Next Steps: Teaching Future Generations an Interprofessional Approach to Diabetic Foot Ulcer Care

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ABSTRACT

Background: We aimed to assess the effectiveness of interprofessional teaching sessions focused on the care of patients with diabetic foot ulcers.

Methods: We conducted a pre-/post-intervention, quasi-experimental study with repeat evaluations on either side of the teaching sessions (n = 28). Surveys and chart reviews were used to assess changes in attitude, knowledge, practice, and patient outcomes.

Results: All 5 infectious disease fellows favorably reviewed the sessions. Positive baseline attitudes towards interprofessional care further improved with respect to shared learning and teamwork (5-point Likert scale scores pre- and post-session: 4.13 vs 4.44, respectively, $P < 0.01$). No other significant changes were observed.

Discussion: Our sessions were associated with improved attitudes toward interprofessional care but likely need to be augmented with experiential learning to achieve practice and outcome improvements.

BACKGROUND

Health care delivery today requires physicians to practice within interprofessional teams. The importance of this skillset is recognized increasingly, including mandates to teach interprofessional skills in graduate medical education.[1,2] However, educational strategies that best hone these skills are nascent.[3,4] Educators need efficient, effective means of teaching interprofessional skills with limited time and resources.

To help meet this need in our infectious disease (ID) fellowship, we designed 2 interprofessional teaching sessions centered on the care of patients with diabetic foot ulcers and incorporated them into the existing curriculum. Fellows are optimal targets for such curricula, because they are still early enough in their training to maximize clinical practice habit change while past the point of focusing on pathophysiology. We chose diabetic foot ulcers as the physiologic topic because interprofessional teams have been associated with improved patient outcomes.[5] Further, our Veterans Affairs (VA) training site also houses a podiatry residency—a keystone profession for diabetic foot ulcer care.

Through our brief curriculum, we sought to change attitudes toward interprofessional care among our ID fellows and increase their knowledge of diabetic foot ulcer care, all in service of improving practice habits and patient outcomes.

METHODS

Setting and Participants

We conducted interprofessional teaching sessions at a VA tertiary care hospital in the Midwest, with a co-located ID fellowship and podiatry residency. Sessions were delivered in person during regular curricular time to 5 ID fellows in January 2023, the academic year midpoint. Podiatry residents and individuals from other professions participated in the sessions, detailed below.

Interprofessional Teaching Sessions

Teaching sessions were informed by the 2011 Interprofessional Education Collaborative Core Competencies for Interprofessional Collaborative Practice and followed best practice for case-based, cooperative learning (Table 1).[3,5] Each 1-hour session was mandatory for ID fellows. The first introduced interprofessional principles and their importance in ID. Cases (injection drug

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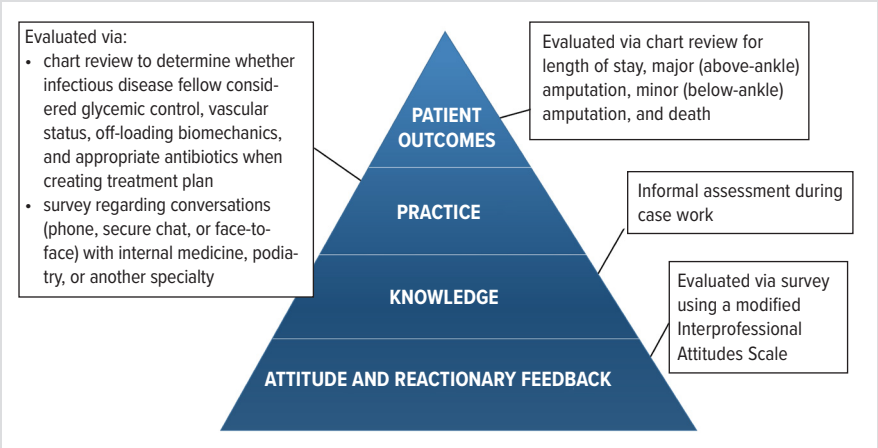
Table 1. Five Key Concepts of Cooperative Learning and How They Were Applied to Case-based Teaching Sessions on Interprofessional Collaboration[3]

