risks of patient-handling injuries to staff employed by country healthcare organisations will be higher than staff providing healthcare in metropolitan hospitals as obesity is more frequent in rural and remote areas compared with urban areas (11). Additionally, obesity increases a patient’s requirement to engage hospital services (12, 13, 14), which further contributes to increased risk of patient-handling injuries to nurses and other healthcare staff in country locations.

Method

This pilot study employed a quantitative analysis of WACHS Patient Admission data and data obtained by conducting a manual examination of patient records at two WACHS hospitals, Northam Hospital and Busselton Health Campus. The inclusion or absence of manual obesity notations, electronic obesity codes, weight, height and Body Mass Index (BMI) recording was examined. BMI has been utilised in this study as it is the most commonly accepted and consistent method for identifying and categorising obesity. The World Health Organization (WHO) has defined the BMI calculation methodology as a person’s weight in kilograms divided by the square of the person’s height in metres (kg/m²) (3). Although there are varying international views surrounding the use of BMI to measure obesity, it has been deemed a reliable, inexpensive and efficient method of measurement (15). This study will include the definition of obesity as patients with a BMI equal to, or more than 30 kg/m², which is in agreement with previous literature examining bariatric coding (9, 12, 16) and
aligns with Australian clinical coding obesity classifications as defined by the Australian Consortium for Classification Development (ACCD) (17).

In hospital environments, weight, BMI scores and/or notations of obesity are routinely captured for many healthcare requirements and manually recorded in patient files. When patients are discharged from hospital, their admission records are analysed by clinical coding staff who examine the notes within the manual patient files and assign up to 50 diagnosis codes to the patient electronic record which represent the treatment(s) provided. Obesity is coded when the condition is clinically observed and impacts the patient’s management during their hospital admission by either requiring the commencement, alteration or adjustment of therapeutic treatment; requiring additional diagnostic procedures and/or requiring increased clinical care and/or monitoring.

The diagnosis coding is undertaken according to the Australian Coding Standards 9th Edition (18) as defined by the Australian Consortium for Classification Development (ACCD). The Australian Coding Standards is a tool used by clinical coding staff that standardises code definitions and is used to ensure data consistency and integrity across all Australian health service providers.

The Patient Admission data was obtained using three patient administrations systems, namely WebPAS®, TOPAS® and HCARE®. The pilot study was approved by the Edith Cowan University (ECU) Human Research Ethics Committee, the WACHS Human Research Ethics Committee, the WACHS Research Governance Office and the WACHS Chief Executive.

Patient admission data

De-identified patient admission data from the WebPAS®, TOPAS® and HCare® data administration systems was provided to the researchers by a WACHS Health Information Manager (HIM). The patient admission data inclusion criteria comprised of patients who were admitted to hospital for five days or greater and discharged between 1 July 2015 and 30 June 2017, patients who were over the age of 18 at the time of hospital admission, and who had principal or additional diagnosis of ‘diabetes mellitus’, otherwise known as diabetes type 2. Diagnoses of diabetes type 2 was selected as an inclusion criterion as there are confirmed links between obesity and 30 illnesses and medical conditions, including type 2 diabetes (19). Research by the Medical Research Council United Kingdom (20) also showed that the obese population have a risk of diabetes 80 times higher than that of the normal weighted population, which categorically connects obesity and diabetes type 2.

The examination of obesity coding was conducted by identification of obesity codes within the selected patient records that met the inclusion criteria. The principal and
additional diagnosis codes relating to obesity as defined by the Australian Coding Standards 9th Edition (18) are:

E66 — Obesity
E66.0 — Obesity due to excess calories
E66.1 — Drug-induced obesity
E66.2 — Extreme obesity with alveolar hypoventilation
E66.8 — Other obesity
E66.9 — Obesity, unspecified; and
U78.1 — Endocrine, nutritional and metabolic diseases — obesity

Patient file examination

WACHS Health Information Managers determined patients and their corresponding episodes (admission and discharge dates) that fell within the pilot study inclusion criteria. The relevant patient identifier number and episode number were provided to clinical coding staff who extracted the physical patient files in preparation for examination. A manual examination of the patient files was then conducted to examine the inclusion or absence of obesity recording, and weight, height and BMI recording. The principal researcher undertook training on patient file examination techniques prior to the manual file examination to ensure sound data extraction methods were met.

Data analysis

A comparative assessment was conducted against the patient file data and the occurrence of principal and additional diagnosis codes relating to obesity, being the E66 coding suite and U78.1 additional diagnosis code. Seven quantitative techniques were utilised to examine the accuracy of the patient admission data compared with manual patient clinical file reviews: sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), false negative rates, false positive rates and Cohen’s Kappa values. This analysis methodology is commonly used in clinical examinations of interventions and comparisons, and is supported by several clinical research projects, including Lee et al. (21) and Ho et al (22). Five additional methods of quantitative analysis were also applied: prevalence coded as obese, weight recorded, height recorded, BMI recorded, and height and weight recorded with no BMI.

Measuring sensitivity determined the degree of obesity recording in the patient admission data when it was first present in the patient files, while specificity measured the absence of obesity conditions in the patient admission data if the condition is absent in the patient files. Accuracy of the clinical coding of obesity-related conditions was examined by the analysis of PPVs and NPVs. Negative predictive value firstly examines the absence of obesity coding and then examines the absence of obesity notations in patient files, conversely PPV firstly examines the cases that were coded as obese and then examines the occurrences of obesity notations in patient files. Cohen’s Kappa values determined the agreement between the patient admission data and the patient file data.

Results

The summary of the statistical analysis of the seven data accuracy indicators is included in Table 1.

Table 1: WACHS Obese patient admissions accuracy analysis

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>Busselton</th>
<th>Northam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence coded as obese (n, %)</td>
<td>30 (9.3)</td>
<td>15 (9.1)</td>
<td>15 (9.4)</td>
<td>14 (8.4)</td>
<td>16 (10.1)</td>
</tr>
<tr>
<td>Weight Recorded (n, %)</td>
<td>194 (59.8)</td>
<td>95 (57.6)</td>
<td>99 (62.3)</td>
<td>94 (56.6)</td>
<td>100 (63.3)</td>
</tr>
<tr>
<td>Height Recorded (n, %)</td>
<td>54 (15.7)</td>
<td>23 (13.9)</td>
<td>31 (19.5)</td>
<td>21 (12.6)</td>
<td>33 (20.1)</td>
</tr>
<tr>
<td>BMI Recorded (n, %)</td>
<td>29 (8.9)</td>
<td>12 (7.3)</td>
<td>17 (10.7)</td>
<td>10 (6.0)</td>
<td>19 (12.0)</td>
</tr>
<tr>
<td>Height and Weight Recorded, no BMI (n, %)</td>
<td>23 (45.1)</td>
<td>11 (52.4)</td>
<td>12 (41.4)</td>
<td>10 (52.6)</td>
<td>13 (40.6)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>41.0%</td>
<td>44.4%</td>
<td>38.2%</td>
<td>48.1%</td>
<td>35.3%</td>
</tr>
<tr>
<td>Specificity</td>
<td>98.1%</td>
<td>97.8%</td>
<td>98.4%</td>
<td>99.3%</td>
<td>96.8%</td>
</tr>
<tr>
<td>NPV</td>
<td>87.7%</td>
<td>90.0%</td>
<td>85.4%</td>
<td>90.8%</td>
<td>84.5%</td>
</tr>
<tr>
<td>PPV</td>
<td>83.3%</td>
<td>80.0%</td>
<td>86.6%</td>
<td>92.9%</td>
<td>75.0%</td>
</tr>
<tr>
<td>False Positive</td>
<td>1.9%</td>
<td>2.2%</td>
<td>1.6%</td>
<td>0.7%</td>
<td>3.2%</td>
</tr>
<tr>
<td>False Negative</td>
<td>59.0%</td>
<td>55.6%</td>
<td>61.8%</td>
<td>51.9%</td>
<td>64.7%</td>
</tr>
<tr>
<td>Kappa</td>
<td>0.48</td>
<td>0.51</td>
<td>0.46</td>
<td>0.59</td>
<td>0.40</td>
</tr>
</tbody>
</table>

The pilot study included 324 subjects consisting of 165 males (51%) and 159 females (49%) aged between 25 and 98 years. There were no subjects between the ages of 18 and 24 years included in the study data; however, subjects in this age category are anticipated to be included in the broader research project. Obesity was coded in 9.3% of all patients, with weight being recorded in 59.8% of all patients and height being recorded in 15.7% of patients. BMI was recorded in 8.9% of all patients, and of the patients that had height and weight recorded, 45.1% of patients did not have BMI recorded.

Analysis of average sensitivity and specificity between obesity coding and obesity recordings in patient files resulted in 41% and 98.1%, respectively. Analysis of average NPVs and PPVs resulted in 87.7% and 83.3%, respectively. The average false positive outcome was 1.9%, while the average false negative outcome was 59%. The average Cohen’s kappa value was 0.48. Graph 1 displays the sensitivity and specificity.
results, and includes an aspirational specificity and sensitivity target established at 100% in order to support enhanced obesity coding accuracy.

Discussion

The comparative data analysis of obese patient coding and obesity recordings in patient files demonstrated generally poor accuracy of the obese patient admission data. Low average sensitivity results (41%), high average false negative results (59%) and the Cohen’s kappa value of 0.48 all support findings of poor accuracy of the obese patient admission data. The average sensitivity result of 41% demonstrated that where obesity was recorded in patient files, only 41% were coded as obese, similarly the average false negative result of 59% demonstrated that of all cases that should have been coded as obese due to the inclusion of obesity notations in the patient files, 59% of these cases were incorrectly coded as ‘normal weighted’. The average Cohen’s kappa value result of 0.48 demonstrated only moderate agreement between the occurrences of coded obesity and the recorded obese patient notations in the patient files. The PPV of 83% did however demonstrate moderate levels of accuracy when clinical coding staff are coding obesity and there is evidence of obesity in the clinical file records.

Conversely, high accuracy of coding non-obese patients was demonstrated by the high average specificity result (98%), and high average NPVs (87%). The specificity result demonstrated that where there are no obesity notations recorded, clinical coders are correctly coding these patients as normal weighted in 98% of all occurrences. Similarly, the average NPV result of 87% demonstrated that of all ‘normal weighted’ coded patients, 87% of these patients did not have obesity notations recorded in patient files.

Low weight, height and BMI measurements were recorded in patient files (59%, 15% and 8%, respectively). Time demands and workload of clinicians is a likely cause for the lack of sufficient recording of these measurements. Galinski, Hudock and Streit (12) noted that approximately 75% of morbidly obese patients have at least one co-
morbid condition. The immediate focus of both doctors and nurses is the treatment of the condition causing the patient to be admitted. This concentrated focus on the health condition(s) causing hospital admission is also mirrored in coding practices, where primary health conditions are coded in the first instance as they are important indicators for health condition data and funding provision by the Western Australian Government. Lack of clinician understanding of the requirement for obesity data recording and multiple uses of this data are likely contributors to a lack of obesity notations in files of obese patients.

An additional contributing factor that may affect obesity accuracy results is the requirement for obesity codes to be added to the coding data set. This ‘opt in’ data approach affects obesity data accuracy outcomes as the absence of obesity coding results in a default data position that indicates ‘normal weighted’. Further data challenges due to clinical coding processes are evident, such as the requirements in the Australian Coding Standards 9th Edition (18) for coders to only code patients as obese if a BMI score or a clinical notation detailing patient obesity is explicitly recorded. In practice, however, the clinical notes transcribed in the patient’s file by doctors, nurses and other clinical staff do not at all times reflect the patient’s height and weight. Table 1 demonstrates low results in recording weight (59%) and low results in recording height (15%). Even when these measurements are included in the patient’s file, in 45% of these instances the measurements were not translated to a BMI calculation by the clinician. Furthermore, clinical notes which indicate a high BMI has been observed (such as ↑ BMI) are not deemed to be sufficient detail to be coded. While the data challenges do not impact the clinical treatment of obese patients, they do affect an organisation’s ability to proactively manage obese patient handling risks by the identification of current risks and predicting the extent of future risks. The ability for clinical coders to utilise height, weight and BMI scores to code obesity, and the resulting impact on obesity data accuracy should be explored further.

