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Patricia Williams

Margaret Giles  
*Edith Cowan University*

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# Viability of Healthcare Service Delivery Alternatives for the Australian Mining Sector

Patricia A. H. WILLIAMS<sup>a,1</sup> and Margaret GILES<sup>b</sup>

<sup>a</sup>*School of Computer and Security Science, Edith Cowan University*

<sup>b</sup>*School of Accounting, Finance and Economics, Edith Cowan University*

**Abstract.** The changing and demanding nature of the mining workforce in rural and remote Australia brings unique challenges to the delivery of healthcare services. In an attempt to control costs whilst delivering cost effective and quality healthcare, new models of delivery must be considered. For a workforce that is fly-in/fly-out, the provision of healthcare is problematic given the lack of consistency in location. A cost-benefit framework is analysed comparing three models of service provision using travel to a major location, locum services and remote health monitoring. Ultimately, new models of care must be considered to address the issues of increasing workforce turnover, to cater for rising healthcare costs, and to improve the health of such communities.

**Keywords.** Fly-in/Fly-out, FIFO, telehealth, telecare, remote health monitoring

## Introduction

The first and best option for timely, appropriate health care provision for Western Australians is delivery in metropolitan Perth. Here, patients can be treated by their regular health practitioner in a timely fashion with adequate resources. This is particularly important for patients needing complex and best practice medical management within a multidisciplinary framework. For patients in rural and remote areas, access to such health care would usually require travel to Perth.

A second best option is for rural and remote communities to be serviced by visiting health care staff, particularly specialists, albeit at great expense and with poor efficiency — 'a necessary evil' [1]. Whilst health care in metropolitan Perth can be responsive to patient needs, for example, most patients being able to see their GP within a few days of seeking an appointment, patients in rural and remote areas often have to wait for the visiting GP whose visits follow a pre-determined schedule. Patients with chronic illnesses may have to wait weeks, possibly in pain and discomfort, for assessment and treatment. In addition, the health care services provided by the visiting health practitioners may not be able to offer the best practice treatment or care. This creates discrepancy in provider and service distribution, particularly since this can be a major problem for remote vulnerable populations, and in consideration that remote

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<sup>1</sup> Corresponding Author: Dr Patricia Williams, School of Computer and Security Science, Edith Cowan University, Australia; E-mail: trish.williams@ecu.edu.au

and rural communities primarily depend on primary care providers for their healthcare [2].

An alternative approach that is gaining acceptance in a number of areas of health care is remote health monitoring. This allows patients to remain *in situ*, providing information, usually via electronic data collection and transmission [3], about their health status to a metropolitan-based health practitioner for assessment, diagnosis, treatment (or referral for treatment) and prognosis. This not only saves the patient travel time and costs but also saves employers the cost and inconvenience of using relief staff.

In this paper, we compare and contrast these first and second best options for health service delivery with a third hitherto ignored option, namely, remote health monitoring by metropolitan-based health practitioners supported by an experienced and local team. Sources of funding are not discussed, although this would be integral to a deeper study into the viability of healthcare delivery models. We also confine the framework for the option to health services for mine workers with chronic but not debilitating health conditions who are working either under FIFO arrangements or based in local communities.

## 1. Background

The Australian mining industry is technically advanced, yet is still heavily dependent on the human element of its operations. Further, it is increasingly difficult to attract both professional and trades workers to mining. With the global financial challenges and an aging workforce, the mining industry has been under pressure to recruit, maintain and still thrive within this context [4]. Using a fly-in/fly-out (FIFO) workforce has been fundamental to attract from a diminishing workforce pool and to attract younger replacement workers. This is an important factor for areas such as Western Australia where the FIFO workforce is 52% of the total resources industry WA employed staff, representing over 45,000 people travelling approximately 2.2 million times through Perth annually [5].

In order to investigate the context within which fly-in/fly-out operates, it is useful to understand the three general conceptual models of the mining geographical workforce locations. These are within new or existing towns and communities, located close to an established community or located long distances from a community.

