



The Leadership Inventory for Medical Education (LIME): A Novel Assessment of Medical Students' Leadership Skills

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Healthcare is becoming more team-oriented: healthcare workers need leadership skills

ACGME has called for leadership training (Swing, 2007)

Canadian Medical Association has called for more leadership skills in healthcare (Collins-Nakai, 2006)

We designed the LIME to measure healthcare workers' leadership skills

A review of leadership literature in healthcare, business, and policy and interdisciplinary discussion of leadership

Identified **4 aspects of leadership**:

Communication: Sensitivity to others' perspectives and ability to facilitate the sharing of ideas.

Team Building: Ability to manage groups of people and fostering their effectiveness.

Systems-Based Practice: Awareness of and facility with the policies and processes of healthcare.

Problem-Solving: Facility with systematic approaches to identifying and overcoming barriers.

The 12-item LIME

Derived from language defining the **4 aspects of leadership**

4-point frequency scale

3 items per subscale, intermixed

Single page, approx 3 minutes to complete

Paper or online

Think about times when you have been in charge of a group or have been active on a team project, perhaps in a healthcare-related field. In these situations, how often did you do each of these actions?	never	sometimes	often	always
Communicated effectively both verbally and non-verbally	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Applied accounting, safety/quality, or marketing skills to create systems improvement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thought about the values your team members find important	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Used a Quality Improvement method for solving problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thought about how economics affects healthcare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thought about why your team was effective or not	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Implemented strategies to encourage teamwork	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Took the cultural/political context into account when communicating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Listed what could go wrong, planned contingencies, and reflected on the results	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Designed novel approaches to create solutions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Used insight about how current policies affect health care	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicated with people in a way they could best understand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4 Factor model fits the data

Confirmatory Factor Analysis:

CFI = .82, TLI = .75

RMSEA = .10 (95% CI .09 to .11)

Each item measures an aspect of one aspect:

Communication

Systems-Based Practice

Team Building

Problem-Solving

Systems-Based Practice

Team Building

Team Building

Communication

Problem-Solving

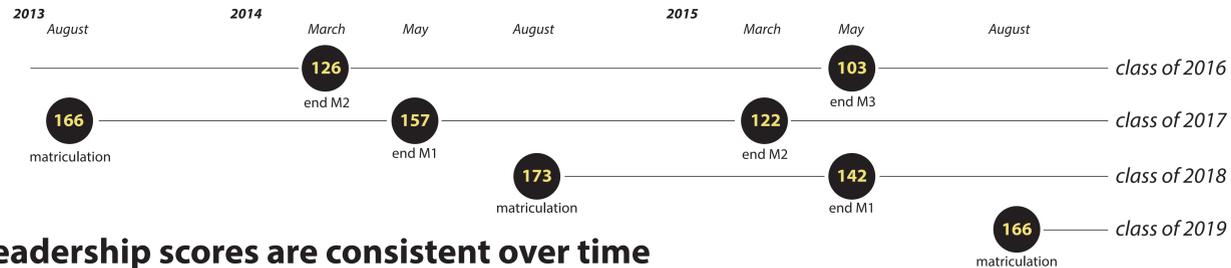
Problem-Solving

Systems-Based Practice

Communication

Scalable: administered >1,000 times since 2013

1,155 complete LIME forms from 660 unique students used in these analyses



Leadership scores are consistent over time

Students with high LIME scores relative to their class at matriculation tend to have high LIME scores relative to their class at later timepoints.

Total LIME scores are consistent (r between .41 and .58)

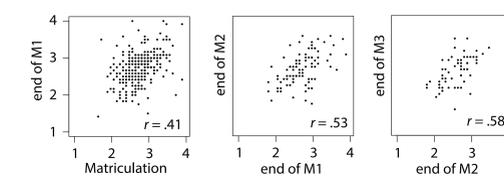
Communication scores are consistent (r between .37 and .47)

Team Building scores are consistent (r between .33 and .58)

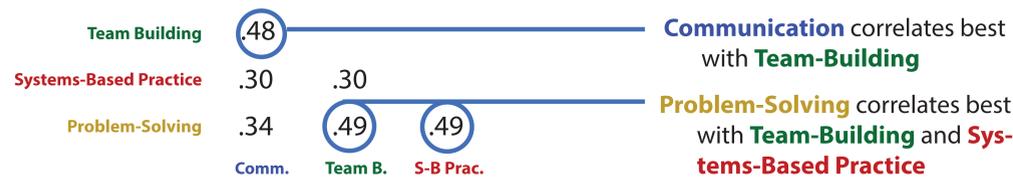
Systems-Based Practice scores are consistent (r between .45 and .50)

Problem-Solving scores are consistent (r between .44 and .50)

Consistency of Total LIME score over time



Sub-scores intercorrelate meaningfully



Communication correlates best with **Team-Building**

Problem-Solving correlates best with **Team-Building** and **Systems-Based Practice**

Sub-scores correlate with other psychosocial measures

Significant correlations after correcting for familywise error (Holm's step-down procedure within each LIME score)

Negative correlations in red

	Ways of Coping with difficult situations (Folkman, 1986)	Ten-Item Personality Inventory (Gosling, 2007)
Total LIME score:	Seeking Social Support ($r = .27$) Positive Reappraisal ($r = .24$) Planful Problem-Solving ($r = .21$) Escape Avoidance ($r = -.11$)	Emotional Stability ($r = .20$) Extroversion ($r = .16$)
Communication:	Positive Reappraisal ($r = .19$) Seeking Social Support ($r = .17$) Planful Problem-Solving ($r = .13$)	Emotional Stability ($r = .18$) Agreeableness ($r = .12$) Extroversion ($r = .11$)
Team Building:	Seeking Social Support ($r = .30$) Positive Reappraisal ($r = .25$) Planful Problem-Solving ($r = .14$)	Emotional Stability ($r = .22$) Extroversion ($r = .22$) Conscientiousness ($r = .13$) Openness ($r = .13$) Agreeableness ($r = .12$)
Systems-Based Practice:	Seeking Social Support ($r = .12$) Escape Avoidance ($r = -.11$)	Emotional Stability ($r = .17$)
Problem-Solving:	Planful Problem-Solving ($r = .17$) Seeking Social Support ($r = .17$) Positive Reappraisal ($r = .16$)	

The LIME appears to be a reliable, scalable measure of leadership in healthcare contexts

The LIME is brief and broad. We are comparing qualitative information with these data to find further evidence of the validity of the LIME.

The LIME shows test-retest reliability and convergent validity in our sample of 660 undergraduate medical students from 4 cohorts at 4 curricular timepoints

These data serve as a baseline. As the University of Michigan adopts its new curriculum, we will continue to measure student leadership abilities over time. The LIME will be useful for assessing changes in leadership behavior at the individual and cohort levels.

Future directions

These results are from only one institution and the LIME is designed to measure leadership as defined by thought leaders at that same institution. Analysis of the LIME's performance in other institutions would be informative.

The confirmatory factor analysis results could show a better fit. Some scale refinement may improve the instrument.

The LIME has only been used in undergraduate medical students. It should be effective for measuring leadership behaviors of residents, attendings, nurses, public health workers, and workers in other health-domains.

These data are only quantitative. Qualitative work with high- and low-scorers will elucidate these findings and the usefulness of the LIME.

References

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- Folkman S. Appraisal, Coping, Health Status, and Psychological Symptoms. JPSP, 1986;50(3):571-579.
- Gosling, et al. A very brief measure of the Big-Five personality domains. J Res in Pers, 2007;37:504-528.



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