It appears that a degree of obesity notations by clinical staff, specifically doctors, are likely due to visible observations of obesity. Within the examined patient files, there were 35 instances of obesity notations recorded in the clinical notes, of which three notations were not supported by a recorded patient weight and 19 instances where obesity notations were likely to be a result of visual patient observation with patient weight recorded at later stages in the patient files. Of the 35 instances of obesity notations only five patient files contained BMI scores, all of which did result in obese categorisation. Furthermore, obesity normalisation may also affect the likelihood of obesity recognition and recording due to the high prevalence of both obese patient presentations within the healthcare setting and in the community. As a result of continually rising obesity rates in Australia, society’s acceptance of heavier body weights as ‘normal’ is also increasing. Maynard et al., (23) detailed that the desired weight of adults has been progressing upward in a similar trend to increases in population obesity rates, and social body weight norms were also progressing towards heavier weights. This may be reflective in the data in that the clinician’s perception of obesity may be more identifiable with higher obese categories such as the morbidly obese category. While clinical notations of obesity are important, these are likely to be subjective observations and should be supported by weight, height and BMI measurement recording.
Although not captured in the data, the clinical recording of obesity could also be affected by the clinician’s reluctance to record words similar to obese, obesity or overweight in the clinical notes to try to preserve patient dignity. Positive patient and clinician relationships are incredibly important and guarded in the healthcare setting, and the clinician may be concerned about using these terms which are often subjective and used in a derogatory manner. This sensitivity issue can be rectified by recording of weight, height and BMI measurements, which are clinical measurements removed of emotion.

Conclusion

Occupational Safety and Health legislation necessitates employers to provide safe workplaces to employees under duty of care requirements. It is well demonstrated that nursing and other associated healthcare occupations such as orderlies or patient care assistants are high-risk professions with increased risk of sustaining back injuries or musculoskeletal sprains and strains. These injuries or multiple similar injuries over the passage of a long career can result in long-term pain and inability to perform the nursing duties. It is within the duty of care requirements and risk management principles that the true context of the risks relating to obese patient management be identified and analysed.

There has been anecdotal awareness that admissions of obese patients are increasing and acknowledgement by healthcare executives, nursing staff and Occupational Health and Safety staff of increased corresponding risks of injuries to nursing and patient care staff due to obese patient handling tasks. There has, however, been no previous evidence-based Australian analysis of either current obese patient admission accuracy or future obese patient admission projections which could inform the current and future risks of obese patient management.

Current obese patient admission coding accuracy has also been demonstrated to be low, particularly in the areas of sensitivity and false negatives. Additional research is required to support these findings. Enhanced training approaches should be considered, including providing awareness to clinical staff of the requirement for increased height, weight and BMI recording, and the potential use of this data for non-clinical uses such as obese patient handling risk mitigation. Training should be provided to clinical coders on the requirement for obesity coding accuracy. The impact of obesity coding processes affecting obesity data accuracy should be examined, particularly the absence of obesity recording resulting in default data coding position indicating ‘normal weighted’. Furthermore, investigation of alternate coding methods to obtain obesity recordings should be conducted such as allowing clinical coders the ability to determine BMI categories if height and weight measurements are available in patient files.

References


1. Obesity data accuracy pilot


An audit of obesity data and concordance with diagnostic coding for patients admitted to Western Australian Country Health Service hospitals

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ABSTRACT
Objective: Accurate patient obesity data can be used to identify and mitigate patient manual handling risks to healthcare staff. This study investigates the accuracy of patient obesity data within the Western Australian Country Health Service (WACHS) and examines factors potentially affecting obesity data accuracy.

Background: Risk of injuries to healthcare staff are increasing due to rising patient obesity. Consistent increases in the prevalence of obesity in Australia have been recorded since 1995 and Australian obesity projections predict that 42% of the population will be obese in 2035. To manage the increased risks of injuries to healthcare workers due to obese patient management, accurate healthcare data relating to patient obesity is required.

Design: Researchers examined records of patients admitted to WACHS hospitals with Type II Diabetes, which has confirmed links with obesity. Manual data extraction and comparison of obesity related data within patient medical records and electronic patient admission data was conducted to determine accuracy.

Results: Analysis of the patient data examination demonstrated poor recording of weight (67%), height (24%) and Body Mass Index (BMI) when weight and height measurements were recorded (10%). Poor obesity data accuracy was also determined by low sensitivity results (40%), high false negative results (60%) and a Cohen’s kappa value of 0.44.

Discussion: The sensitivity result demonstrates that only 40% of obese patients were coded as obese when obesity is recorded in their medical files, and the false negative result demonstrates that where obesity notations were present in medical files, 60% of these cases were incorrectly coded as ‘normal weighted’. There was only moderate agreement between the occurrences of coded obesity and the recorded obese patient notations in the medical files.

Conclusion: Further research is required to inform enhancements to improve obesity recording and coding accuracy, which will increase the collection of reliable obesity data that could be used to reduce obese patient handling risks to nurses and other healthcare staff.
Increased risk of injuries to healthcare staff due to rising patient obesity is creating challenges for Australian healthcare organisations. Despite some Australian hospitals implementing ‘no lift’ policies, staff continue to experience musculoskeletal injuries due to obese (bariatric) patient handling requirements, particularly those staff who work in country or rural locations and the ageing healthcare workforce. Due to these injuries, which may affect both a worker’s long term ability to perform work tasks and their home lifestyle, healthcare organisations are increasingly being affected by high insurance premiums and demands to improve staff safety.

The high prevalence of obesity within the Australian community is well documented, with the Australian Bureau of Statistics’ (ABS) National Health Survey 2017–18 revealing that 31.3% of Australians aged 18 years and over were obese, and 35.6% were overweight. Consistent increases in the prevalence of obesity rates in Australia have been recorded since the ABS commenced collecting obesity data in 1995, from 18.7% in 1995, 24.4% in 2007–08 to 31.3% in 2017–18. More disturbingly, Australian obesity projections predict that in 2035, 42% of the population will be obese. This data demonstrates continuing risks for healthcare workers due to the population obesity prevalence increase and increases in obese patients requiring hospital admissions.

Accurate healthcare data relating to patient obesity is required to manage the increased risks of injuries to healthcare workers due to obese patient management. Healthcare organisations may have difficulties in designing and implementing evidence-based proactive risk management approaches due to lack of relevant data. Absence of obesity data may cause either ignorance of this risk or cause organisations to rely on anecdotal evidence of the risks. Seigal & Ruoff promote the use of data to reduce organisational risks, assist organisational decision making ability and develop strategic direction and action plans to meet organisational needs. Similarly, Stanfill et al. assert that the need for data and data analysis in healthcare has never been bigger, and accurate coding and reporting of health diagnosis and conditions has become more crucial as healthcare data requirements have advanced.

In hospital environments, weight, BMI scores and/or notations of obesity are routinely captured for many healthcare requirements and are either manually or electronically recorded in patient files. Many Australian healthcare organisations are currently transitioning to the adoption of electronic health records, however a variety of methods of recording patient information is currently being used including the use of manual patient files, electronic records or hybrid models that involve manual files being scanned into patient admission databases. When patients are discharged from hospital, their admission records are analysed by clinical coding staff who assign up to 50 diagnosis codes to the patient electronic record. Obesity is coded when the condition is clinically observed and impacts the patient’s management during their hospital admission by either requiring the commencement, alteration or adjustment of therapeutic treatment; requiring additional diagnostic procedures and/or requiring increased clinical care and/or monitoring. Diagnosis coding is undertaken according to the Australian Coding Standards 9th Edition as defined by the ACCD. The Australian Coding Standards is a tool used by clinical coding staff that standardises code definitions and is used to ensure data consistency and integrity across all Australian health service providers.

Identifying obese patient admissions, and the related injury risks to healthcare workers who manage obese patients, is especially important for healthcare organisations in country or rural locations, as obesity rates are generally higher in country locations than metropolitan locations. In order to identify these risks in country hospital locations, an examination of obesity data accuracy is required. The
Western Australian Country Health Service (WACHS) was selected for this study as it is the largest country (rural) health system in Australia, which provides an extensive range of health services across an area of 2.53 million square kilometres for an estimated population of 531,000 people.

Accuracy of obesity coding data has been examined in several international studies such as Martin et al. and Quan et al. which assessed variability between obesity coding and manual chart reviews,12,13 and both studies found large variances between the chart review results and clinical coding data. McClean, Cross and Reed conducted a pilot study into the accuracy of obese patient admission data recorded by the Western Australian Country Health Service in 2017,15 which revealed poor recording of weight (59%), height (15%) and Body Mass Index (BMI) when weight and height measurements were recorded (8%). Poor obesity data accuracy was also determined by low sensitivity results (41%) and high false negative results (59%). The sensitivity result demonstrated that, where obesity was recorded in patient files, only 41% were coded as obese. The obesity accuracy analysis methods used in the pilot study were successful and the study demonstrated a requirement for further analysis that may be able to inform enhancements to improve obesity recording and coding accuracy.

**AIM**

This research aims to determine if obese patient admission data recorded by WACHS provides sufficient accuracy to be used to implement risk mitigation strategies for nurses and other healthcare staff performing obese patient handling tasks.

**METHOD**

**DESIGN AND SETTING**

This study employed a retrospective audit of WACHS Patient Admission data and a manual examination of medical records at four WACHS regional hospitals (Sites A, B, C and D). The hospitals were selected as they are larger health campuses in four different regions of Western Australia, and therefore are more likely to capture variations in rural obesity rates. The study examines the inclusion or absence of manual obesity notations, electronic obesity codes, weight, height and BMI recording. The application of BMI to measure obesity in this study was selected due to BMI being widely accepted as a reliable, inexpensive and efficient method of obesity measurement.16 In this study obesity is defined as a BMI equal to, or more than 30 kg/m² which is in agreement with previous literature examining bariatric coding and ACCD definitions of obesity.5,13,18 The World Health Organization (WHO) defines the BMI calculation methodology as a person’s weight in kilograms divided by the square of the person’s height in metres (kg/m²).17 The study was approved by the Edith Cowan University (ECU) Human Research Ethics Committee, the WACHS Human Research Ethics Committee, the WACHS Research Governance Office and the WACHS Chief Executive.

**PATIENT CHARACTERISTICS**

De-identified patient admission data from the WebPAS®, TOPAS® and HCare® data administration systems was provided to the researchers by a WACHS Health Information Manager (HIM). The patient admission data inclusion criteria comprised of records for patients who were admitted to hospital for five days or more and discharged between 1 July 2015 and 30 June 2017, patients who were over the age of 18 at the time of hospital admission, and who had principal or additional diagnosis of “diabetes mellitus”, which includes Type II diabetes. Diagnoses of Type II diabetes was selected as an inclusion criterion as it has a confirmed link with obesity.19,20 Records of patients who were admitted to hospital more than once in the audit period were included.

The data excluded records of patient boarders such as palliative care, and patients who use other health services such as outpatient treatments. Patients who had diagnosis terms of Type 1 Diabetes Mellitus, Family history of diabetes mellitus, Pre-existing diabetes mellitus, Type 1, or ‘in pregnancy’ were also excluded from the data. These exclusions were selected due to palliative care and outpatient services not conforming to the research focus of examining patient admission to hospitals, lack of confirmed links between obesity and Type 1 diabetes, and pregnancy-related diabetes being a potentially temporary condition.