### 1.1. *New or Existing towns and Community-based Workforce*

This model is where workers reside within an existing or new community, with the majority of workers living in the community itself, as in the new Bowen, Galilee and Surat Basins [6]. For such contexts there is a demand for, and mostly met need for supporting healthcare infrastructure including primary and acute care. This is generally provided by the state authorities as they encompass more than just the mining community itself, as they are designed to accommodate both the workers and their families. Whilst in the early stages of a new remote community development this may reflect a hub and spoke model of infrastructure, with the spokes being local healthcare providers and the hub being initially in more metropolitan areas, this model transposes into a more central healthcare delivery model and the community numbers grow and the infrastructure is put in place to support this growth.

In north-west Western Australia, towns such as Port Hedland were built and the associated infrastructure developed to accommodate mine workers and their families. As compensation for contributing to this, mining companies received tax rate concessions. However, over the past 25 years fewer towns have been developed and fly-in/fly-out (FIFO) has become a popular alternative for both the mining companies and its employees [7, 8]. It became an established viable practice in the 1990s for minerals, oil and gas mining operations, whereas coal mining has remained a primarily community-based operation [8].

### *1.2. Proximity to Established Community*

This is where there may be an influx of workers to existing communities—where there is the opportunity to commute daily to a mine site. Where workers can live in the area with their family, particularly in smaller communities, there are specific health problems both for the workers and for their families [9]. There has been considerable criticism of the impact of fly-in/fly-out on established communities, particularly its impact on healthcare services [10], and the resulting social fabric and infrastructure [11]. As the Australian mining industry increasingly experiences a drain on technical human resources [12], fly-in/fly-out has become a workable model. Where a mine site is located in proximity to a community, there is often additional pressure on local resources where the workforce includes a fly-in/fly-out component.

### *1.3. Remote Location*

In remote mine sites, the mining operations are self-contained. Accommodation and all services are provided at the work site for the workers, but not for their families. Thus, they consist of an almost entirely FIFO workforce, on a rotational basis of a number of days on site and a number of days at their home location. The cost for this to the mining companies is favourable, particularly where mining operations may be short-term or are in isolated areas. These costs relate to taxation, capital gains and the changing nature of the employment structure with more contract labour [7]. This model of workforce deployment is increasingly popular in Western Australia and Queensland [13].

## **2. The Effect on Healthcare Service Delivery**

The effect on regional centres and remote communities, of a move away from established communities to a predominantly FIFO workforce, has meant a change in the social structure of both the communities themselves and of the familial arrangements. Given that the local community is no longer required to provide many of the essential and non-essential services, the major centre from which the employees are drawn, benefits for instance Perth, yet the regional centre does not. Previously existing training and employment opportunities are lost, decline in population and subsequent decline in regional funding occurs and slowing or negative economic development is apparent [8]. The mining industry itself takes a differing view on this, suggesting that FIFO and drive-in/drive-out (DIDO) arrangements promote benefits to the regional communities in which FIFO and DIDO are situated [14].

In situations where a workforce is drive-in/drive-out, and can be placed in an existing community, whilst preferable from a family perspective, this causes an influx of population to communities with a resulting pressure on existing, usually limited, healthcare services. There is increasing pressure on the mining industry to contribute to the health care services within remote communities. It is cited that up to 25% of primary care and regional healthcare services are being used by the FIFO works and thus creating more stress on local services [15, 16]. As the Health Workforce Australia (2011) report suggests ‘the flow-on effects are likely to place an increased demand on health services and reduce the ability to attract and retain health workers. The shorter-term impact could be: increased demand for housing and increasing housing costs for health professionals whose salaries cannot cover market rates (housing rental increases as high as 400% have been documented); and increased competition for labour in a market where health sector wages and conditions already cannot compete with the mining sector’.

