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A cellulitis guideline at a community hospital – *we can* reduce costs by standardizing care.

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ABSTRACT

OBJECTIVES
To assess whether there is: a) a clinical difference between patients with cellulitis treated according to the recommendations of a clinical cellulitis guideline, and those treated otherwise and b) a difference in the cost of antibiotic treatment of the two groups.

METHODS
Emergency Department (ED) patients diagnosed with cellulitis at a community hospital were graded using a 4-point scale, and physicians were encouraged to treat based on an established practice guideline. Patients were contacted 5 days after their ED visit, and again at 10 days if they had not improved by 5 days. Physician 'compliance' was defined as having followed three or more of the five elements of the guideline.

RESULTS
Of the 272 patients, 147 (54.1%) were classified as Grade I, 53 (19.5%) Grade II, 33(12.1%) Grade III, and 6 (2.2%) Grade IV. In 12.1% the grade was not assigned. 43.5% were treated in compliance with the guidelines, of which 83.3% reported improvement at 5 days, compared to 87.7% of those treated otherwise. At 10 days, 98.8% of the patients treated in compliance with the protocol had improved compared to 94.7% of those treated otherwise. Average antibiotic cost/patient was: Grade 1: $8.48, Grade II: $16.65, Grade II: $96.53 in the 'compliance' group, and $35.68, $51.28, and $150.18 respectively in the 'non-compliance' group.

CONCLUSIONS
Patients treated in accordance with the cellulitis guideline had similar outcomes to those treated otherwise, at significantly lower cost. Efforts to encourage compliance with the guideline are indicated.

Keywords: *cellulitis; clinical practice guideline; skin infections; soft tissue infections*

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Introduction

Cellulitis is an acute spreading inflammation involving skin and soft tissue, excluding muscle, considered to result from bacterial infection. Patients present with recent onset localized erythema, swelling, tenderness and warmth, and may have systemic symptoms.[1-3]

In spite of literature supporting the efficacy of inexpensive and relatively narrow spectrum antimicrobial regimens,[4-15] and questioning the need for routine parenteral drug administration,[15-17] studies have demonstrated a wide variation in strategies used to treat cellulitis. No clear-cut guidelines have been published for the use of intravenous antibiotics in the treatment of cellulitis.[17] Although hospital admission is often considered in cases where intravenous antibiotics are prescribed, several studies have demonstrated success with outpatient intravenous programs.[13,14,17-20]

A call has been made for the development of guidelines to assist in the choice of effective, fiscally responsible cellulitis treatment regimens.[1,10,17]

In 2000 the Nova Scotia Guidelines (NSACG) were developed by a multidisciplinary team at the Queen Elizabeth II Health Sciences Centre in Halifax, Nova Scotia. The 'Cellulitis Guideline Team' included representatives from Emergency Medicine, Infectious diseases, Plastic Surgery, Nursing and Pharmacy. Using a review of the literature, and 'expert opinion' in cases where published evidence was considered insufficient, a guideline with a four level grading system was designed (Appendix 1) with specific therapeutic regimens recommended for each level of severity (Appendix 2), ranging from oral antibiotics in Level I (least severe), to immediate empiric intravenous anti-microbial administration and urgent referral in level IV (most severe).[3] Appended to the guideline is a table of alternate antibiotics to use in select circumstances (Appendix 3), information to bear in mind when treating cellulitis, and a price list of the antibiotic choices.

A pilot study suggested that the guideline was safe for patients, liked by physicians, and was associated with lower cost.[18]

Objectives

We sought to observe the impact of the guideline at a community hospital in terms of compliance with the recommendations, patient outcome, and cost of treatment. We hoped to demonstrate that use of the guideline was associated with no difference in clinical outcome compared to patients treated otherwise, yet at a lower cost.

Materials and Methods

This observational study was performed at the Dartmouth General Hospital, in Nova Scotia, a community hospital with an 36,000 emergency visits/year. All patients age 16 years or greater, diagnosed with cellulitis between November 1, 2001 and October 31, 2002 were included. The study was approved by the institutional research ethics board.