**PROCEDURE**

The examination of obesity coding was conducted by identification of obesity codes within the selected patient records that met the inclusion criteria. The principal and additional diagnosis codes relating to obesity as defined by the Australian Coding Standards 9th Edition are:11

- E66 – Obesity;
- E66.0 – Obesity due to excess calories;
- E66.1 – Drug induced obesity;
- E66.2 – Extreme obesity with alveolar hypoventilation;
- E66.8 – Other obesity;
- E66.9 – Obesity, unspecified; and
- U78.1 – Endocrine, nutritional and metabolic diseases – obesity

WACHS Health Information Managers determined patients and their corresponding episodes (admission and discharge dates) that fell within the study inclusion criteria. A manual examination of the medical files was then conducted to examine the inclusion or absence of obesity recording, and weight, height and BMI recording. Sections of the medical files examined included but were not limited to Emergency
Department notes, nursing admission screening tools, handover/interim care plans, progress notes, medication charts, anaesthetic records, insulin charts, malnutrition screening tools, dietetics assessments, fluid balance charts, perioperative pathway forms and discharge summaries. The principal researcher undertook training on medical file examination techniques before the manual file examination to ensure sound data extraction methods were met.

DATA ANALYSIS

A comparative assessment was conducted against the medical file data and the occurrence of principal and additional diagnosis codes relating to obesity, being the E66 coding suite and U78.1 additional diagnosis code. Seven quantitative techniques were utilised to examine the accuracy of the patient admission data compared with medical file reviews: sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), false negative rates, false positive rates and Cohen’s Kappa values. This analysis methodology is commonly used in clinical examinations of interventions and comparisons, and is supported by several clinical research projects, including Lee et al. and Ho et al.21,22 Seven additional methods of quantitative analysis were also applied: percentage coded as obese, weight recorded, height recorded, BMI calculated, height and weight recorded with no BMI, obesity or BMI notations recorded and obesity or BMI notations recorded but height and weight not recorded.

Measuring sensitivity determined the degree of obesity recording in the patient admission data when it was first present in the medical files, while specificity measured the absence of obesity conditions in the patient admission data if the condition is absent in the medical files. Accuracy of the clinical coding of obesity-related conditions was examined by the analysis of PPVs and NPVs. Negative predictive value firstly examines the absence of obesity coding and then examines the absence of obesity notations in medical files, conversely positive predictive value firstly examines the cases that were coded as obese and then examines the occurrences of obesity notations in medical files. Cohen’s Kappa values determined the agreement between the patient admission data and the medical file data.

RESULTS

The summary of the results of the statistical analysis of obesity data accuracy indicators is shown in Table 1. The study included 590 records consisting of those of 297 males (50.3%) and 293 females (49.7%) aged between 18 and 98 years. Obesity was coded in 10.8% of all patients, with weight being recorded in 67.3% of all patients and height being recorded in 24.1% of patients. BMI was calculated in 10.8% of all patients, and of the patients who had height and weight recorded, 62% of patients did not have BMI recorded. Obesity or BMI notations were recorded in 19.4% of all patients, however 9.3% of obesity or BMI notations were not supported by height or weight records.

Analysis of average sensitivity and specificity between obesity coding and obesity recordings in medical files resulted in 40 and 96.2% respectively. Analysis of average negative predictive values and positive predictive value resulted in 86.9 and 71.8% respectively. The average false positive outcome was 3.8%, while the average false negative outcome

| TABLE 1: WACHS PATIENT ADMISSION OBESITY ACCURACY AND INTER-RATER RELIABILITY ANALYSIS |
|-------------------------|---------|---------|----------|---------|---------|---------|---------|
|                         | All     | Male    | Female   | Site A  | Site B  | Site C  | Site D  |
| Records within research criteria | 847     | 422     | 425      | 209     | 199     | 219     | 220     |
| Records audited          | 590     | 297     | 293      | 166     | 100     | 158     | 166     |
| Coded as obese (n, %)    | 64 (10.8%) | 31 (10.4%) | 33 (11.3%) | 14 (8.4%) | 3 (3.0%) | 16 (10.1%) | 31 (18.6%) |
| Weight recorded          | 397 (67.3%) | 190 (64.0%) | 207 (70.6%) | 94 (56.6%) | 70 (70.0%) | 100 (63.3%) | 133 (80.1%) |
| Height recorded          | 142 (24.1%) | 63 (21.2%) | 79 (26.6%) | 21 (12.6%) | 9 (9.0%) | 33 (20.1%) | 79 (47.6%) |
| BMI calculated           | 64 (10.8%) | 20 (6.7%) | 44 (15.0%) | 10 (6.0%) | 7 (7.0%) | 19 (12.0%) | 28 (16.9%) |
| Height and weight recorded, no BMI | 88 (62.0%) | 44 (69.8%) | 44 (55.7%) | 12 (57.1%) | 8 (88.8%) | 14 (42.4%) | 54 (68.3%) |
| Obesity or BMI notations recorded | 115 (19.4%) | 47 (15.8%) | 68 (23.2%) | 27 (16.2%) | 12 (12.0%) | 34 (21.5%) | 42 (25.3%) |
| Obesity or BMI notations recorded but height and weight not recorded | 55 (9.3%) | 23 (7.7%) | 32 (10.9%) | 21 (12.6%) | 11 (11.0%) | 12 (7.5%) | 11 (6.6%) |
| Sensitivity              | 40.0%   | 42.6%   | 38.2%    | 48.1%   | 8.3%    | 35.3%   | 47.6%   |
| Specificity              | 96.2%   | 95.6%   | 96.9%    | 99.3%   | 97.7%   | 96.8%   | 91.1%   |
| NPV                     | 86.9%   | 89.9%   | 83.9%    | 90.8%   | 88.6%   | 84.5%   | 83.7%   |
| PPV                     | 71.8%   | 64.5%   | 78.8%    | 92.9%   | 33.3%   | 75.0%   | 64.5%   |
| False positive           | 3.8%    | 4.4%    | 3.1%     | 0.7%    | 2.3%    | 3.2%    | 8.9%    |
| False negative           | 60.0%   | 57.4%   | 61.8%    | 51.9%   | 91.7%   | 64.7%   | 52.4%   |
| Kappa                   | 0.44    | 0.44    | 0.43     | 0.59    | 0.09    | 0.40    | 0.42    |
was 60%. The average Cohen’s kappa value was 0.44. Graph 1 displays the sensitivity and specificity results, and includes an aspirational specificity and sensitivity targets established by the study authors of 100% in order to support enhanced obesity coding accuracy.

As a result of patient records being archived in offsite locations due to limited hospital storage, patient records being used on hospital wards or in outpatient departments due to ongoing treatment, patients records being utilised for clinical coding or limitations of researcher availability (as discussed in limitations section), 257 records were unable to be examined.

**DISCUSSION**

Generally, poor obesity accuracy of the patient admission data was demonstrated in the comparative data analysis of obese patient coding and obesity recordings in medical files. Low average sensitivity results (40%), high average false negative results (60%) and the Cohen’s kappa value of 0.44 all support findings of poor accuracy of the obese patient admission data. The sensitivity result demonstrates that, where obesity was recorded in patient files, only 40% were coded as obese, similarly the average false negative result of 60% demonstrated that of all cases that should have been coded as obese due to the inclusion of obesity calculations or notations in the medical files, 60% of these cases were incorrectly coded as ‘normal weighted’. Cohen’s kappa value demonstrates correlation between occurrences of coded obesity and the recorded obese patient notations in the medical files, with the closer the result value is to one, the higher the correlation. The study’s average Cohen’s kappa value result of 0.44 demonstrated only moderate agreement. The positive predictive value of 71.8% did however demonstrate moderate levels of accuracy when clinical coding staff are coding obesity and there is evidence of obesity in the clinical file records.

Conversely, high accuracy of coding non-obese patients was demonstrated by the high average specificity result (96.2%), and high average negative predictive values (86.9%). The specificity result demonstrated that where there are no obesity notations recorded, clinical coders are correctly coding these patients as normal weighted in 96.2% of all occurrences. Similarly, the average negative predictive value result of 86.9% demonstrated that of all ‘normal weighted’ coded patients, 86.9% of these patients did not have obesity notations recorded in medical files.

There was poor completeness of weight, height and BMI measurement data in patient files (67.3, 24.1 and 10.8% respectively). While scales to measure patient weight are commonly available in healthcare organisations, equipment to measure patient height is often lacking which could contribute to the low recording of patient height, which negatively impacts clinician ability to conduct BMI calculations. Wall mounted and calibrated height measurement tools should be readily available in hospital wards to measure patient height. For patients who are mobility impaired, bed-ridden or unable to stand due to their health conditions, healthcare workers may be challenged to obtain height data, an essential measurement used in BMI calculations that translate to obesity coding. Several evidence-based methods of obtaining reliable height measurements from bone measurements are available, such as the Ulna length method, Demi-span method or knee height method. These methods provide accurate estimates of stature in normally proportioned adults, and clinicians should be trained in the use of these alternate height measurement techniques.23–25
Poor completeness of weight, height and BMI data may also be due to time demands and workload of clinicians, breadth of total clinical recording requirements, and lack of organisational direction for the need of this data. Galinski, Hudock & Streit highlight that approximately 75% of morbidly obese patients have at least one co-morbid condition. The immediate focus of both doctors and nurses is the treatment of the condition causing the patient to be admitted. This concentrated focus on the health condition(s) causing hospital admission is also mirrored in coding practices, where primary health conditions are coded in the first instance, as they are important indicators for health condition data and funding provision by the Western Australian government.

Stanfill et al. asserts that data recording and analysis in healthcare has increased substantially over time, and high data collection requirements that healthcare organisations place on their clinicians may affect their prioritisation of obesity data recording. In addition to the competing data priorities, lack of clinician awareness of the importance and use of obesity data for clinical, safety and funding purposes are likely contributors to the absence of obesity data and notations in files of obese patients. Insufficient organisational prioritisation of obesity data recording and use of the data itself, and related lack of auditing of the obesity data recording, may also be a factor that further influences low obesity data recording. As healthcare organisations progress to electronic patient records, consideration should be given to mandatory recording fields for patient height and weight, automated BMI calculations, and indicators or ‘file flags’ for patients who are obese and require additional patient care measures.

The requirement for obesity codes to be added to the coding data set in an ‘opt in’ data approach is likely to be an additional contributing factor that will affect obesity coding accuracy. If obesity is not coded, the default data position indicates ‘normal weighted’. Another challenge to obesity data accuracy is requirements within the Australian Coding Standards 9th Edition for coders to only code patients as obese if a BMI score is provided or a clinical notation detailing patient obesity is explicitly recorded. Currently, if weight and height are available within the medical record, coders are not able to calculate and code BMI. In practice, however, weight, height and BMI recording itself is low. Even when weight and height is recorded in the patient’s medical file, in 62% of these instances the measurements are not translated to a BMI calculation by the clinician.

Furthermore, clinical notes which indicate a high BMI has been observed (such as ↑ BMI) are not deemed to be sufficient detail to be coded. While the data challenges do not impact the clinical treatment of obese patients, they do affect an organisation’s ability to proactively manage obese patient handling risks by the identification of current risks and predicting the extent of future risks. The ability for clinical coders to use height, weight and BMI scores to code obesity, and the resulting impact on obesity data accuracy should be explored further. Again, with the adoption of electronic patient records, mandatory recording of height and weight, automated BMI calculations, and a check box field that indicates an impact to clinical care may be worthy of further examination.

