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ORIGINAL ARTICLE

Development of the assessment for collaborative environments (ACE-15): A tool to measure perceptions of interprofessional "teamness"

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ABSTRACT

As interprofessional education moves from classroom to clinical settings, assessing clinical training sites for a high level of "teamness" to ensure optimal learning environments is critical but often problematic ahead of student placement. We developed a tool (Assessment for Collaborative Environments, or ACE), suitable for a range of clinical settings and health professionals, that allows rapid assessment of a clinical practice's teamwork qualities. We collected evidence of tool validity including content, response process, internal structure, and convergent validity. Expert review and cognitive interviews allowed reduction of the initial 30-item tool to 15 items (the ACE-15). Data from 192 respondents from 17 clinical professions and varied clinical settings (inpatient, ambulatory, urban, and rural) were used for factor analysis, which resulted in a single factor solution. Internal consistency reliability Cronbach's alpha was high at 0.91. Subgroup analysis of 121 respondents grouped by their clinical teams (n = 16 teams) showed a wide range of intra-team agreement. Data from a subsequent sample of 54 clinicians who completed the ACE-15 and a measure of team cohesion indicated convergent validity, with a correlation of the tools at r = 0.81. We conclude that the ACE-15 has acceptable psychometric properties and promising utility for assessing interprofessional teamness in clinical training sites that are settings for learners, and, in addition may be useful for team development.

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Introduction

Since the Institute of Medicine's (IOM) decade of quality chasm reports (e.g. IOM 2001, 2006) brought widespread attention to clinical teamwork as a means of improving safety and quality in healthcare, interest in measuring teamwork has escalated. In addition, as academic health professions programs increasingly require students to engage in interprofessional education (IPE) in order to acquire attitudes and behaviours consistent with good teamwork, there is increased effort to measure teamwork as an essential component of clinical training. These national trends have prompted researchers to develop a large and diverse array of instruments to measure attributes and characteristics of clinical teams, their organizational contexts, and learners' acquisition of the knowledge, skills, and attitudes necessary for optimal team performance.

A number of compendia and synthesis papers provide systematic organization and evaluation of these published instruments (e.g. Brennan, Bosch, Buchan, & Green, 2013; Canadian Interprofessional Health Collaborative, 2012; Havyer et al., 2013; the National Center for Interprofessional Practice and Education Measurement Instruments; Reeves, Lewin, Espin & Zwarenstein, 2010; Valentine, Nembhard, & Edmondson, 2015). Such resources lend an overview of the measurement landscape, and help identify gaps in content, purpose, and use of teamwork tools. Many tools were developed for specific types of providers, types of patients served, settings of care, or culture of the team, i.e. they are contextually dependent (IOM, 2015). For example, Havyer et al. (2013) reported 73 teamwork assessment tools that measure teamwork among medical students, residents, fellows, and practicing physicians. Other tools focus on specific settings, such as primary care (Brennan et al., 2013), acute care (Kenaszchuk, Reeves, Nicholas, & Zwarenstein, 2010), and intensive care units (Shortell, Rousseau, Gillies, Devers, & Simons, 1991) or patient populations, such as geriatric (Fulmer et al., 2005). Some tools were developed within a specific cultural context, including: (a) the CSI (Communication and Sharing Information) scale, developed to measure sharing of medical information and interprofessional communication in the French healthcare system (Anthoine, Delman, Coutherut, & Moret, 2014), and (b) a measure of competencies in interprofessional collaboration of hospital-based health professionals developed in Japan (Yamamoto et al. 2014). A growing number of measures focus on IPE learners' perceptions and attitudes. For example, the JeffSATIC (Hojat et al., 2015) measures attitudes towards interprofessional collaboration in health profession students, and the SPICE-R (Dominguez, Fike, MacLaughlin, & Zorek, 2015) measures student perceptions of interprofessional clinical education. Finally, many measures are lengthy (i.e. > 30 items) and cover multiple constructs as evidenced by factor analysis. For example, the Team Development Measure (Stock, Mahoney, & Carney, 2013), a measure of the development of team functioning, comprises four separate factors, and the TeamSTEPPS teamwork perception questionnaire consists of five sub-scales with seven items each (Agency for Healthcare Research and Quality, 2014).