Staff were informed about the guideline at departmental rounds, and through letters and emails. Copies of the guidelines were posted in the emergency department (ED), and fold-up pocket copies of the guidelines were supplied to staff members. Physicians were asked, that when managing patients with cellulitis, they grade the severity of infection using the 4-point severity scale (appendix 1) and refer to the antibiotic recommendations (appendix 2) to guide their choice of prescription, unless their clinical judgment deemed otherwise.

All patients diagnosed in the ED with cellulitis were identified daily from the ED log by one of three discharge planning nurses, who collected the patients' clinical records. Each patient was called 5 days after the ED visit to ascertain their level of improvement. If the patient indicated at the 5 day follow-up call that their condition was unimproved from the time of their ED visit, patients were advised to consult a physician for re-evaluation, and were called again 10 days after the initial visit.

Information regarding cellulitis severity (according to the grading system), disposition and treatment provided, and follow-up recommendations were extracted from the patient record. Data was entered into a Microsoft Access database, and analyzed using STATA 8.2 statistical software (*StataCorp LP, Texas*). The cost of antibiotic treatment was calculated using the 2001 Queen Elizabeth II Health Sciences Centre pharmacy formulary, with the cost of infusion equipment added for intravenous antibiotics. The cost of hospital admission or home care antibiotic administration was not calculated, and these costs were not compared.

Compliance with the guidelines was assessed according to five criteria: choice of antibiotic, dose of antibiotic, mode of administration, duration of treatment, and follow-up recommendation. For the purposes of the study, 'compliance' was defined as at least 3 of the 5 criteria used being in concordance with the guidelines. Patient outcome and cost of antibiotic treatment was compared between the 'compliance' and 'non-compliance' groups.

Results

A total of 272 patients were diagnosed with cellulitis during the study period. The average age was 48 years, with 48.1% being female. There were no significant differences in either the average age or sex of patients treated in 'compliance' with the guideline versus those treated otherwise. A total of 41 patients were lost to all follow-up, 20 from the 'compliance', and 21 from the 'non-compliance' groups. Eight patients had 'partial' follow up; 6 patients 'unimproved' at 5 days were lost to 10 day follow-up (4 in the 'compliance' and 2 in the 'non-compliance' group). These were considered 'unimproved' at 10 days for the purposes of data analysis. Two patients (one in each group) were unobtainable at 5 days, but were contacted at 10 days. Both of these reported 'improvement', and were analyzed as 'improved at 10 days, but not at 5 days'.

Using the suggested grading scheme, 54.1% (n=147) of patients were classified as Grade 1, 19.5% (n=53) as Grade 2, 12.1% (n=33) as Grade 3, 2.2% (n=6) as Grade 4. 12.1% of patients (n=33) had insufficient information recorded on their chart to be able to establish a grade.

Four patients were admitted to hospital on the initial visit. Two of these were classified as Grade 2 patients, although one of these was admitted for reason other than cellulitis (to the cardiology service), two were classified as Grade 3, (at 10 day follow-up one of the grade 3 patients was still in hospital, while the others had all been discharged.

Of the 6 Grade 4 patients, none were admitted. All except one were reviewed in the ED 24 hours after the initial visit, and showed signs of initial response. Only one had been referred to another service (maxillo-facial surgery). At 5 day follow-up, five of these patients reported that they were better, while one patient still reported condition as being "worse" at 10 days, and was referred back to his physician at both calls.

Patients treated in a manner that was considered 'compliant' with the guideline was 43.5% (n=104). 'Compliance' was more likely in patients rated at Grade 3 (p=0.11), while patients were significantly more likely to be treated in 'non-compliance' with the guideline if they were categorized as Grade 2 (p<0.001) (Table 1.)

Table 1
Comparison between 'compliance' and 'non-compliance' according to grade of severity.