It appears that a degree of obesity notations by clinical staff are likely due to visible observations of obesity. Within the examined medical files, there were 115 instances of BMI or obesity notations recorded in the clinical notes, of which 55 records were not supported by a recorded patient weight or height. Of the 115 records with obesity notations, only 64 medical files contained BMI scores. Furthermore, visual obesity identification may be affected by obesity normalisation due to increased prevalence of both obese patient presentations within the healthcare setting and in the community. As a result of continually rising prevalence of obesity in Australia, society’s acceptance of heavier body weights as ‘normal’ is also increasing, such as described by Maynard and others. Therefore, a clinician’s visual assessment may underestimate BMI. While clinical notations of obesity are important, these are likely to be subjective observations and should be supported by measured weight, height and BMI data.

Finally, lack of obesity records and coded data has healthcare funding implications. All diagnosis codes are processed through a series of calculations including Diagnosis-related Groups (DRGs) and National Weighted Activity Units (NWAUs) that result in hospital funding for the patient service that is determined by the Activity Based Funding (ABF) system. If treatment is provided for obese patients where patient care is affected by the obesity condition, lack of obesity recording or coding will result in these factors not being included in the funding calculations. For example, this will mean that instances of change in patient care such as increased staffing requirements for lifting, turning or toileting of obese patients, use of bariatric equipment, increases in anaesthetic or medication doses, change in rehabilitation approaches, and change in clinical risk categories for obese maternity patients will not be included in the funding calculations. The impact on healthcare funding due to lack of obesity coding or coding inaccuracy should also be explored further.

LIMITATIONS

Examining the clinical methods of obtaining the data contained within patient files and the accuracy of this data is outside of the scope of the research study. The data within patient files is recorded by trained clinical staff and is considered to be the gold standard for analysis and comparison. Due to the distance between WACHS hospitals and associated travel requirements for researchers to attend
CONFLICT OF INTEREST
The authors of this paper declare no conflict of interest.

ACKNOWLEDGEMENTS
The authors thank the Western Australian Country Health Service (WACHS) for their contributions to this study, South West Regional Director Kerry Windsor and the hospitals and staff who assisted with the study particularly Meegan Kidd, Program Officer Clinical Coding and regional Clinical Coding staff.

FUNDING SUPPORT
This study was supported in-kind by WACHS.

REFERENCES

CONCLUSION
Healthcare organisations have a legal obligation under Occupational Safety and Health/Work Health and Safety legislation to ensure safe workplaces are provided to employees who manage obese patients. Anecdotal awareness of increased obese patient admissions and corresponding increased risks of injuries to healthcare staff are acknowledged by healthcare executives, nursing staff and Occupational Health and Safety staff, however the ability for healthcare organisations to identify obese patient admission trends and adopt risk management approaches is impacted by low obese patient admission coding accuracy, particularly in the areas of sensitivity and false negatives.

IMPLICATIONS FOR RESEARCH, POLICY AND PRACTICE
Enhanced methods to record BMI and obesity should be considered, including mandatory recording of weight and height and progressing organisational movement to electronic healthcare records. Automated BMI calculations and user-friendly methods to indicate patient care impacts of obesity will assist clinicians to easily record obesity data and simplify obesity coding, which will increase obesity data accuracy. Until full adoption of electronic health records, healthcare organisations should promote the importance of obesity data and increase clinical staff awareness of the requirement for improved height, weight and BMI recording, and the potential use of this data for non-clinical uses such as obese patient handling risk mitigation. The impact of current obesity coding processes should be examined, particularly the absence of obesity recording resulting in the default data coding position indicating ‘normal weighted’. Furthermore, investigation of alternative coding methods to obtain obesity recordings should be conducted such as allowing clinical coders the ability to determine BMI categories if height and weight measurements are available in medical files.


Estimated Financial Impacts of Inaccurate Obese Patient Data Recorded by the Western Australian Country Health Service

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Sue Reed

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Purpose: Pressure on Australia’s healthcare system is increasing annually due to corresponding increases in chronic diseases such as obesity and rapidly ageing population growth across Australia, resulting in requirements for increased funding. This study investigates the financial impact to hospitals due to inaccurate obese patient recording and coding.

Background: Australian healthcare organisations receive Activity-Based Funding (ABF) which provides reimbursement of costs relating to the type of patient care delivered and the resources required for the patient treatment. Accurate healthcare data are essential to ensure accuracy of ABF and appropriate reimbursement of costs incurred by hospitals that manage obese patients. Managing obese patients results in operational funding requirements such as increased staffing and purchasing of equipment such as hoists, bariatric wheelchairs and bariatric beds, and hospitals must ensure that these clinical requirements are documented accurately in order to be reimbursed of these costs by way of ABF.

Methods: This study identifies the financial implications of inaccurate obesity data within the Western Australian Country Health Service (WACHS) and examines factors that may affect obesity data recording accuracy. The study involves 85 cases of identified obesity data inaccuracy that were adjusted by entering corrected obesity codes, which then adjusted Diagnosis-related Groups, National Weighted Activity Units and Activity-Based Funding results.

Results: The study demonstrated estimated annual lost funding opportunities of $2.23 million due to obesity coding inaccuracy. An annual average of 616 cases of obesity data inaccuracy was calculated with an average lost funding opportunity of $3625 per case.

Conclusion: Improvements are required in the clinical recording and coding of patient obesity, such as mandatory recording of patient weight and height data and automated BMI calculations within electronic patient records. Enhanced obesity recording and coding accuracy will result in increased funding opportunities and reduced cost burdens that hospitals currently experience when required to fund obesity-related clinical and safety requirements within operational budgets.

Keywords: obesity, obese, patient admission, coding, administrative data, finances

Introduction

Although the Australian budget for healthcare services in hospitals is extensive at $23.6 billion in 2020–21, this budget supports over 1300 public and private hospitals to provide care for the Australian community.1,2 Funding to provide hospital services and care to patients must be carefully managed, however hospital funding is affected by increasing presentations of the ill or injured in hospitals. In
2018–19, Australian hospitals provided 30.9 million days of patient care, an increase from 28.7 million days of patient care provided in 2014–15. Increasing Australian population growth, particularly Australia’s increasing ageing population of Baby Boomers (people born 1946 and 1966) are contributors to increased requirements for health services, as the probability of requiring healthcare services increases with age. This cohort represents 36% of all public hospital admissions in 2018–19 and according to the Australian Medical Association, when admitted, they remain hospitalised for 33% longer than all other age cohorts.

A second contributing factor to increased hospital admission is increasing chronic diseases in Australia. The Australian Bureau of Statistics’ (ABS) National Health Survey 2017–18 reveals that Australian obesity rates have increased dramatically, from 18.7% in 1995 to 31.3% in 2017–18. Alarming, the Australian obesity rate is predicted to reach 42% by the year 2035. Significant increase in future risks to healthcare organisations and staff is supported by research that has demonstrated a strong correlation between population obesity rates and obese patients requiring hospital admission, and the increased likelihood of obese patients requiring hospitalisation than non-obese patients. Additionally, obesity contributes to increased risks of developing other chronic conditions, such as heart disease, diabetes, stroke, chronic kidney disease, cancers and mental health conditions, all of which may also require hospital admission.

Pressure on Australia’s healthcare system is increasing annually due to corresponding increases in chronic diseases and rapidly ageing population growth across Australia, resulting in requirements for increased funding for resources including workforce, equipment and infrastructure. Healthcare organisations receive Activity-Based Funding (ABF) which provides reimbursement of costs relating to the type of patient care delivered and the resources required for the patient treatment. ABF was enacted in 2011 as a result of the National Health Reform Agreement with the aim of increasing transparency of how funds are allocated to hospitals and to give hospitals incentives to use funding more efficiently. ABF is payment for the number of patients treated and the type of care required and reflects workload and associated costs incurred by the hospital. Patient care and treatment is recorded and coded through a series of calculations that result in allocation of ABF to the hospital for the patient treatment. It is essential that accurate clinical recording of care and coding occurs in order for hospitals to be allocated ABF correctly.

Accurate obesity data is also essential to ensure accuracy of ABF reimbursement of costs to hospitals that manage obese patients. Managing obese patients results in operational funding requirements such as increased staffing and purchasing of equipment such as hoists, bariatric wheelchairs and bariatric beds, and hospitals must ensure these clinical requirements are documented accurately in order to be reimbursed of these costs by way of ABF. Accuracy of clinical coding of obesity has been examined internationally and has revealed discrepancies between the manual patient files and coded data.

A study of obesity data accuracy within the Western Australian Country Health Service (WACHS) was conducted between 2017 and 2019 that involved an examination of 590 patient records which also resulted in findings of poor accuracy, comprising of low average sensitivity results (40%), and high average false negative results (60%). Obesity data recording by clinicians was found to be impacted by lack of knowledge on methods to collect height measurements of patients who are mobility impaired, bedridden or unable to stand due to their health conditions. Poor completeness of obesity data was also impacted by time demands and workload of clinicians, breadth of total clinical recording requirements and lack of organisational direction for the need of obesity data. McClean, Cross and Reed’s study highlighted the need for an in-depth examination of the financial impact of inaccurate obesity data which may influence healthcare organisations to improve methods of recording obesity data, improve obesity data accuracy and receive accurate ABF reimbursements. This research aims to examine the financial impact to hospitals due to inaccurate obese patient coding.

**Methods**

**Design and Setting**

This study employed a quantitative analysis of 85 WACHS Patient Admission data records which were determined to contain obesity data inaccuracies in McClean, Cross and Reed’s 2019 manual examination of 590 patient files and electronic records. The 85 obesity data inaccuracies consisted of 38 cases that were not coded as obese despite weight and height measurements being recorded that allowed an obesity calculation to be determined, and 47
cases that included records of clinical notations detailing obesity however obesity was not recorded.

When patients are admitted into hospitals, their weight, height, BMI score and/or obesity notations are recorded and utilised for many clinical purposes. On discharge, coding staff analyse patient records and may allocate to the electronic clinical record up to 50 diagnosis codes which represents the treatment(s) provided. Coding of obesity occurs when the condition is identified and affects the patient’s clinical management during their hospitalisation, such as altering or adjusting planned treatments, commencing additional treatments or investigative procedures and/or necessitating increases in clinical care. Staff allocate diagnosis codes according to the Australian Coding Standards defined by the Australian Consortium for Classification Development (ACCD).17 The Australian Coding Standards is a tool that standardises code definitions and ensures consistency of data across all Australian hospitals. Diagnosis codes form part of complex calculations that result in Diagnosis-related Groups (DRGs) and National Weighted Activity Units (NWAUs) that results in ABF reimbursements to hospitals.

WACHS was selected for this study and previous related studies15,16 as population obesity rates are demonstrated to be higher in country locations,18 and injury risks to healthcare workers and financial implications to hospitals in country locations will be higher than those in metropolitan locations. WACHS is the largest publicly funded country (rural) health system in Australia and provides health services across Western Australia, an area of 2.5 million square kilometres.19

Patient Admission Data
WACHS Health Information Managers provided de-identified patient admission data from three patient administrations systems, namely WebPAS®, TOPAS® and H Care®, to the researchers. Inclusion criteria comprised of patients admitted to hospital for five days or greater and were discharged between 1 July 2015 and 30 June 2017, patients over the age of 18 when admitted to hospital, and who had principal or additional diagnosis of “diabetes mellitus”, otherwise known as diabetes type two. Diagnoses of diabetes type two was selected as an inclusion criterion as obesity is categorically connected to diabetes type two.20,21 It should be noted that the Australian obesity problem is a greater issue than just type two diabetes; however, this study is limited to only patients with type two diabetes.

The data excluded patient boarder care types including patients who utilised health services use such as outpatient treatments or palliative care, due to these forms of care not aligning to the research requirement of hospital admissions. Patients also excluded from the study included those diagnosed with type one Diabetes Mellitus, patients with a family history of diabetes mellitus, patients with pre-existing diabetes mellitus, descriptions of “type one” or “in pregnancy”. These health conditions do not have confirmed links with obesity and diabetes in pregnancy is a potentially temporary condition.