Key Concept	Abstract Description	Concrete Application
Positive interdependence	Students have complementary roles and share a common goal	*Session 1:* Infectious disease (ID) fellows participated in 20-minute small group discussions with nurses, case managers, pharmacists, and an advanced practice provider with the shared goal of delivering high quality care to: a) a person who injects drugs with endocarditis or b) a person receiving palliative care with a central line-associated bloodstream infection. Results were shared back to the larger group in the ensuing 10 minutes. *Session 2:* ID fellows paired with podiatry residents to develop a collaborative care plan for patients with diabetic foot ulcers, sharing the goal of limb salvage (20 minutes to develop a plan; 10 minutes to share the plan with the larger group).
Face-to-face promotive interaction	Close, usually synchronous, activities such as discussion or joint decision-making where learners help each other succeed	*Sessions 1 and 2:* Case-based learning was held synchronously and face-to-face. Cases required input from all professions to achieve the desired goal. Each case packet contained a written description of the initial clinical presentation, photographs of the wound, pertinent labs/microbiology/pathology, and radiographic images.
Individual accountability	Each individual is held responsible for contributing a fair share to the group's success	*Session 2:* Cases of patients with diabetic foot ulcers were chosen so that they contained principles of biomechanics that would be well known to the podiatry residents but unfamiliar to the ID fellows, and principles of antibiotic selection that would be well known to the ID fellows but outside the expertise of the podiatry residents. Facilitators ensured members of each discipline contributed to the group's success by addressing these principles.
Interpersonal and small group skills	Team skills	*Session 1:* Four learning objectives aligned with the 2011 Interprofessional Education Collaborative Core Competencies for Interprofessional Collaborative Practice:[5] 1. Review the process of professional socialization and recognize how it influences your perspective of interprofessional team members (information available at the UW Center for Interprofessional Practice and Education: www.cipe.wisc.edu). 2. Describe the principles of effective interprofessional healthcare teams (information available at UW Center for Interprofessional Practice and Education: www.cipe.wisc.edu). 3. Engage members of your interprofessional team to develop care plans to meet specific patient needs. 4. Communicate with team members to better understand their responsibility in executing a treatment plan.
Group processing	Reflecting on how the group functioned and what might make it work better	*Session 2:* The closing 10 minutes were spent actively eliciting learners' response to the collaborative case work and how they might apply this approach to clinical practice.

use-associated endocarditis and catheter-associated bloodstream infection) emphasized the importance of interprofessional care across the spectrum of infectious disease. They facilitated perspective sharing among fellows and other invited professionals: nurses, case managers, pharmacists, and an advanced practice provider. The second session was co-facilitated by an ID physician and a podiatrist. ID fellows were paired with podiatry residents to work through diabetic foot ulcer cases with the intent of fostering appreciation of each other's expertise.

Figure. Impact of Curriculum on Attitude, Knowledge, Practice, and Patient Outcomes, Following Miller's Pyramidal Framework for Clinical Assessment.[6]



Study Design and Curriculum Evaluation

We designed a pre-/post-intervention, quasi-experimental study with repeat evaluations on either side of the teaching sessions to reduce maturation threats and regression to the mean. We collected 14 weeks of pre-intervention data and 14 weeks of post-intervention data on attitudes, practice, and patient outcomes—an assessment approach informed by Miller's pyramidal framework (Figure).[6] Each time ID fellows finished their weeklong VA consult rotations, they completed a 3-part survey. First, attitudes were assessed using a modified interprofessional attitudes scale. Items were subcategorized into shared learning and teamwork, patient-centeredness, interprofessional biases, diversity and ethics, and community-centeredness.[7] Responses were based on a 5-point Likert scale, with 5 corresponding to strongly positive. Second, fellows were asked to identify a patient with a diabetic foot ulcer for whom they provided care. A study team member then abstracted 2 ID-specific and 10 non-ID-specific care practices from clinical documentation by the fellows and patient outcomes assessed at 1 month via chart review (Table 2). Third, fellows who cared for a

patient with a diabetic foot ulcer that week were asked to name the disciplines with which they collaborated. Fellows received monetary compensation for completing the surveys. Knowledge was assessed informally during the teaching sessions, and post-session surveys were distributed for participant feedback. ID fellows provided written informed consent; patient consent was waived. The University of Wisconsin Health Sciences Institutional Review Board and William S. Middleton Memorial VA Research and Development Committee approved this study.