Grade	Compliant	Non-compliant
I	70 (47.6%)	77 (52.4%)
II	14 (26.4%)	39 (73.6%)
III	20 (60.6%)	13 (39.4%)
IV	0 (0.0%)	6 (100%)

Of the 'compliance' group of patients contacted, 83.3% (n=70) reported an improvement at 5 day follow-up phone call compared to 86.8% (n=99) in the 'non-compliance' group (p=0.25). Of those treated in a 'compliant' manner who had not reported an improvement at 5 days, 9 had seen another doctor. Of these, 5 had been given different antibiotics. One patient's antibiotics had been discontinued and therapy for gout had been initiated. Of patients treated in 'non-compliance' who had not improved at 5 days, 11 had seen another doctor, 5 having been given different antibiotics. There was no difference in reported improvement between those treated in 'compliance' or 'non-compliance' with the guidelines in any of groups 1-3.

At 10 day follow-up of patients that had reported no improvement (or could not be contacted) at day 5, 9 patients (64.3%) in the 'compliant' category reported that their condition had improved. Of these patients, one had seen a physician between 5 and 10 days, without a change in treatment. Of the 15 patients in the 'non- compliant' category contacted at 10 days, 8 (53.3%) reported a subsequent improvement; 5 had seen another doctor, of which 3 had been given different antibiotics.

In total, 94.0% (n=79) of the 'compliant' group, and 93.9% (n=107) of the 'non-compliant' group reported improvement by day 10, with no statistical difference between groups (p =0.49) Table 2.

Table 2
Breakdown of patient outcome by 'compliance' or 'non-compliance'

	Compliant (% of total)	Non-compliant (% of total)
Total	104	135
Lost to follow-up	20 (19.2%)	21 (15.6%)
Available for analysis	84 (80.8%)	114 (84.4%)
Improved at 5 days	70 (83.3%)	99 (86.8%)
Not improved (or not contacted) at 5 days, but improved at 10 days	9 (10.7%)	8 (7.0%)
Repeat visit to a doctor in 10 days	9	11
Received a different antibiotic within 10 days.	5	5
Improved at 5 or 10 days	79 (94.0%)	107 (93.9%)
Lost to 10d F/U	4	2

The cost of treatment in the 'non-compliant' group exceeded that of the 'compliant' group by a factor of 4.21 for Grade I patients, 3.08 for Grade II and 1.58 for Grade 3 (Table 3).

Table 3
Average cost per patient in severity categories I to III

Grade of Cellulitis	'Compliant' group	'Non-compliant' group
I	$8.48	$35.68
II	$16.65	$51.28
III	$96.53	$150.18

Discussion
Variation in practice patterns for treating cellulitis is a significant issue for physicians.[1,17, 18] Patients differ significantly in terms of disease severity and in terms of their underlying ability to deal with physical insult, or to withstand under-treatment. Cellulitis, although generally a benign disease, with a reasonably predictable course,[3] can be a precursor to devastating conditions such as necrotizing infections and septic shock. Few tools have been described to grade the severity of illness, or provide directions as to how to identify cases where a poor outcome is more likely,[2] and concerns about avoiding poor outcomes result in the frequent use of broad spectrum parenteral antimicrobial therapy in cases where narrow spectrum, oral therapy would be adequate.[15,16] Studies designed to minimize cost have focused on avoiding hospitalization by providing IV therapy in the community,[20-22] or on using less expensive intravenous antibiotic regimens rather than avoiding unnecessary parenteral therapy (with the attending cost, discomfort and inconvenience) in the first place.[11,13,14,16,17]

In this study, we showed that stratifying the levels of severity of cellulitis enables us to identify patients who can safely be treated with less invasive and expensive regimens.

We were surprised that none of the six patients in the most severe group (Group IV) were admitted, and that all had good outcomes at outpatients. Considering that these presentations are relatively uncommon, and that poor outcome, although rare, can be devastating, we stand by our recommendation to triage these patients into the most aggressive referral and treatment categories.

Guidelines for the management of skin and soft tissue infections, such as the Australian Therapeutic Antibiotic Guidelines section on cellulitis and skin infections[23] categorize cellulitis as 'mild' or 'severe'. We submit that there is a subset of patient with cellulitis that falls between these extremes and for whom over-aggressive therapy might be avoided by an initial dose of intravenous antibiotics followed by close follow-up for re-evaluation. The finding that 'compliance' was more likely in grades 1 and 3 and less so in grade 2 cellulitis, with no difference in outcome between the treatment groups, supports the idea of this subset of patients with less severe disease (although not 'mild') that is more likely to be treated with more intensive or expensive treatment than is necessary. The use of our guidelines was not compared against the use of the more traditional 'mild' and 'severe' guidelines, so that our suggestions remain conjecture at this time.