Procedure
Accuracy of obesity coding was examined by initially identifying patients coded as obese within patient records that met the inclusion criteria. The principal and additional diagnosis codes relating to obesity as defined by the Australian Coding Standards Ninth Edition18 are:

- E66 – Obesity;
- E66.0 – Obesity due to excess calories;
- E66.1 – Drug induced obesity;
- E66.2 - Extreme obesity with alveolar hypoventilation;
- E66.8 – Other obesity;
- E66.9 – Obesity, unspecified; and
- U78.1 - Endocrine, nutritional and metabolic diseases – obesity

WACHS health records that fell within the inclusion criteria were extracted by Health Information Managers, including patients identifiers and episode details (admission and discharge dates). Clinical record staff then extracted the physical patient files in preparation for examination. The principal researcher then conducted a manual examination of the patient files to examine the inclusion or absence of obesity recording, and weight, height and BMI recording. To ensure accuracy of research data, prior to the manual file examination the principal researcher was trained in patient file examination techniques. The Ethics Committees of Edith Cowan University and the WA Country Health Service approved the use of the data in this research, including a waiver of consent for access to patient records.

Data Analysis
In McClean, Cross and Reed’s 2019 study, 85 records were determined to contain obesity data inaccuracies.16 This 2020 study utilised recorded weight, height, BMI and/or obesity notations in the 85 patient files to determine correct obesity diagnosis codes. The updated patient
admission data was resubmitted to determine changes to DRGs and NWAUs, which are used to determine the Activity-Based Funding (ABF) allocated for the patient care. Average ABF financial variations were then extrapolated against WACHS obesity discrepancy rates, ABS population obesity data and WACHS annual admission data and projections to determine the funding effect to WACHS due to obesity data inaccuracies. Patient admission data was supplied by a WACHS Health Information Manager and WACHS patient admission projections were supplied by the WA Health Central Modelling Unit.

**Results**

This study examined 85 cases of identified obesity data recording inaccuracy, of which 11 cases resulted in DRG, NWAU and financial variations when the cases were adjusted by entering correct obesity codes. Table 1 displays the summary of the results of the changes to DRGs, NWAUs and ABF finances when correct obesity coding is applied these cases.

Frequency of ABF increases due to obesity inaccuracy was determined and is displayed in Figure 1. The average ABF increase due to obesity data inaccuracy was $3,625 per case.

A financial variation case rate of 1.86% was calculated by dividing the total amount of financial variations in this study by the total cases examined and was applied to the estimated obese patient admissions data to determine the number of estimated annual obesity coding discrepancies resulting in ABF increases. Additionally, the average ABF increase due to obesity data inaccuracy was applied to determine related estimated annual ABF variations at WACHS. A summary of the statistical analysis conducted is included in Table 2.

The results show corresponding increases in obesity coding discrepancies align with increasing obesity rates and increasing obese patient admissions over the eight-year period analysed. Annual average cases of obesity inaccuracy are calculated to be 616 cases. Estimated ABF variations due to obesity coding inaccuracy during this timeframe range from $2,092,929 to $2,456,135, with an average of $2,231,520 per financial year.

![Figure 1](https://doi.org/10.2147/JMDH.S321395)

**Figure 1** Frequency Histogram displaying increases in Activity-Based Funding (ABF) when accurate obesity codes are applied.

<table>
<thead>
<tr>
<th>Case</th>
<th>Obesity Code Applied</th>
<th>Pre DRG</th>
<th>Post DRG</th>
<th>Pre NWAU</th>
<th>Post NWAU</th>
<th>Pre-Financial Costs</th>
<th>Post Financial Costs</th>
<th>ABF Increase</th>
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Discussion

The data analysis of obese patient coding inaccuracy demonstrated substantial financial implications to WACHS funding. The application of ABS obesity rates and the financial variation rate of 1.86% to WACHS admission data resulted in the finding that an average of 616 annual cases of obesity inaccuracy will occur if obesity data accuracy improvements are not implemented. The number of cases will likely be higher in WACHS regional and remote communities as obesity rates are higher in these areas, however no ABS obesity data for these communities is available for discrete examination. The cases of obesity data inaccuracy will result in lost ABF opportunities to WACHS estimated at $2,231,520 each financial year. In the current fiscal environment where health care funding challenges are frequent, improving obesity clinical recording and coding accuracy to ensure ABF reflects the clinical impact of caring for obese patients should be a priority. Correcting inaccurate obesity recording results in additional $3625 ABF per case to hospitals. Additionally, improvements to obese data collection will allow healthcare organisations to enhance obese patient handling safety strategies and reduce risks of injuries to nurses and other healthcare staff, which will also bring about financial benefits such as reduced workers’ compensation costs and reduced casual/agency staff costs incurred to replace injured workers.

Much of the current clinical and safety implications involved in caring for obese patients both at WACHS and generally in Australian hospitals is absorbed within hospital operational budgets. Additional staff are regularly required when managing morbidly obese patients to ensure safe patient handling practices by the staff involved. Lifting or manoeuvring obese patients if mechanical means such as hoists are unavailable, which is common in smaller country hospitals, will often involve two to four healthcare workers and can require even more staff if managing morbidly obese patients. Changes in rehabilitation approaches commonly occur for morbidly obese patients as rehabilitation requirements are extended above the admission health issue to address patient general wellbeing concerns such as mobility.

Obese patients, particularly the morbidly obese, will require utilisation of bariatric equipment or furniture that have higher safe working load ratings such as hoists and slings, bariatric beds, bariatric wheelchairs, bariatric chairs, and bariatric toilets. Both obese patients themselves and this equipment/furniture requires additional hospital space, and therefore bariatric rooms require more hospital space per patient than normal weighted patients. It is common for health services to modify a two person patient room to a one person bariatric patient room. Additional space requirements due to management of obese patients may reduce a hospital’s overall room or bed availability and therefore impact a hospital’s health servicing ability to its community, which may in time impact on requirements to expand healthcare facilities. Costs for bariatric equipment and building modifications or extensions to accommodate obese patients can be expensive and is often funded out of a hospital’s operational budget. Additionally, costs to train staff to safely manage obese patients, particularly the morbidly obese, are often funded by operational budgets rather than ABF.

Table 2 WACHS Estimated Obese Patient Admissions, Estimated Obesity Coding Discrepancies and Estimated Annual ABF Variation

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Australian Obesity Rate</th>
<th>WACHS Total Admissions</th>
<th>Estimated Obese Patient Admissions</th>
<th>Estimated WACHS Obesity Coding Discrepancies</th>
<th>Estimated ABF Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013/14</td>
<td>29.3%</td>
<td>105,708</td>
<td>30,972</td>
<td>577</td>
<td>$2,092,929</td>
</tr>
<tr>
<td>2014/15</td>
<td>29.8%</td>
<td>106,074</td>
<td>31,610</td>
<td>589</td>
<td>$2,136,015</td>
</tr>
<tr>
<td>2015/16</td>
<td>30.3%</td>
<td>107,978</td>
<td>32,717</td>
<td>610</td>
<td>$2,210,838</td>
</tr>
<tr>
<td>2016/17</td>
<td>30.8%</td>
<td>102,391</td>
<td>31,536</td>
<td>588</td>
<td>$2,131,040</td>
</tr>
<tr>
<td>2017/18</td>
<td>31.3%</td>
<td>103,902</td>
<td>32,521</td>
<td>606</td>
<td>$2,197,593</td>
</tr>
<tr>
<td>2018/19</td>
<td>31.9%</td>
<td>104,956</td>
<td>33,470</td>
<td>624</td>
<td>$2,261,731</td>
</tr>
<tr>
<td>2019/20 projected</td>
<td>32.4%</td>
<td>108,061</td>
<td>35,012</td>
<td>653</td>
<td>$2,365,882</td>
</tr>
<tr>
<td>2020/21 projected</td>
<td>33.1%</td>
<td>109,844</td>
<td>36,347</td>
<td>678</td>
<td>$2,456,135</td>
</tr>
<tr>
<td>Annual Average</td>
<td>31.1%</td>
<td>106,114</td>
<td>33,023</td>
<td>616</td>
<td>$2,231,520</td>
</tr>
</tbody>
</table>
financial impacts to healthcare organisations due to require-
ments to manage obesity is a hidden cost burden that often
requires funding out of operational budgets to ensure both
staff and patient safety. Given future projections of
Australian obesity rates, financial impacts to healthcare or-
ganisations, especially those in county and rural locations, will
be significant and planning for future obese patient admis-
sions will be required, including hospital financial models and budget submissions.

Financial implications relating to obese patients also
includes increased medications in comparison to normal
weighted patients, due to their higher percentage of adi-
pose tissue and lower percentages of water and lean body
mass. Examples of these medications include but are not
limited to lipophilic drugs, some chemotherapeutics and
some anticoagulants such as Enoxaparin, unfractionated
Heparin, Carvedilol, Apixaban, Ribavirin, Prasugrel and
Cephalolin, which can be costly to both patients and the
Australian Government by way of the Pharmaceutical
Benefits Scheme (PBS) subsidies.

Obesity coding inaccuracies that result in lost funding
opportunities are generally attributed to issues relating to
recording of patient obesity by clinicians rather than cod-
ing practices itself. The recording issues can involve lack
of data such as height, weight and/or BMI recording, lack
of recording of obesity visually observed by clinicians and
lack of recording of changes in patient care due to obesity.
It has also been anecdotally reported that obesity recording
by clinicians may be impacted by obesity normalisation
within society and fear of stigmatising patients. Further
examination is required to develop improvement opportu-
nities that will enhance clinical recording and coding of
patient obesity, which will result in reduced ABF varia-
tions and increased funding opportunities for hospitals.
A manual examination of patient records determined
between six to nine locations within the manual patient
files for weight, height and/or BMI to be recorded by
clinicians. The multiple recording locations may confuse
busy clinical staff and may result in low recording of
obesity. As hospitals transition towards electronic health
records, future opportunities may be available for manda-

tory recording of patient weight and height data by clin-
icians, which could then generate automated BMI
calculations within the electronic record. Simplified meth-
ods for staff to record changes in clinical care due to the
obesity condition should also be considered.

For healthcare organisations maintaining manual
patient files, improvements to obesity recording will
occur if clinicians are informed on the benefits of accurate
obesity data. Education that links the impacts of poor
obesity data and potential effects of improved obesity
data recording such as enhanced safety of staff who man-
age obese patients and additional opportunities for funding
which could be used for increased resourcing, equipment
or training may improve obesity recording. Additionally,
strong management direction and policy regarding
improved weight, height and BMI recording should be
initiated, such as consideration of mandatory recording of
obesity data. These improvements will influence a culture
shift for improved obesity data recording, ensuring
enhanced ability by healthcare organisations to increase
safety approaches for staff managing obese patients and
recoup finances for obesity-related tasks.

Limitations
The inclusion criteria of patients only with Type Two
Diabetes is a recognised limitation of this study and due
to the confirmed links between diabetes and obesity, it is
acknowledged that recorded obesity rates in the patient
files may differ from obesity rates in the general popula-
tion. Expansion of the patient inclusion criteria should be
considered for future research to allow a broader study of
obesity recording accuracy. A second limitation to this
study is the clinical accuracy of obesity-related measure-
ments recorded in patient files, which exceeds the scope of
this research study. All clinical data within patient files is
recorded by trained staff and is considered to be the gold
standard for analysis and comparison.

