Point-of-Care Guides

Predicting Hospital Readmission

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This guide is one in a series that offers evidence-based tools to assist family physicians in improving their decision-making at the point of care.

This series is coordinated by Mark H. Ebell, MD, MS, Deputy Editor.

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CME This clinical content conforms to AAFP criteria for continuing medical education (CME). See CME Quiz Questions on page 270.

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Clinical Question

What is the best way to predict unplanned readmissions or early death following a hospitalization?

Evidence Summary

In 2007, the Medicare Payment Advisory Committee reported that 18% of hospital admissions resulted in a readmission, of which 76% were potentially avoidable.[1] The development of a clinical decision rule to identify patients at risk of readmission could aid in directing interventions and resources, potentially improving cost-effectiveness of care and reducing postdischarge mortality.

There are generalized clinical decision rules to help predict readmissions for all types of patients, and condition-specific clinical decision rules for patients with conditions such as heart failure or pneumonia. Two of the most widely used and validated generalized clinical decision rules for predicting readmissions are LACE (length of stay, acuity of admission, comorbidity, emergency department use within six months of admission)[2] and HOSPITAL (low hemoglobin level, discharge from oncology, low sodium level, procedure during hospitalization, nonelective index admission type, number of hospital admissions during the previous year, length of stay).[3,4]

The LACE rule *(Table 1)* predicts 30-day early death or unplanned readmission after discharge from a hospital to the community.[2] It was derived from a multicenter cohort of 4,812 patients from 11 hospitals in five cities in Ontario, Canada, and then it was externally validated using 1,000,000 patients selected from databases of all hospital admissions in Ontario.[2]

The LACE rule uses administrative data readily available to clinicians, making it easy to use.[2] Although there are many comorbidity indices published, the LACE rule uses the Charlson Comorbidity Index.[5] The rule has a possible total score of 19. The validation study showed that for each one-point increase in the LACE score, the odds of an unplanned readmission increases by 18% (odds ratio = 1.18; 95% confidence interval [CI], 1.14 to 1.21), with a moderately predictive c-statistic of 0.68. A one-point increase in LACE score increases the odds of early death by 29%, with a c-statistic of 0.793.[2]

In another validation study, a five-point increase in the LACE score doubled the risk of readmissions or death (hazard ratio = 2.0; 95% CI, 1.7 to 2.3).[6] It is important to note that although the LACE rule was originally derived and validated in Canada, this validation study was performed in a U.S. hospital, using 1,239 patients from the Vanderbilt Inpatient Cohort Study.

The HOSPITAL rule predicts potentially avoidable hospital readmissions and includes the following components and points[3,4]:

- Low hemoglobin level at discharge (< 12 g per dL [120 g per L]) = 1 point
- Discharge from oncology service = 2 points
- Low sodium level at discharge (< 135 mEq per L [135 mmol per L]) = 1 point
- Procedure during hospital stay = 1 point
- Index admission type is nonelective = 1 point
- Number of hospital admissions during the previous year: 0 = 0 points, 1 to 5 = 2 points, ≥ 6 = 5 points
- Length of stay ≥ 5 days = 2 points

This HOSPITAL score was derived from a cohort of 9,212 patients discharged from the Brigham and Women's Hospital in Boston, Mass., and then it was externally validated using a cohort of 117,065 patients from nine large hospitals in four countries. Readmissions planned at the time of the index hospitalization and unforeseen read-

missions for conditions unrelated to the original index hospitalization were considered unavoidable and were not included in the analysis of the rule.[4] Unlike the LACE score, most of the components are clinical rather than administrative. The HOSPITAL rule has a possible total score of 13 points. Patients with a score of 0 to 4 have a 5.8% estimated risk of potentially avoidable readmissions, those with a score of 5 or 6 have an 11.9% estimated risk, and those with a score of 7 or more have a 22.8% estimated risk.[4]

Should either of these clinical decision rules be used in practice? Both have been externally validated in multiple countries and contain data that are readily available. However, both rules have only modest accuracy as measured by the c-statistic. The LACE rule requires calculation of the Charlson Comorbidity Index, which can be practically calculated only at the time of discharge or shortly thereafter. An advantage of the HOSPITAL rule is that it uses only clinical data that are available prior to discharge. This could potentially enable a physician to more readily intervene with high-risk patients before discharge. However, although both rules would in theory predict risk of readmission and early death, there are no conclusive studies to determine the actual impact of intervening based on the results of a clinical decision rule.[7]

Applying the Evidence

A 64-year-old man is discharged after being hospitalized for chest pain. During the four-day hospitalization, he underwent a percutaneous coronary intervention for a myocardial infarction. He had a history of chronic obstructive pulmonary disease and type 2 diabetes mellitus. He had an initial sodium level of 132 mEq per L (132 mmol per L) that corrected to 140 mEq per L (140 mmol per L) prior to discharge, and a hemoglobin level of 14.1 g per dL (141 g per L) at discharge. He had not been hospitalized or to the emergency department in the previous year. What is his risk of readmission or early death within 30 days of discharge?

Answer: He has a HOSPITAL score of 2, with a nonelective admission and a procedure during hospitalization contributing the only points. His sodium level corrected and was not low by discharge. His estimated risk of potentially avoidable readmission is 5.8%. The patient's LACE score is 12, with points derived from the acute admission, length of stay, and comorbidity index. This corresponds to a 17.0% expected probability of death or unplanned readmission.

Because of his readmission risk, you arrange for close outpatient follow-up with you and a cardiologist, as well as coordination with a case manager, a nutritionist to optimize diet, and home-health and social workers to assess for barriers to care.

Table 1. LACE Rule to Predict Readmission or Death After Hospital Discharge

Component	Points	Score	Probability of readmission or death within 30 days of discharge (%)
Length of stay (days)		0	2.0
< 1	0	1	2.5
1	1	2	3.0
2	2	3	3.5
3	3	4	4.3
4 to 6	4	5	5.1
7 to 13	5	6	6.1
≥ 14	7	7	7.3
Acute/emergent admission		8	8.7
No	0	9	10.3
Yes	3	10	12.2
Charlson Comorbidity Index score*		11	14.4
		12	17.0
0	0	13	19.8
1	1	14	23.0
2	2	15	26.6
3	3	16	30.4
≥ 4	5	17	34.6
Emergency department visits in the past 6 months		18	39.1
		19	43.7
0	0		
1	1		
2	2		
3	3		
≥ 4	4		
Total points:	_____		

*—The scale is available at http://www.pmidcalc.org/?sid=7722560.

Adapted with permission from van Walraven C, Dhalla IA, Bell C, et al. Derivation and validation of an index to predict early death or unplanned readmission after discharge from hospital to the community. CMAJ. 2010;182(6):553, 555.

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