We are aware of only one other cellulitis guideline that uses a 4 grade system to stratify the severity of illness, published by Eron et al in 2003.[24] The grades of severity are somewhat similar to the NSACG, but, in contrast to our guideline, suggestions for the management of patients in the two middle grades are given as overlapping options, to be chosen at the physician's discretion. Our approach is to give support to a range of physicians managing cellulitis, including those who may have insufficient faith in their ability to determine the optimal strategy for patients in the two middle categories. A plan of treatment is given, with advice to choose the higher level if in doubt, and with strict follow-up criteria. Our guideline also offers the option of 'stepping down' therapy from intravenous to oral, once 'low risk criteria' as categorized in Group I, remain present for greater than 24 hours.

Our study has a number of limitations. The two groups compared were not randomly assigned, and it could be argued that, in spite of the grading system, the patients who received more expensive or invasive therapy were sicker, and the higher level of treatment was appropriate, and was the actual reason for the similar outcome in each group. We did not obtain data on how many patients had failed treatment that had been started by their primary care physicians before they presented to the ED. If we presume that the initial treatment was the first line antibiotic suggested by the guideline, these patients would be expected to have been more likely to have ended up in the 'non-compliant' category. We found no indication in the patient records, nor in follow-up calls that patients in each level of severity in each group were different from those of the same level in the other group.

'Improvement' at 5 and 10 days was assessed according to subjective patient reporting. We believe that the subjective response of the patient reflects, again, the reality of clinical medicine. The incidence of a change in antibiotic treatment was similar in both groups.

We did not factor in the cost of additional courses of antibiotics into the total cost. The fact that only 13 patients (5%) received additional antibiotics, and that this was more frequent in patients treated in a 'non-compliant' manner suggest that adding these costs would not change our findings significantly. With regard to the cost of hospital admission that might be avoided by identifying patients who could be treated with oral treatment, or with intravenous therapy at home, only four patients in our study were admitted to hospital, of which only one was in 'non-compliance with the guideline. These numbers were too small for meaningful estimation of the difference in costs resulting from the site of care. Apart from the obvious economical advantages of avoiding hospital admission, a recent systematic review found that six month mortality was lower for patients given hospital care at home, and that patients treated at home reported greater satisfaction.[25]

In spite of the above findings, the dissemination of 'hospital-at-home' services continues to be a challenge in many areas,[26] and the option of prescribing treatment with intravenous antibiotics by community services outside of the hospital may not be an option for many providers.

A total of 41/272 (15.1%) of patients were lost to follow-up completely. Although there was no record of them revisiting or being admitted to the Dartmouth General Hospital, we have no way of knowing if they did indeed, fail treatment and require further management. An additional 6 patients were lost to 10 day follow-up, after reporting an 'un-improved' condition at 5 days; these were analyzed as treatment failures, although they may well have been improved at 10 days.

Including all patients originally lost to follow-up in the analysis as having failed treatment, overall improvement at 10 days would be 76.0% (79/104) for the 'compliant' group, and 79.3% (107/135) for the 'non-compliant' group (p =0.26).

Finally, the NSACG does not address the rising concern with community acquired methicillin-resistant Staphylococcus aureus (CAMRSA). It has been suggested that empirical antimicrobial choices for skin and soft-tissue infections need to be reconsidered in areas where MRSA is prevalent in the community.[27] The same authors however found no association between patients' outcomes and the susceptibility of the pathogen to the prescribed antimicrobial agents, which in the majority of cases were β-lactam agents such as cephalexin and dicloxacillin to which MRSA isolates are not susceptible.[27] These findings have also been reported by other authors.[28,29] The discrepancy is plausibly explained by the fact that CAMRSA isolates are usually obtained from purulent infections that are in most cases adequately treated by incision and drainage without antibiotics. At this time, an increase in the incidence of treatment failure of cellulitis has not been identified in Nova Scotia. Time will tell whether the first-line therapeutic recommendations need to be reevaluated.