The number and location of rural hospitals in Australia,
is though large in number, are spatially remote, and the
WA Country Health Service (WACHS) has been selected
as a case study. However, WACHS itself incorporates 94
sites country health locations, and time and funding
restraints warranted a sample of four sites to be included
in the research studies. The four sites were selected as
a representation of the vastness of WA country locations
and incorporated a variety of population obesity rates in
rural and remote locations within Australia. A third limita-
tion of this study was researcher availability to attend rural
hospital locations to collect data. While valid results were
obtained in this study, future research may require collec-
tion of larger data collections and increased researcher
availability will require consideration, however future use
of electronic health records by hospitals will potentially
accommodate remote data collection by researchers, which
could reduce this limitation in the future.
Conclusion
Australian healthcare services and hospitals are under increasing financial pressure as patient admissions rise annually, due to factors such as increasing population obesity and age-related illnesses. In order to obtain accurate ABF to fund treatment of obese patient admissions, hospital administrators must ensure accurate clinical recording of obesity. Insufficient obesity data recording currently results in lost ABF reimbursement which is due to multiple recording locations of height, weight and BMI within patient files, lack of organisational communication regarding requirements for this data and competing clinical workload pressures. Understanding of causes for poor obesity recording should be explored further. Improvement opportunities to increase obesity data recording should be examined such as streamlined data recording locations in both physical and electronic patient files, consideration of mandatory reporting of height and weight, and simplified methods to record changes in patient care due to obesity. Increased accuracy of obesity recording within clinical files of obese patients will ensure ABF will reflect the obesity conditions managed, and healthcare organisations will be funded appropriately.

Data Sharing Statement
The data that support the findings of this study are available from the corresponding author, Kim McClean, upon reasonable request.

Ethics Approval and Informed Consent
This study is approved by the Human Research Ethics Committee of Edith Cowan University (Ethics approval number: 2019-00051-MCCLEAN) and the Human Research Ethics Committee of the WA Country Health Service (Ethics approval number: RGS1359). A waiver of consent under section 2.3.10 of the National Statement National Statement on Ethical Conduct in Human Research (Australia) was approved by the Edith Cowan University Human Research Ethics Committee and the WA Country Health Service Human Research Ethics Committee.

Acknowledgments
We are grateful for the assistance and information gained from staff of the WA Country Health Service, particularly the Health Information Managers and Coding staff, and Ms. Meegan Kidd, Project Officer Clinical Coding.

Author Contributions
All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding
There is no funding to report.

Disclosure
The authors declare that they have no competing interests.

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Funding
There is no funding to report.

Disclosure
The authors declare that they have no competing interests.

References


Evaluating the Effectiveness of a Clinical Practice Intervention in Increasing Obesity Data Recording at a Western Australian Country Health Service Hospital: A Quasi-Experimental Controlled Trial

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Purpose: Identification and mitigation of obesity-related risks to staff and healthcare organisations can occur using patient obesity data; however, a 2017/18 audit of obesity data accuracy was assessed to be poor. This study investigates the results of an intervention to improve obesity data recording and coding accuracy at an Australian hospital.

Background: Increasing population obesity rates result in increased organisational and financial risks to hospitals. Australian obesity prevalence has steadily increased since 1995, and 42% of the Australian population is predicted to be obese in 2035. To reduce risks to healthcare staff who care for obese patients, complete and accurate obesity recording is required.

Methods: Following a previous audit of obesity recording and coding accuracy of patients admitted to hospital with Type II diabetes, a 12-month intervention was undertaken, comprising staff education, introduction of tape measures and obesity decision-making tools, recording of patient volunteered height, regular reinforcement of obesity recording requirements and enhanced clinical coding of obesity. A re-audit was subsequently conducted to determine if the intervention impacted obesity recording and coding at the previously audited site.

Results: Improved recording of obesity-related measures and obesity data accuracy were observed, including increased patient BMI, impacted by increased patient height measurements and increased patient weight measurements. Obesity recording accuracy increased due to the intervention, including increased sensitivity, increased negative predictive values and reduced false negatives.

Conclusion: The obesity recording intervention was successful; however, as hospitals increasingly use electronic health records, improvement opportunities should be considered such as compulsory recording of patient weight and height, embedded BMI calculators and “check boxes” for recording impacts of obesity conditions on treatment. Immediate improvement of obesity recording in manual patient files can be achieved in the meantime by implementing targets of 100% weight, height and BMI recording, introducing education programs and auditing compliance.

Keywords: obesity, obese, patient handling, coding, administrative data, intervention, training

Introduction

Pressure on Australia’s healthcare system is increasing annually partially due to the ageing population of Baby Boomers and increases in chronic conditions such as obesity. Obese patients are demonstrated to have a higher likelihood of...
requiring clinical care than patients who are within healthy weight ranges.\textsuperscript{1,2} Obesity also contributes to the increased risk of developing other chronic health conditions such as heart disease, diabetes, stroke, kidney disease, cancers and mental health conditions, all of which may also require hospital admission.\textsuperscript{3} Managing obese patients results in increased risk of injuries to healthcare staff and organisations\textsuperscript{4} and, although “no lift” approaches have been implemented in some Australian hospitals, musculoskeletal injuries continue to occur due to care requirements to move obese (bariatric) patients, particularly to nurses and other staff providing care to obese patients.

A high prevalence of obesity within the Australian population is well documented, with the Australian Bureau of Statistics’ (ABS) National Health Survey 2017–18\textsuperscript{5} revealing that 31.3\% of Australians aged 18 years and over were obese. Australian obesity rates have consistently increased, from 18.7\% in 1995, to 24.4\% in 2007–08 and 31.3\% in 2017–18.\textsuperscript{5,6} Concerningly, 42\% of the Australian population is predicted to be obese in 2035.\textsuperscript{8} Correlations between population obesity rates and hospital admissions of obese patients have been demonstrated, which presents ongoing risks for healthcare workers and requirements for obesity risk reduction initiatives by healthcare organisations.\textsuperscript{1,9–11}

While recording and measuring obese patient healthcare requirements is important from a staff safety perspective, it is also important for public health information which may inform obesity-related education and targeted treatment campaigns. The obesity condition cost the Australian economy \$8.6 billion in 2011/12 in direct and indirect costs and is anticipated to rise by \$87.7 billion between 2015 to 2025 if no public health action is taken to curb obesity.\textsuperscript{11} Increased recording of obese patients admitted in hospitals will increase focussed obesity-related treatment such as engagement of dieticians, social workers and other allied health workers. Conversely, increased weight, height and BMI recording will also identify patient malnutrition and inform engagement of similar hospital services.

McClean, Cross and Reed’s 2020 literature review\textsuperscript{4} identified risks to healthcare staff and organisations who manage obese patients including increased back, wrist, knee and shoulder injuries to nurses. Caring for obese patients requires more time, is more labour intensive and requires more staff and increased patient handling skills and solutions than managing normal-weight patients, all of which can be problematic in time- and resource-poor hospitals. Additionally, hospitals that treat obese patients were found to experience high liability and financial risks as a result of increased workers’ compensation and common law claims by injured staff and potential medical negligence claims by patients with obesity.\textsuperscript{4}

Work, health and safety obligations require healthcare organisations to manage risks to their staff as far as practicable. In order to adopt sound risk management practices to protect staff managing obese patients, accurate obesity data is required. Inaccurate or unavailable patient obesity data may make it difficult for healthcare organisations to design and implement evidence-based proactive risk management approaches. Additionally, incompleteness of obesity data may result in either organisational ignorance of obesity risks or organisational reliance on anecdotal awareness of obese patient risks. Use of data to reduce organisational risks is promoted by Stanfill et al,\textsuperscript{12} who recognise significant advancements in healthcare data requirements and data analysis, including accurate coding and reporting of health diagnosis and conditions.

Increased admission of obese patients will occur in country hospitals due to obesity rates being generally higher in country locations than metropolitan locations.\textsuperscript{13} This will also result in higher injury risks to healthcare workers in country hospitals. In order to identify and reduce obesity-related risks to staff in country hospitals, assurance of accurate obesity data is required. The Western Australian Country Health Service (WACHS) was selected for this study as it is the largest country (rural) health system in Australia, which provides an extensive range of health services across an area of 2.53 million square kilometres for an estimated population of 531,000 people.\textsuperscript{14}

Several international studies have examined the accuracy of obesity data and coding: for example, Martin et al\textsuperscript{15} and Quan et al\textsuperscript{16} both assessed variability between obesity coding and patient charts and found large inconsistencies. McClean, Cross and Reed’s 2019 retrospective audit\textsuperscript{17} examined accuracy of admission records of obese patients in four WACHS hospitals, which revealed poor recording of weight (67\%), height (24\%) and body mass index (BMI) when weight and height measurements were recorded (38\%). Poor obesity data accuracy was also determined by low sensitivity results (40\%) and high false negative results (60\%). This analysis of obesity recording and accuracy revealed that improvement is required to accurately reflect the frequency of obese patients treated in WACHS hospitals and inform risk
management strategies to protect staff from patient handling injuries when managing obese patients. Therefore a broad intervention was undertaken to raise awareness of the requirement to record obesity and enhance methods to record obesity at one WACHS hospital. To assess whether this strategy had made any impact on obesity recording or data accuracy, a repeat audit of obese patients’ records was conducted and compared to the original audit. Here, we report on the results of the second audit.

**Methods**

**Intervention Design**

The hospital-wide intervention at site A to address improved obesity recording and coding was conducted over 12 months. Site A had previously participated in the preceding retrospective audit which provided a baseline for this intervention. The intervention included several approaches aimed to improve obesity data recording and coding:

(i) education sessions for medical, nursing staff and clinical coding staff to emphasise the importance of accurate obesity data recording for both clinical and safety decision making, recording locations within medical charts for height, weight and BMI measurements and evidence-based methods to measure height of patients who are bed-ridden or unable to stand due to their health conditions;

(ii) introduction of tape measures to nursing staff to undertake height measurements of bed-ridden patients;

(iii) introduction of obesity decision-making tools such as BMI charts and measurement tools in emergency departments, wards and clinical coding offices to allow easy identification of obesity;

(iv) recording of patient-volunteered height measurements, if known, if patient height could not be measured in the hospital;

(v) education in the above obesity recording improvements for all newly employed clinical staff;

(vi) regular email, newsletter and patient file reminders (flags) to clinical staff reinforcing the requirement for patient height, weight and BMI recording in medical charts; and

(vii) enhancements to clinical coding instructions to allow the determination of obesity by coding staff by calculating BMI if recorded height and weight measurements are available.

The education sessions for medical, nursing staff and clinical coding staff occurred prior to the commencement of the intervention and involved 16 dedicated sessions with hospital leaders, ward staff, dieticians, allied health staff and coding staff. Following the education sessions, clinical shift co-ordinators conducted obesity recording reminders at shift changes. Manual BMI calculators and tape measures were distributed to nursing stations and allied health offices and education posters on obtaining height by using the ulnar (forearm) length method were distributed in nursing stations, allied health offices and near all patient scales. Three email reminders written by hospital executives were sent to all hospital staff each quarter prompting staff to record weight, height and BMI and included: (i) justification of why BMI recording was required, (ii) recording locations in medical charts and (iii) links to BMI online tools. Additional BMI-related information was included in a staff newsletter and manual reminder flags were placed in patient files.