Statistics

We aggregated care metrics into the percentage of applicable ID-specific and non-ID-specific metrics met. We used nonparametric, Fisher's exact, and Mann-Whitney U tests due to our small sample size and lack of independence between observations.

Table 2. Multilevel Assessment of the Teaching Sessions on Interprofessional Collaboration Following Miller's Pyramidal Framework[6]

Assessment Level	Pre-intervention[a]	Post-intervention[b]	*P* value
Attitude			
Shared learning, mean (range)	4.13 (2-5)	4.44 (3-5)	<0.01
Patient-centeredness, mean (range)	4.67 (4-5)	4.69 (4-5)	0.86
Interprofessional biases, mean (range)	3.33 (1-3)	3.38 (2-4)	0.91
Diversity and ethics, mean (range)	4.86 (4-5)	4.82 (5-5)	0.61
Community-centeredness, mean (range)	3.87 (2-5)	3.89 (2-5)	0.93
Practice			
Interprofessional communication			
with primary team, n (%)	7 (100)	4 (100)	—
with podiatry, n (%)	4 (57)	1 (25)	0.35
Percent of applicable ID-specific care metrics met,[c] mean (range)	100 (100-100)	100 (100-100)	--
Percent of applicable non-ID-specific care metrics met,[d] mean (range)	20 (0-75)	11 (0-43)	0.30
Patient outcomes			
Death, n (%)	0 (0)	0 (0)	—
Major amputation (above-ankle), n (%)	0 (0)	0 (0)	—
Minor amputation (below-ankle), n (%)	3 (43)	1 (25)	1.00
Length of hospital stay in days, mean (range)	19.3 (7-36)	22.0 (15-29)	1.00

Abbreviations: IPC, interprofessional care; ID, infectious disease.

[a]Fellows completed 14 attitudinal surveys and saw 7 patients with foot ulcers in the pre-intervention phase.

[b]Fellows completed 14 attitudinal surveys and saw 4 patients with foot ulcers in the post-intervention phase.

[c]ID-specific care metrics were (1) interpretation of culture results and (2) appropriate antibiotic use.

[d]Non-ID-specific care metrics were: (1) mention of hemoglobin A1C, (2) addressed hemoglobin A1C values >7.5%, (3) recorded pedal pulses, (4) mentioned ankle-brachial index values, (5) recommended vascular diagnostics, if applicable, (6) recorded statin use, (7) recommended statin use, if applicable, (8) recorded tobacco use, (9) recommended tobacco cessation, if applicable, and (10) mentioned off-loading.

RESULTS

All fellows participated in the curriculum and pre- and post-assessments (n = 5) and cared for 7 and 4 patients with diabetic foot ulcers in the pre-intervention and post-intervention phases, respectively. Evaluations suggest the teaching sessions were viewed favorably. The first session was rated 4.38 on average (n = 4). One participant said, "I learned that everyone looks at a case study differently based on their level of expertise and role… [The session] strongly showed that every member of the team can bring a different perspective to the table."

The second session was rated 4.95 on average (n = 5). One participant said that they learned to "use efficient but often [frequent] communication."

Fellows demonstrated strongly positive attitudes toward interprofessional collaboration, which improved following the teaching sessions, particularly in the domain of shared learning and teamwork (4.13 pre-intervention vs 4.4 post-intervention, $P < 0.01$, Table 2). ID fellows provided all ID-specific care metrics over the course of the study. They provided fewer non-ID care practices at baseline, and this did not increase over the course of the study. Patient outcomes, including length of stay, amputations, and death, did not change.