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Our tool was designed to fill one measurement gap—rapid assessment of a clinical team's level of teamwork—based on the assumption that embedding IPE learners in clinical teams that demonstrate optimal levels of teamwork will reinforce the behaviours educators expect of learners. In other words, as IPE has moved from classrooms to clinical settings, educators must ensure that chosen clinical practice sites have a reflective, open structure where teamwork skills are role modelled (e.g. Reeves & Oandasan, 2005). Thus, increasing attention is being paid to whether a clinical site will be an optimal learning environment for demonstrating and reinforcing team skills (IOM, 2015). This challenge was pointed out earlier by the Interprofessional Education Collaborative—IPEC (Interprofessional Education Collaborative Expert Panel, 2011) which noted that of the various barriers IPE must overcome, lack of collaborative practice role models is one of the most difficult. Our goal, therefore, was to develop a brief measure of interprofessional teamwork that can be used by faculty or program directors in planning clinical placements for interprofessional learners. To be useful and widely adoptable, the measure should be non-specific to setting or type of patient and feasible for busy clinicians, i.e. short (under 5 minutes to complete); clear (each item with a single focus); and in a familiar format that expedites completion.

There are many definitions of healthcare team qualities that make teams effective (e.g. Reeves et al., 2010; Valentine et al., 2015). In accord with the Institute of Medicine report, *Core Principles & Values of Effective Team-Based Health Care* (Mitchell et al., 2012), we defined effective teams as having core interrelated qualities that together embody the notion of "teamness". These include *shared goals* that reflect patient/family priorities and that can be articulated, understood, and supported by all team members; *clear roles*, such that team members' contributions optimize the team's efficiency and ability to accomplish more than the sum of its parts; *mutual trust* that creates norms of reciprocity and greater opportunities for shared achievement; *effective communication* that is candid, complete, and continuously refined; *measurable processes and outcomes* that are used to track and improve performance; and *organizational support* at the system level to promote team success. What makes this IOM report particularly compelling is that while the Committee based the core qualities on the literature, members of the Committee then personally interviewed members of 11 clinical teams across the country about their opinion of the qualities and how each came into play in their clinical environment. Verbatim quotes from these interviews, included in the report, provide rich and specific descriptive language about the qualities.

Tool development is an incremental, iterative process that starts with conceptual design and modification of a measure and then gathers evidence to support its reliability and validity. Classic measurement theory has been adapted for health services research by emphasizing construct validity (defined as the degree to which a score represents an intended underlying construct), with evidence from multiple sources, including content, response process, internal structure, relation to other variables, and consequences (Cook & Beckman, 2006). With this backdrop, we embarked on a multi-step psychometric study to develop, refine, and gather evidence to support the validity of the ACE-15, an assessment tool for the interrelated qualities that embody "teamness". The acronym ACE resulted from the overall intent of "assessment of clinical environments".

Methods

Step 1. Tool development

Using clinical teams' verbatim terms described in the IOM report (2012), and cross-referenced with terms used in the IPEC report (2011), we developed an initial bank of 30 Likert-type items based on the convention of generating at least twice the number of items expected in the final version of a psychometric measure (Shultz, Whitney, & Zickar, 2014). Items were anchored by a 4-point scale (*strongly disagree* to *strongly agree*), with four or more items for each of the six core qualities of teamness described above. We used two approaches to assess content validity for these items. First we assembled an international panel of eight recognized experts in IPE, collaborative practice, or measurement/assessment science. Experts were from the USA, the UK, and Canada and from the fields of decision science, evaluation, medicine, nursing, pharmacy, psychology, and sociology. Each agreed to review the 30 items vis-a-vis the IOM report and give feedback at both the conceptual (do the items link to the concept?) and technical (are the items specific, focused, and clear?) levels. All experts provided feedback. All reported strong conceptual fit between the IOM report and the items. Individual experts' lengthy and varied technical feedback was used to improve the wording of items.