Conclusion

The Nova Scotia Adult Cellulitis Guidelines allows clinicians to assess the severity of cellulitis so that treatment can be tailored to disease severity and risk of complications. This study suggests that the use of the guideline is safe, and that compliance with at least three of the five recommendations of the guideline is associated with considerable cost savings in the management of cellulitis. These results should be validated in a cluster-randomized clinical trial. Other directions to pursue include efforts to increase physician compliance with the guideline.

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Appendix 1: Cellulitis Grading System

Nova Scotia Adult Cellulitis Guidelines[1]

Definition
Acute spreading inflammation involving the soft tissue, excluding muscle, characterized by recent onset soft-tissue erythema, warmth, swelling & tenderness, considered to be of infective origin, and acquired in the community. *This does not include infected surgical wounds or previously treated (< 3 months) deep diabetic infections.*

Grading scale:

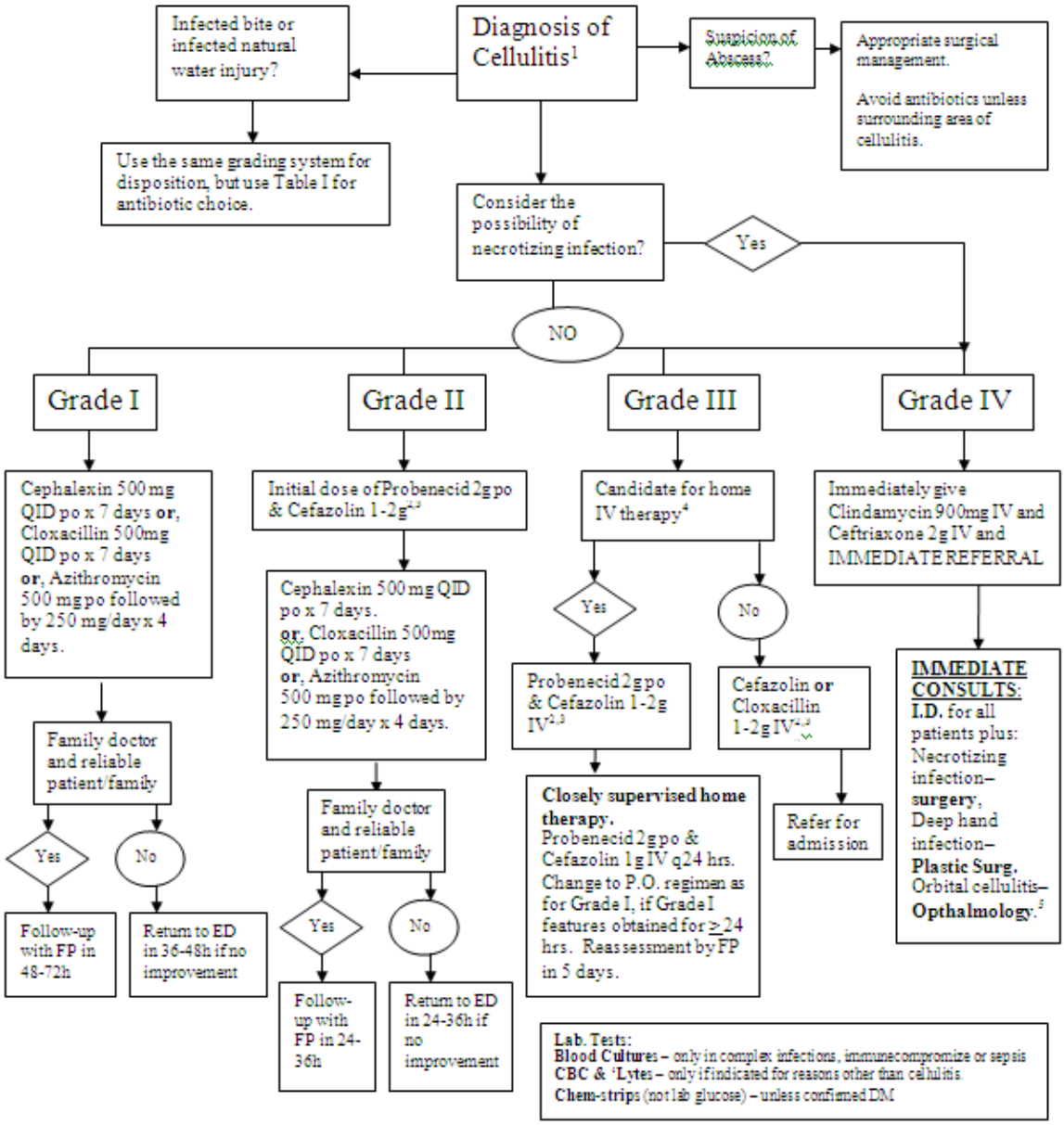
Grade	Clinical features
I	• Symptoms/signs restricted to superficial swelling, erythema, warmth, mild lymphadenopathy, & mild pain; absence of systemic symptoms in patients without risk factors for poor outcome.[2]
II	• dominant systemic signs – fever, chills lymphangitis &/or rapidly advancing edge. • mild cellulitis (as defined in grade I) in high-risk,[2] non-neutropenic, splenic patients .
III	• severe facial, perineal or extensive skin involvement (i.e. if any dimension of the area of skin involved is greater than the distance between the patient's median wrist crease and the point of the elbow). • failure to respond to >48 hrs of adequate oral Rx, • a history of episodes of cellulitis requiring prolonged intravenous therapy.
IV	• deep perineal, orbital, joint, or deep hand involvement. • cellulitis in neutropenic or asplenic patients. • - suspicion of necrotizing, deep-seated infection or severe sepsis.[3]