A lack of suitable and low cost transport for those dispersed and distanced from healthcare facilities is a fact of life for many rural Australians. ‘Historically, the ambulance service, the Royal Flying Doctor Service (RFDS) and Patient Assisted Travel Schemes (PATS) play key roles’ [17]. Indeed, the review of primary health care delivery models for rural and remote Australia suggests that the inequalities between remote and metropolitan healthcare delivery needs addressing [18]. Policy to date has looked at the healthcare workforce but not at the models of healthcare that can support better and more appropriate delivery of care. Accordingly, five categories of delivery model have been identified: discrete services, integrated services (for instance coordinated care teams), comprehensive primary care services (such as Aboriginal Medical Centres), outreach services (including fly-in/fly-out and ‘hub and spoke’ models of care) and virtual outreach services (utilising virtual clinics and telehealth solutions).

It is the discrete and integrated service, compared to the outreach and virtual outreach that this paper examines. In particular the virtual outreach model is important in Australia given its vast size and shortage of health professionals in remote areas. Whilst telehealth refers to the delivery of healthcare services at a distance using technology-assisted communication, to date this has focused on synchronous consultation type communication in Australia such as tele-consultations [18]. Increasingly telehealth covers ‘store and forward’ activities mainly used for image-based diagnosis such as teleophthamology and teleradiology, whereas telecare refers to remote monitoring for disease management and prevention [19]. It is this area of primary care, rather than secondary care where telehealth is used in the majority of current scenarios, which need further exploration. Numerous barriers exist in introducing telehealth in the primary care and preventative setting, not least of which is the integration of the activities with existing healthcare systems [19].

Much of the focus is on how to improve access to healthcare and reduce costs in rural and remote healthcare service delivery. What is not being widely explored is how the mining industry both impacts this and how it could contribute more to the access and sustainability incorporating this into its own workforce healthcare needs. This is particularly important given the predominance of the fly-in/fly-out workforce, and specifically in states such as Western Australia.

*'Population health outcomes worsen with degrees of remoteness, as do the challenges faced by health professionals and health service managers, which include longer working hours, professional isolation, longer periods on-call and high levels of stress. There is a serious problem of maldistribution of the health workforce nationally, which significantly disadvantages regional, rural and remote communities, particularly in accessing some specialists and dental and allied health services. These problems are likely to increase, especially considering that the rate of population ageing is faster in rural areas, with consequent higher demand on health services. Added to this foreseeable demand are influxes of different population groups to remote communities for mining and other activities'* [20].

### 2.1. Remote Health Monitoring

Jennett *et al.*, [21] demonstrated that remote monitoring in a personal care situation reduces utilization of healthcare services, together with a reduction in healthcare costs. Yet it is perhaps the socio-economic costs and benefits that need investigation further to assess the usefulness of remote monitoring. This would include perceptions of users in relation to the access to care, cost-effectiveness, social isolation issues, acceptability, quality of care and quality of life.

The promotion of wellness and monitoring of employees with either chronic conditions or preventative monitoring, given some of the harsh conditions in which the mining employees work, could be a beneficial focus for mining companies. There are numerous wireless, wearable sensor devices available that could enhance monitoring of workers [22]. However, what is often cited as problematic are those issues related to the triage of results from remote health monitoring [23]. What is known is that specific healthcare issues impact the FIFO workforce, including psychosocial well-being [13] and increasingly mental health issues [24]. Thus it is useful to examine whether or not additional remote health monitoring could be a viable alternative to other forms of healthcare provision currently available to FIFO workers. It may provide support for workers taking a greater responsibility for their own healthcare needs in terms of education and monitoring, which is a particular issue for cohorts of men (of which the FIFO workforce is predominantly comprised of) [25]. The benefits of remote health monitoring though are not restricted to just the FIFO workforce.