**Audits**

Obesity recording and accuracy of coding was examined 2 months post the 12-month intervention timeframe to allow records to be coded. Inclusion and exclusion criteria for the intervention were identical to the criteria of the original audit. Inclusion criteria comprised records for patients who were admitted to hospital for 5 days or more between 17 February 2020 and 16 February 2021, patients who were over the age of 18 at the time of hospital admission, and who had principal or additional diagnosis of “diabetes mellitus”, which includes Type II diabetes. Diagnoses of Type II diabetes was selected as an inclusion criterion as it has a confirmed link with obesity. Records of patients who were admitted to hospital more than once in the audit period were included. Exclusion criteria included records of patient boarders such as palliative care, and patients who use other health services such as outpatient treatments, patients diagnosed with Type 1 diabetes mellitus, those with a family history of diabetes mellitus or pre-existing diabetes mellitus, and keywords relating to Type 1, or “in pregnancy”. Further details of data collection are reported in the original audit. Site E was nominated as a control site due to no involvement in the original audit or intervention and was also audited using the same criteria and methods.
WACHS health information managers determined patients and their corresponding hospital admission episodes that fell within the study inclusion criteria. The audit process included a visual examination of the medical files to examine the inclusion or absence of obesity recording and weight, height and BMI recording. Comparison between electronically-coded obesity data and obesity recording in medical files was then conducted. The principal researcher undertook training on medical file examination techniques prior to the original audit to ensure sound data extraction methods were adhered to.

**Data Analysis**

Statistical analysis, equivalent to the original audit, was performed using Statistical Package for the Social Sciences (SPSS) version 27, which is common methodology used in clinical examinations of interventions and comparisons. Seven quantitative obesity recording measures were examined:

(I) percentage coded as obese,
(II) weight recorded,
(III) height recorded,
(IV) BMI calculated using the Quetelet index (mass (kg)/height (m)²),
(V) height and weight recorded with no BMI,
(VI) Obesity or BMI notations recorded, and
(VII) Obesity or BMI notations recorded but height and weight not recorded.

Accuracy of clinical recording and coding of obesity-related conditions was examined by the analysis of seven additional measures:

(I) sensitivity,
(II) specificity,
(III) positive predictive values (PPVs),
(IV) negative predictive values (NPVs),
(V) false positives,
(VI) false negatives, and
(VII) Cohen’s kappa values.

These seven analysis measures are commonly used in clinical examinations of interventions and comparisons, and are supported by several clinical research projects, including Ho et al. Sensitivity determined the degree of obesity recording in the patient admission data when it was first present in the medical files, while specificity measured the absence of obesity conditions in the patient admission data if the condition is absent in the medical files. PPVs examined cases that were coded as obese and then examined the occurrences of obesity notations in medical files; conversely, NPVs examined absence of obesity coding and then examined the absence of obesity notations in medical files. Analysis of false positives determined records coded as obese despite the obesity condition not being recorded and analysis if false negatives determined records not coded as obese despite the obesity condition being recorded. Cohen’s kappa values determined the agreement between the patient admission data and the obesity data within clinical records.

**Results**

A total of 166 patient records met the inclusion criteria and were assessed in the pre-intervention audit in September 2017 and 166 records were similarly assessed in the post-intervention audit between March and April 2021. The pre-intervention audit included records consisting of 87 males (52%) and 79 females (48%) aged between 25 and 98 years. A summary of the results of the statistical analysis of obesity data recording and accuracy is shown in Tables 1 and 2.

**Pre-Intervention Obesity Recording and Coding**

Obesity was coded in 8.4% of all patients, with weight being recorded in 56.6% of all patients and height being recorded in 12.6% of patients. BMI was calculated in 6% of all patients, and, of the patients who had height and weight recorded, 57.1% of patients did not have BMI recorded. Obesity or BMI notations were recorded in 16.2% of all patients; however, 12.6% of obesity or BMI notations were not supported by height or weight records. Sensitivity and specificity between obesity coding and obesity recordings in medical files resulted in 48.1% and 99.3%, respectively. Analysis of PPVs and NPVs resulted in 92.9% and 90.8%, respectively. Recorded false positives were 0.7%, while recorded false negatives were 51.9%. The Cohen’s kappa value was 0.59.

**Post-Intervention Obesity Recording and Coding**

The post-intervention audit included records consisting of 76 males (46%) and 90 females (54%) aged between 19 and 96 years. Obesity was coded in 10.2% of all patients, with weight
<table>
<thead>
<tr>
<th></th>
<th>2017/18 Data Collection</th>
<th>2021 Intervention Site</th>
<th>2021 Control Site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Site A</td>
<td>Site B</td>
</tr>
<tr>
<td>Records within research criteria</td>
<td>847</td>
<td>209</td>
<td>199</td>
</tr>
<tr>
<td>Records audited</td>
<td>590</td>
<td>166</td>
<td>100</td>
</tr>
<tr>
<td>Male</td>
<td>297 (50.3%)</td>
<td>87 (52%)</td>
<td>52 (52%)</td>
</tr>
<tr>
<td>Female</td>
<td>293 (49.7%)</td>
<td>79 (48%)</td>
<td>48 (48%)</td>
</tr>
<tr>
<td>18–24 years</td>
<td>6 (1%)</td>
<td>0 (0%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>25–34 years</td>
<td>27 (5%)</td>
<td>4 (2%)</td>
<td>8 (8%)</td>
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<tr>
<td>35–44 years</td>
<td>56 (9%)</td>
<td>1 (1%)</td>
<td>24 (24%)</td>
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<tr>
<td>45–54 years</td>
<td>61 (10%)</td>
<td>5 (3%)</td>
<td>21 (21%)</td>
</tr>
<tr>
<td>55–64 years</td>
<td>91 (15%)</td>
<td>20 (12%)</td>
<td>24 (24%)</td>
</tr>
<tr>
<td>65–74 years</td>
<td>116 (20%)</td>
<td>32 (19%)</td>
<td>12 (12%)</td>
</tr>
<tr>
<td>75+ years</td>
<td>233 (39%)</td>
<td>104 (63%)</td>
<td>10 (10%)</td>
</tr>
<tr>
<td>Coded as obese (n, %)</td>
<td>64 (10.8%)</td>
<td>14 (8.4%)</td>
<td>3 (3.0%)</td>
</tr>
<tr>
<td>Weight recorded</td>
<td>397 (67.3%)</td>
<td>94 (56.6%)</td>
<td>70 (70.0%)</td>
</tr>
<tr>
<td>Height recorded</td>
<td>142 (24.1%)</td>
<td>21 (12.6%)</td>
<td>9 (9.0%)</td>
</tr>
<tr>
<td>BMI calculated</td>
<td>64 (10.8%)</td>
<td>10 (6.0%)</td>
<td>7 (7.0%)</td>
</tr>
<tr>
<td>Height and weight recorded, no BMI</td>
<td>88 (62.0%)</td>
<td>12 (57.1%)</td>
<td>8 (88.8%)</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded</td>
<td>115 (19.4%)</td>
<td>27 (16.2%)</td>
<td>12 (12.0%)</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded but height and weight not recorded</td>
<td>55 (9.3%)</td>
<td>21 (12.6%)</td>
<td>11 (11.0%)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>40.0%</td>
<td>48.1%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Specificity</td>
<td>96.2%</td>
<td>99.3%</td>
<td>97.7%</td>
</tr>
<tr>
<td>NPV</td>
<td>86.9%</td>
<td>90.8%</td>
<td>88.6%</td>
</tr>
<tr>
<td>PPV</td>
<td>71.8%</td>
<td>92.9%</td>
<td>33.3%</td>
</tr>
<tr>
<td>False positive</td>
<td>3.8%</td>
<td>0.7%</td>
<td>2.3%</td>
</tr>
<tr>
<td>False negative</td>
<td>60.0%</td>
<td>51.9%</td>
<td>91.7%</td>
</tr>
<tr>
<td>Kappa</td>
<td>0.44</td>
<td>0.59</td>
<td>0.09</td>
</tr>
</tbody>
</table>
Table 2 WACHS Patient Obesity Recording Characteristics and Intervention Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Site A Pre-Intervention</th>
<th>Site A – Intervention</th>
<th>Difference in Proportions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Records within research criteria</td>
<td>209</td>
<td>220</td>
<td>11</td>
</tr>
<tr>
<td>Records audited</td>
<td>166</td>
<td>166</td>
<td>0</td>
</tr>
<tr>
<td>Coded as obese (n, %)</td>
<td>14 (8.4%)</td>
<td>17 (10.2%)</td>
<td>3 (1.8% ↑)</td>
</tr>
<tr>
<td>Weight recorded</td>
<td>94 (56.6%)</td>
<td>96 (57.8%)</td>
<td>2 (1.2% ↑)</td>
</tr>
<tr>
<td>Height recorded</td>
<td>21 (12.6%)</td>
<td>55 (33.1%)</td>
<td>34 (20.5% ↑)</td>
</tr>
<tr>
<td>BMI calculated</td>
<td>10 (6.0%)</td>
<td>56 (33.7%)</td>
<td>46 (27.7% ↑)</td>
</tr>
<tr>
<td>Height and weight recorded, no BMI</td>
<td>12 (57.1%)</td>
<td>12 (21.8%)</td>
<td>0 (35.3% ↓)</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded</td>
<td>27 (16.2%)</td>
<td>22 (13.2%)</td>
<td>5 (3% ↓)</td>
</tr>
<tr>
<td>Obesity or BMI notations recorded but height and weight not recorded</td>
<td>21 (12.6%)</td>
<td>14 (12.6%)</td>
<td>2 (stable)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>48.1%</td>
<td>59.1%</td>
<td>11% ↑</td>
</tr>
<tr>
<td>Specificity</td>
<td>99.3%</td>
<td>96.5%</td>
<td>2.8% ↓</td>
</tr>
<tr>
<td>NPV</td>
<td>90.8%</td>
<td>93.9%</td>
<td>3.1% ↑</td>
</tr>
<tr>
<td>PPV</td>
<td>92.9%</td>
<td>72.2%</td>
<td>20.7% ↓</td>
</tr>
<tr>
<td>False positive</td>
<td>0.7%</td>
<td>3.5%</td>
<td>2.8% ↑</td>
</tr>
<tr>
<td>False negative</td>
<td>51.9%</td>
<td>40.9%</td>
<td>11% ↓</td>
</tr>
<tr>
<td>Kappa</td>
<td>0.59</td>
<td>0.6%</td>
<td>0.01% ↑</td>
</tr>
</tbody>
</table>

Notes: ↑ Indicates an increase; ↓ Indicates a decrease.

Discussion

Generally, the 12-month intervention at site A resulted in great improvements in the recording of obesity-related measures and obesity data accuracy. An increase from 6% to 33% in patient BMI recordings resulted, impacted by an increase from 12% to 33% in patient height measurements and an increase from 56% to 58% in patient weight measurements being obtained. Completeness of BMI recording was also positively demonstrated by a 35% reduction in cases where BMI was achievable using weight and height measurements but was not recorded. Written notations in clinical files of obesity or BMI also reduced by 3%, indicating increased use of BMI measurements to indicate obesity by clinicians rather than visual observation of obesity. Increasing use of BMI data to indicate obesity was also demonstrated in a reduction in cases of written notations in clinical files of obesity or BMI despite height and weight measurements not being obtained; a reduction of 7 cases occurred as well as reductions in cases where height and weight were not recorded.
Obesity accuracy results also generally improved due to the intervention, including sensitivity increases from 48% to 59%, NPV from 90% to 94% and reduction in false negatives from 52% to 41%. The Cohen’s kappa value also increased slightly, by 0.01%. The sensitivity result demonstrates that, where obesity was recorded in patient files, 59% were coded as obese; similarly, the NPV result of 94% demonstrated that, of all “normal weighted” coded patients, 94% did not have obesity notations recorded in medical files. The slight increase in the Cohen’s kappa value demonstrated moderate correlation between occurrences of coded obesity and the recorded obese patient notations in the medical files.

Conversely, the small reduction in specificity, from 99% to 96%, resulted in a slight reduction in accuracy when coding non-obese patients as “normal weighted”.

Figure 1 WACHS obesity recording pre- and post-intervention.