[1] age ≥16 years.

[2] 'High risk patients' = Neutropenia, asplenia, active cancer, SLE, transplant, prosthetic joint or valve, HIV with CD4 count < 200), or chronic venous insufficiency, chronic lymphedema, post mastectomy, axillary node dissection or radical pelvic surgery affecting the infected body part.

[3] Severe sepsis = Systemic signs/symptoms with evidence of end organ dysfunction or hypoperfusion.

Appendix 2: Cellulitis Algorithm



[1] See definition on page 1.
[2] Antibiotic treatment must be initiated immediately (or ASAP) upon suspicion of diagnosis in patients grade II to IV. Avoid probenecid in chronic renal failure or acute gout.
[3] If patient reports shortness of breath or hives within 24 hrs of penicillin use, use Azithromycin 500 mg IV OD.
[4] Clinical decision by attending physician (patient too sick), or logistical decision (home support or patient compliance concerns)
[5] Consults to several different disciplines may need to be made simultaneously.

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Appendix 3: Infections of injuries sustained in natural water or as a result of bite wounds

	Circumstance of Original Injury:[i]		
Grade	Mammal Bite	Salt Water	Fresh Water
I	Amox/Clav [ii]875 mg po BID x 7-10 days. If Pen. Allergy, Moxifloxacin 400 mg OD OR Ciprofloxacin 500 mg po BID **plus** Clindamycin 300 mg QID, x 7 days.	Doxycycline 200 mg po OD **or** Ciprofloxacin 500 mg po BID x 7-10 days	TMP-Sulpha[iii] DS x 1 tab po BID **or** Ciprofloxacin 500 mg po BID x 7-10 days
II	Ceftriaxone 1g IV, then P.O. regimen as in I, above.	Ciprofloxacin 400 mg IV, then PO as above.	
III[iv]	Ceftriaxone 1-2 g IV OD + Metronidazole 500 mg po BID x 7-10 days.	Ciprofloxacin 400 mg IV BID x 7-10 days (‘step down to PO when grade 1 criteria for 24 hours.)	
IV	Refer to hospital as per main algorithm.		

[i] Consult ID if patient pregnant and has a penicillin allergy.
[ii] Amoxicillin/Clavulanate
[iii] Trimethoprim-sulfamethoxazole
[iv] If no signs of improvement in 48hrs, consult an Infectious Disease specialist.

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