Following IRB approval, we administered the 30-item ACE in face-to-face interviews with a convenience sample (n = 33) of inpatient and ambulatory care clinicians from medicine, nursing, nutrition, pharmacy, and social work. The main criterion for inclusion was that clinicians self-identified as members of stable clinical teams. Snowball sampling was used. Clinicians were either professionally known to the investigators or nominated by other clinicians. The majority of the clinicians were affiliated with the investigators' academic health centre, although some were preceptors at clinical sites in the wider network of student training sites. To assess response process, face-to-face sessions or 'cognitive interviews' were chosen over mailed surveys as an approach to improve content validity. Cognitive interviews assess respondents' understanding of items, and feedback can improve instrument design (Knafl et al., 2007). As respondents read and scored items, comments or concerns were noted by the interviewer and later used for item refinement.

We eliminated 16 of the 30 items because they had low score variance (i.e. only 1–2 of the 4 anchors per item were chosen) and therefore poorly discriminated, were redundant, or were considered confusing by respondents and/or expert panel members. One double-barrelled item was retained but divided into two, resulting in 15 items (Table 1). We ensured that one or more items remained in each of the six categories of teamness qualities. Three of the 15 items were negatively worded (to be reverse scored) to increase the care with which respondents would read items rather than simply score all

Table 1. ACE-15: Assessment for collaborative environments.

	Strongly disagree	Disagree	Agree	Strongly agree
1. Team members contribute to setting and evaluating goals for improving the practice	1	2	3	4
2. The team has a culture of mutual continuous learning	1	2	3	4
3. The team fosters a culture of continuously improving communication	1	2	3	4
4. The team is well supported by the overall organization (e.g. practice improvement is encouraged; team training is supported)	1	2	3	4
5. Team members fail to appreciate each other's values and diversity	1	2	3	4
6. Team members appreciate each other's roles and expertise	1	2	3	4
7. Team members have the autonomy to implement their part of the plan once the patient's needs and goals are clear	1	2	3	4
8. The team is effective in assigning and implementing administrative tasks (e.g. leadership, record keeping, meeting facilitation, etc.)	1	2	3	4
9. Team members do not feel safe bringing up concerns about roles and responsibilities for discussion, proactive improvement, and prevention	1	2	3	4
10. All voices on the team are heard and valued.	1	2	3	4
11. The team encourages trust by paying attention to important personal or professional connections (e.g. celebrating achievements, milestones, etc.)	1	2	3	4
12. Members of the team are active listeners and pay close attention to the contributions of others, including the patient and family	1	2	3	4
13. The team engages in routine, frequent, meaningful evaluation to improve its performance	1	2	3	4
14. Team members tend not to recognize their own limitations in knowledge and skills	1	2	3	4
15. The team constructively manages disagreements among team members	1	2	3	4

Directions: The interprofessional "health care team" refers to stable members of the care team (excluding volunteers, trainees, or others temporary team members) who provide care and support in a particular context or for a particular panel of patients. Please rate "the team" as a whole as you respond to the questions. Although some team members may differ from the majority, try to score "the team" as if it were a single entity.

items with the same anchor. The possible range of scores was 15–60, with high scores indicating high teamness. Demographic items were added to finalize the ACE-15.

Step 2. Internal structure and reliability

We assessed psychometric properties of the ACE-15 in a convenience sample of 192 interprofessional clinicians (with a small subset of non-clinician administrative staff) in urban and rural areas who self-identified as working in stable teams. Although we targeted clinicians, survey directions state that "the healthcare team refers to stable members of the care team who provide care *and support* in a particular context or for a particular panel of patients". This rather broad definition resulted in 10 respondents self-identifying as administrative staff on their teams, and we retained them in the sample because administrative staff can provide support.

Depending on clinical practice preference, we provided paper copies of the survey or sent it electronically using a secure, web-based system (LimeSurvey: www.limesurvey.org). Data management was handled by MedEdNet, an educational research network. As shown in Table 2, a majority of respondents were female and had been members of the same care team for 1 or more years. Seventeen separate health professions were represented, with the largest groups being physicians (17.2%), nurse practitioners (15.6%), dentists (11.5%), and staff RNs (8.9%). For seven respondents, professional affiliation was missing.