Figure 2 WACHS obesity data sensitivity and specificity: pre- and post-intervention.
A specificity measurement of 96% does, however, demonstrate very good accuracy. Similar to the reduced specificity result, a reduction in PPV was recorded, from 93% to 72%, which demonstrated a reduction in accuracy of the percentage of patients coded as obese who actually were obese. PPV outcomes are influenced by the prevalence of obesity in the patient population, which is very low in both the pre-intervention and post-intervention results, at 8% and 10%, respectively. The 21% reduction in PPV was due to an increase of 4 cases of false positives, where patients were incorrectly coded as obese despite no clinical recording of obesity in the patient files. Due to the low prevalence of 18 cases of obesity recording, a minor increase of 4 cases of false positives resulted in the large decrease in PPV. The 3% increase of false positives was also demonstrated in the results, which is a low measurement of false positives.

Control site E was also analysed to determine if external factors impacted obesity recording and accuracy during the intervention timeframe. The control site was not included in the pre-intervention analysis and did not receive obesity-related coaching or information. Site E demonstrated generally high levels of obesity recording and accuracy, with 14% of patients coded as obese, 87% of patient weights recorded and 37% of patient heights recorded. However, low translation to BMI measurements resulted in only 10% of total cases having BMI measurements recorded and 74% of cases with height and weight measurements not recording BMI measurements. Sensitivity, specificity, NPV and PPV measurements were relatively high, at 72%, 97%, 95% and 81% respectively. Both false positives and false negatives were relatively low at 3% and 28%, respectively. The Cohen’s kappa measurement was 0.7, which demonstrates good agreement between clinical files and coded obesity data. The control site obesity recording and coding accuracy results demonstrate site variability in processes and methods of recording obesity, which can be affected by site leadership, occupational functions or internal training. Site E demonstrated strong allied health obesity recording, mostly by dieticians, occupational therapists or physiotherapists. These functions were represented at all other examined sites; however, methods and levels of detail of recording differed and high levels of obesity recording appeared to be dependent on fastidious staff. While Site E demonstrates strong recording of obesity and coding accuracy, Table 1 demonstrates fluctuations across the five sites, likely due to variability of local instructions, processes and individual recording practices of staff.

Instruction to staff by healthcare leaders on requirements for obesity recording and education for staff on methods/tools to measure obesity, how obesity is used and recording locations within clinical files is essential for improved recording and accuracy of obesity data. Depending on the clinical presentation of the patient, there may be up to nine locations in patient files where obesity-related data can be captured, which may create confusion and reporting fatigue for staff. Staff may also not be aware of the importance of and uses of obesity data, such as staff safety approaches, clinical malnutrition or ABF/financial implications. Staff may not be aware of location of scales, particularly bariatric scales, or how to accurately measure height of bed-ridden patients using the ulna length method, demi-span method or knee height method.22-24

Organisational reinforcement of requirements for obesity recording is required and has been demonstrated to successfully influence obesity recording improvements in the intervention. Education and emphasis on obesity recording requirements should be conducted at site inductions for new staff and on an ongoing schedule in a variety of methods to ensure clinical understanding and compliance. While the intervention resulted in a 27% increase in BMI recording, which is a positive result, aspirational targets of 100% should be set by hospitals to support a mandatory reporting requirement. Quality improvement processes such as audits of clinical files to ensure accuracy and completeness of clinical data does occur within hospitals but these processes should be expanded to also include reviews of obesity recording. These improvement actions will increase obesity recording and coding in busy hospital environments where potential competing priorities such as immediate treatment needs, heavy workloads and lack of staff may be present.

In country hospitals where patients may be individually known to staff due to community interaction or repeated hospital admissions, a patient’s obesity status and history may be well known to staff but undocumented in patient files. This represents risks to both unfamiliar staff and the healthcare organisation. Furthermore, as obesity is higher in rural locations,14 country hospital staff are at risk of normalising obesity,25 and accepting both visual and clinical indications of obesity as “normal” and therefore underestimating BMI. Indications of visual weight observations occurring was indicative in the intervention data,
with 12.5% of BMI recordings being in the obese category and 39% being in the underweight or healthy weight categories. Under-reporting of obesity was also observed, predominantly in cases where patients were obese but able to move independently and obese patients admitted with mental health crises.

Although immediate improvement of obesity recording can be improved by implementing hospital education programs and auditing compliance, mandatory recording fields for patient height and weight should be considered as Australian hospitals move towards adoption of electronic health records. Electronic fields for recording obesity data should be made available and easily located by clinicians, which will reduce confusion around recording requirements and duplication. BMI calculations can be automated using height and weight measurements, and indicators or a “check box” should be designed for obese patients where the obesity condition impacts the patient’s management during their hospital admission, which will meet coding requirements for clinical coders to code the obesity condition. Studies in the United States have determined that identification of patient obesity has increased with the adoption of electronic health records, along with the ability to record frequency of obese patient hospitalisations and obesity treatment provided. This potential recording and coding improvement will also automate and address low BMI recording, where clinical coders currently are unable to code obesity if weight and height are available within the medical record but BMI is not calculated. Although the intervention improved clinical recording of BMI when weight and height measurements were obtained, 22% of records still did not record BMI despite availability of weight and height measurements.

Improved obesity data, including BMI, will indicate if both clinical risks and staff safety risks may be present and can inform bariatric risk management plans. Requirements for mobility assistance, additional staff support and bariatric equipment can all be documented in one clinical location within the bariatric risk management plan. During the pre- and post-intervention analyses, much of the clinical planning for bariatric support and required documentation/records were in a variety of locations in the patient file, including the general notes section. Risks can be present for staff, the patient and the organisation if the documented hazards and care plans are not easily located and understood by nursing staff. Increased obesity recording and accuracy of obesity data will result in improved ability to identify risks to both obese patients and staff who manage them and will allow risk management strategies to be implemented. This will reduce risks of injuries to healthcare staff and allow healthcare organisations to meet their workplace health and safety obligations, reduce workers’ compensation claims and maintain staff resourcing levels.

Finally, improved obesity recording and coding will positively impact healthcare funding. Hospital funding is partially generated by the Activity Based Funding (ABF) system, which provides payment for patient care that can vary significantly due to the complexity of patient treatment and length of stay. In cases of obesity, if the patient treatment is modified due to the obesity condition being present and poor obesity recording occurs, the hospital will not receive correct financing relating to the case. This can mean that treatment requirements such as staffing increases to safely accommodate lifting, turning or toileting of obese patients, requirements for bariatric equipment, increased medication or anaesthetic doses, increased rehabilitation requirements and increased clinical requirements for obese maternity patients will not be included in ABF reimbursements. Further exploration of financial impacts on hospitals due to lack of obesity recording or inaccurate coding should also be considered.

Case Studies of Inaccurate Obesity Recording/Coding

A 66-year-old male admitted with an anal abscess for treatment. Patient weight recorded as 118 kilograms, no height, BMI or obesity notations recorded. One to two staff required to assist in bed mobility tasks, sheet changes and washing of patient. Patient showered on trolley bath with two staff assisting. Patient transfers from bed using ceiling hoist and three staff to assist. Patient also hoisted to wheelchair with three staff to assist; clinically noted that positioning patient in wheelchair is challenging due to his increased weight. Patient hoisted back to bed with two staff assisting and use of ceiling hoist. Obesity not coded by clinical coders.

A 79-year-old female admitted with cellulitis of lower limb requiring treatment. Patient weight recorded as 134 kilograms, no height, BMI or obesity notations recorded. Patient required transfer from bed to toilet using one staff member to assist her and patient also required one staff member to assist her to lift legs back into bed. Patient was not able to turn herself in bed and required two staff to assist her with repositioning in bed. She also needed two staff to assist with “sit to standing” movement. Use of
a standing hoist and two staff was required to transfer the patient from the toilet back to bed. Obesity not coded by clinical coders.

An 82-year-old female admitted with motor neurone disease requiring treatment. Patient weight recorded as 90 kilograms, no height, BMI or obesity notations recorded. Patient presented with mobility issues and clinical notes stated, “heavy transfer, will need to be a full hoist”. Obesity not coded by clinical coders likely as insufficient obesity recording to code obesity.

**Limitations**

The obesity recording and coding intervention commenced in February 2020, 3 weeks after the first cases of COVID-19 in Australia and approximately a month prior to COVID-19 restrictions and impacts in Western Australia. During the entire 12 months of the intervention significant healthcare planning for COVID-19 patient surges occurred and staff anxiety relating to COVID-19 was high. While the intervention was successful, it is very likely that obesity recording compliance of some staff was affected by the impacts of COVID-19.

Similarly, competing priorities and constraints relating to increased clinical workload, resourcing limitations and hospital pressures were present during the intervention. WACHS, and many other Western Australian hospitals, experienced increased hospital admissions and emergency department presentations due to a variety of factors such as increased mental health cases linked to illicit substance abuse, compounded during the intervention as a result of delays in mental health treatment due to COVID-19 restrictions. Increased workload and pressures potentially affected completeness of obesity recording and accuracy of obesity coding at higher than normal occurrences.

An additional limitation of this study is the inclusion of only patients with Type II diabetes. This health condition inclusion was selected as diabetes is strongly linked to obesity, and it is possible that rates of obesity recording in the data of patients with diabetes may be higher than in the general population. A broader examination of obesity recording accuracy of the general patient population may be made available by expanding the patient inclusion criteria. The accuracy of clinical data within patient files is also outside the scope of this study; this clinical data is recorded by trained clinical staff and is considered to be the gold standard for analysis and comparison.

Finally, researcher availability was also a limitation of this study. Sizable distances between WACHS hospitals and metropolitan locations impacted researcher ability to conduct manual file examinations. While the data collection and analysis demonstrated successful results, increased data collections and increased researcher availability should be considered for future similar research. The adoption of electronic health records by healthcare organisations will reduce this limitation by allowing researchers to examine patient files remotely.

**Conclusion**

The identification of obese patients admitted to hospitals is important for management of patient treatment, management of staff safety and reduction of organisational risks. Methods to increase obesity recording by clinical staff and accuracy of obesity coding by clinical coders were demonstrated by this successful intervention; however, more must be done to reduce risks to healthcare organisations, patients and staff. Due to high clinical workloads and timely patient treatment requirements, methods of obesity recording are required to be simple and user-friendly. Organisational progression in adoption of electronic health records will help to improve obesity recording, including mandatory recording of weight and height, automated BMI calculations and “check boxes” to indicate obesity impacts on patient care requirements. Until electronic health records are adopted by healthcare organisations, promotion of obesity data recording requirements should occur, including potential uses of this data for non-clinical purposes such as obese patient handling risk mitigation and ABF reimbursements. Auditing of obesity recording should occur, which could inform training and improvement strategies. In addition to staff safety improvements, increased obesity recording and coding accuracy will also increase accuracy of funding allocations to hospitals and reduce the necessity for hospitals to pay for costly obesity management requirements such as increased staffing and bariatric equipment out of operational hospital funds.

**Data Sharing Statement**

The data that support the findings of this study are available from the corresponding author, Kim McClean, upon reasonable request.

**Ethics Approval and Informed Consent**

This study is approved by the Human Research Ethics Committee of Edith Cowan University (Ethics approval...
number: 2019-00051-MCCLEAN) and the Human Research Ethics Committee of the WA Country Health Service (Ethics approval number: RGS1359). A waiver of consent under section 2.3.10 of the National Statement on Ethical Conduct in Human Research (Australia) was approved by the Edith Cowan University Human Research Ethics Committee and the WA Country Health Service Human Research Ethics Committee.

Acknowledgments
We are grateful for the assistance and information gained from staff of the WA Country Health Service, particularly the Health Information Managers and Coding staff, and Ms. Meegan Kidd, Project Officer Clinical Coding.

Author Contributions
All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding
There is no funding to report.

Disclosure
The authors declare that they have no competing interests.

References