## 3. Cost-benefit Framework

The number of patients eligible for the remote health monitoring option will depend primarily on the type of health condition. Good candidates for remote health monitoring are patients that have ongoing or chronic health conditions including diabetes, asthma, hypertension [26], and cardiopulmonary diseases and motor disorders [27]. Other candidates for remote health monitoring include patients requiring pre-surgery consultations (such as assessment by an anaesthetist).

To evaluate the net benefits of remote health monitoring (option 3) in comparison with locum services (option 2) and travel to Perth (option 1), fixed and variable costs of all options need to be considered. These costs include out-of-pocket expenses for the patients as well as costs to the mining company. Table 1 summarizes the types of costs applicable to each of the health service delivery options.

Health services are provided by General Practitioners (GP) usually operating from a medical centre and Specialists who usually require GP referrals. The cost per visit to a city-based GP (\$68) should apply whether the patient is physically visiting or remotely Skyping or telephoning. Unit costs for GP visits and Specialist visits were taken from Medicare Benefits Scheme July 2011 Items 36 and 131, respectively [28]. The same service offered by a visiting locum however is much more expensive (\$340). Wakerman *et al.*, [1] report that ‘the FTE salary cost for a locum doctor is \$750,000’ (p. 2) which is about five times the salary cost of a metropolitan-based GP. Similarly, the cost per visit or Skype to a city-based Specialist (\$77) is cheaper than the rate that might apply for visits to rural and remote locations. Note that, in Western Australia, city-based Specialists such as neurologists and geriatricians do hold clinics monthly or bi-monthly at major regional centres. The pricing for these services is not dissimilar to city prices.

**Table 1.** Cost items of health service provisions: comparative analysis

Cost items	Alternative health service delivery options		
	Travel to Perth (1)	Locum services (2)	Remote health monitoring (3)
GP	Normal GP service fee	Normal GP service fee times a factor of 750000/150000	Normal GP service fee
Specialist	Average specialist service fee	Specialist service fee may apply at a higher rate	Average specialist service fee
Data collection and transmission equipment and middleware	n.a.	n.a.	Annual depreciated cost
Medical equipment	Included in GP service fee	Included in Locum service fee	Annual depreciated cost for monitors, test equipment, x-ray machines, scales, etc.
Materials			Estimated per patient usage (syringes, etc.)
Patient costs	Return airfare Accommodation	Gap payment	Nil
Patient time/workplace relief	Absence from site for 1 or more days	n.a.	n.a.
Staff turnover	Turnover is high in the mining industry [35]		
Selection criteria for employment	The best candidates for the position may be excluded from selection due to underlying health conditions		

Unlike health service delivery in the city or in the country using locum services, remote health monitoring will require special equipment that will collect readings, provide data to city-based health practitioners and provide feedback to patients. Argawal and Lau (2010) [26] suggest mobile smart-phones have this capability. Moreover, smart-phone applications can be written specifically for the disease monitoring process. The

depreciated annual cost of this type of technology will need to be added to costs related to a Web interface for use by doctors.

Other equipment that is normally used in GP or Specialist practices (such as blood pressure monitor, scales, stethoscopes, etc.) will need to be included in an on-site health centre. Where rural and remote communities already have a nursing post, this equipment may already be provided. Mining companies might also have an on-site pseudo-medical suite with this equipment. Whether or not it will be needed or replaced will depend on the precise community or mine site—similarly for materials costs.

For patients who need to travel to Perth for their check-ups, there are costs related to airfares and accommodation. There is also the opportunity cost for the patient (foregone pay) of not working and lost productivity for the mining company. If these patients are attended by locum health practitioners then gap payments are considerable. Remote health monitoring avoids these patient expenses by allowing the patient to receive medical advice *in situ*. It also reduces the productivity loss from worker absence in the case of the patient having to travel to Perth for their health consultation.