DISCUSSION

We saw improved attitudes towards shared learning and teamwork following delivery of our interprofessional teaching sessions. We hope this may portend more interprofessional care and improved patient outcomes, but our small sample size and brief follow-up did not allow us to fully investigate this. Teaching sessions might offer an efficient, effective means of fostering positive attitudes toward interprofessional collaboration, which tend to wane as training progresses, with more profound drops among surgical colleagues.[8] Therefore, our findings of improved attitudes among fellows – especially embarking on medical-surgical collaborations – is noteworthy.[8] However, we need to further investigate the durability of this improvement and its impact on clinical practice and patient outcomes.

Our teaching sessions represent a first – and not final – step toward attaining high-caliber interprofessional skills. While we improved attitudes toward interprofessional care, the effect on practice patterns and patient outcomes has not been realized. A particular increase in attitudes regarding shared learning and teamwork makes sense given that teaching sessions focused on cooperative learning between members of different disciplines. The education literature supports cooperative learning as an effective strategy to teach teamwork skills.[3] It consists of 5 key concepts, which we reified in our teaching sessions (Table 1). These same concepts are also important aspects of interprofessional teamwork in health care.[9] Cooperative learning provides a way of instilling

core teamwork skills, but experiential, service-driven learning is likely necessary to habitualize interprofessional collaboration into a learner's clinical practice.[3] As a next step, therefore, our team intends to model and guide interprofessional collaborations during bedside care of patients with diabetic foot ulcers. We hope to gather feedback from non-ID learners, such as podiatry residents, involved in these interprofessional collaborations. We hypothesize that experiential learning will help ID fellows and their collaborators improve non-ID care metrics in particular, as their interprofessional focus precipitates more comprehensive care.

While promising, our study has significant limitations worthy of acknowledgement. First is its small sample size. Although we had 100% participation amongst our ID fellows, the cohort was small. Furthermore, they cared for few patients with diabetic foot ulcers. Even when we included all patients with diabetic foot ulcers cared for by our fellows in the pre- and post-intervention periods, we captured data on only 11 patients. This reduced our ability to detect statistically and clinically significant changes. We used multiple measures of curriculum evaluation to strengthen our work, from reactionary feedback to patient outcomes. However, if fellows had cared for 1 patient with a diabetic foot ulcer each week—resulting in 28 hypothetical patients rather than 11 actual patients—and no one (0%) sustained a minor (below ankle) amputation in the post-intervention group, we still would be underpowered to detect a statistically significant difference in minor amputations given our pre-intervention rate of 30% (hypothetical *P* value of 0.22). Second, we cannot comment on the durability of attitudinal improvements beyond 14 weeks. The effect of brief interventions—especially those without bedside teaching follow-up—may wane with time. However, our 14-week post-intervention period is longer than most interprofessional education studies, leaving us cautiously optimistic that a brief intervention might sustain improvements.[4] Third, we focused exclusively on ID fellows. Capturing attitudinal changes and experiences of those with whom they were collaborating, such as podiatry and internal medicine residents, would be an important next step in evaluating this curriculum. Reactionary feedback from non-ID fellows attending the teaching sessions was positive, although more in-depth data similar to that obtained from the fellows are lacking. Fourth, we assessed non-ID care metrics by abstracting notes written by the ID fellows. Fellows may have thought that it was unnecessary to reiterate this information in an ID note. While our practice-level evaluation may have underestimated non-ID-specific care provided, the low level of formal documentation suggests ample room for improvement.

CONCLUSIONS

A brief educational intervention emphasizing interprofessional care for patients with diabetic foot ulcers was well received by ID fellows and associated with improved attitudes toward shared learning and teamwork in the 14 weeks following curriculum delivery. More robust shared learning within the clinical environment may be needed to achieve clinically significant improvements in practice and outcomes for patients with diabetic foot ulcers.

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