There is considerable literature about mental health discrimination as well as gender, race and age discrimination in employment. There is also some literature about genetic discrimination. Very few studies were found that looked at implicit or direct health discrimination in hiring. One such study reported a randomized control trial in which resumes differing only in an applicant's health status were faxed to advertised job openings [29]. The author found that 'applicants who voluntarily disclose their HIV-status face great difficulty in obtaining an interview regardless of their education level and job status' (p. 210). Good applicants may thus be screened out of position shortlists due to voluntary health status declarations or failing medical examinations which are prerequisites to offers of employment.

The final two rows of Table 1 refer to two additional costs that may be impacting mining labour forces currently and which could be reduced if remote health monitoring is adopted. In a study of staff turnover in mining workforces in rural and remote Western Australia, Brown [35] found that there were complex issues involved in both the decision to work in the mining industry and either fly-in/fly-out or relocate, and the decision to resign. Some of these issues related to family dynamics and some to the shift-work nature of the employment in this industry. In the survey, there was no specific mention of access to healthcare as a deterrent to remaining in the job.

In competitive labour markets with identical and easily replaceable workers, staff turnover incurs virtually no costs. In less than competitive labour markets, where workers need to have specific and highly valued skills, the attraction and retention of workers is difficult and/or where there is considerable on-the-job training, staff turnover can be very costly [32]. The latter describes the situation for workers employed by mining companies located in rural and remote areas of Western Australia. Potential mine workers have to have specific skills or competencies. In addition, the workers have to trade-off the prospect of remuneration being higher than for the same work in the city against less desirable working conditions. For example, FIFO workers have two lifestyles to juggle and on-site workers have to manage without some of the goods and services available in the city. In both cases, living away from family and friends for short or long periods, respectively, can be debilitating.

To offset the negative aspects of FIFO or on-site working conditions, employers may offer benefits such as use of an on-site gym, subsidised housing, airport transfers and trade registrations. Subsidised private health cover and access to employee assistance programs might also be provided. However, having good quality health

cover is not the same as being able to access health care in a timely and appropriate way. There is potential for mining companies in rural and remote areas to add health care to their offer of health cover to encourage workers to stay.

Whilst there are normative models for the evaluation of telehealth/teleconsultation type services, there are few if any for the evaluation of remote health monitoring particularly for preventative monitoring and primary care activities [30]. Yet, there is clear demand for such services in devising new models of care for rural and remote healthcare service delivery [31].

The intangible benefits must also be considered although not necessarily quantifiable from a monetary perspective. Similarly, the barriers to any adoption of remote health monitoring must also be balanced in considering its use. The clinical utility as well as the patient wellness utility must be included.

#### **4. Conclusion**

There exist uncomfortable tensions between the delivery of healthcare, including its costs and infrastructure establishment, and the cultural differences between work and social culture in the mining industries. In summary the collision between the social and the economic environment within which remote and mining healthcare is situated causes problems in how to best deliver effective and efficient healthcare services. Whilst there is some criticism of the mining industry and its limited compensation back to the community for use of the healthcare services, there are many examples where mining companies do contribute to local communities [15, 33]. This is aligned with the corporate social responsibility on the mining industry to develop sustainable communities in which the mining organizations operate [34]. In addition to this positive social perspective, there is potential for considerable cost savings as a result of the use of remote health monitoring for those workers with suitable physical or mental health conditions. These savings can accrue to both the individual and to the mining company that employs them.

It is acknowledged that the use of remote health monitoring will not replace particular health care service provision that requires face-to-face consultations, however it can supplement some services. For instance, this has been shown to be beneficial in rural mental health [18]. Ultimately the objective of considering alternatives is to both improve the quality of care and to reduce or contain healthcare delivery costs. The first step is to assess the general viability of remote health monitoring for mining communities and then investigate the health issues that could be addressed with remote health monitoring for mine workers, together with the viability of the associated clinical and administrative processes to support sustainability of the delivery of these services. Arguably, the clinical processes that surround the use of remote health monitoring, be they for wellness or ongoing clinical care, and engaging and building confidence within the clinical community, may be a challenge.

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