Approximately 95% of respondents supplied a score for every item, and eight items were scored by every subject. The seven items with missing scores had no more than three missing data points. Given the small amount of missing data, scores were calculated by imputing missing values with the average item score across subjects. Multiple imputation strategies were also employed and confirmed that this approach did not bias any parameter estimates.

As mentioned, the total number of *individual* respondents was 192. After a first wave of survey of individual clinicians (with n = 71 yield), and with IRB approval, we then focused sampling on clinical teams where individual respondents could be linked to their team, thereby allowing us to not only analyze the data of individuals but also *groups* of individuals in teams. Thus, of the 192 respondents, 121 were

Table 2. Characteristics of respondents (n = 192).

Characteristic	Category	All respondents (N = 192), n (%)
Gender[A]	Female	126 (66.3)
Profession[B]	Administration	6 (3.1)
	Attorney	1 (0.5)
	Dental assistant	4 (2.1)
	Dental hygiene	4 (2.1)
	Dentist	22 (11.5)
	Dietician	2 (1.0)
	LPN	1 (0.5)
	MA	9 (4.7)
	NP	30 (15.6)
	OT	9 (4.7)
	Office staff	3 (1.7)
	PA	1 (0.5)
	PT	2 (1.0)
	Pharmacist	8 (4.2)
	Physician	33 (17.2)
	Psychologist	1 (0.5)
	RN	17 (8.9)
	Radiation tech	1 (0.5)
	Social worker	6 (3.1)
	Respiratory Tx	2 (1.0)
	Resident physician	23 (12.0)
Time on team	<1 year	54 (28.6)
	1–2 years	50 (26.5)
	3–5 years	27 (14.3)
	≥ 5 years	58 (30.7)

[A] data on gender missing n = 2, [B] data on profession missing n = 7.

members of stable clinical teams, with 16 teams in the final sample. Teams consisted of three or more members from two or more professions. Team size ranged from 3 to 20 members (mode = 7 members), and all but two teams had between 3 and 10 members. The majority of teams (n = 12) were in urban settings (8 ambulatory and 4 hospital-based inpatient teams). Four teams, all ambulatory primary care, were in rural settings.

We used an exploratory factor analytic approach to examine the dimensionality of the ACE-15. We used maximum likelihood as the extraction method and extracted all factors with eigenvalues > 1.0. We explored several different rotation options including Varimax (orthogonal) and Oblimin (oblique). We examined the univariate and bivariate distributions of the items to assess the multivariate normality assumption underlying the maximum likelihood extraction procedure. Since conclusive evidence that the multivariate normality assumption is met is difficult to ascertain, we tested the sensitivity of the factor solution using principal axis factoring (PAF) which has been recommended in cases when multivariate normality is violated (Fabrigar, Wegener, MacCallum, & Strahan, 1999). After settling on the final factor solution, we assessed the absolute fit of the factor model with the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR). For the RMSEA, values < 0.08 are commonly used as the cutoff for acceptable model fit (MacCallum, Browne & Sugawara, 1996). For the SRMR, values < 0.08 are commonly used as the cutoff for good model fit (Hu & Bentler, 1999). We then used Cronbach's alpha, decrease in Cronbach's alpha if item deleted, and item-total correlations to assess the reliability of the final scale. ANOVA models were then used to compare ACE scores based on team member characteristics. We calculated team-level scores and standard deviations by averaging the total scores for the individuals within each team. All analyses were conducted with the R statistical computing environment (R core team, 2015).

Step 3. Relation to other variables

Finally, in a test of convergent validity using the ACE-15 and a published measure of team cohesion, we collected data from a new convenience sample of 54 individual clinicians who self-identified as practicing in inpatient and ambulatory teams. The sample for this step in validity assessment consisted of staff RNs (35.9%), nurse practitioners (32.1%), physicians (24.5%), two physician assistants, and two social workers. A majority of respondents were female (84.9%) and had been a member of the same care team for 1 or more years (90.6%).

Convergent validity refers to evidence of validity that results from a comparison of scores with another instrument assessing the same or a similar construct (Cook & Beckman, 2006). In this case, we selected as a comparison tool a brief 4-item Likert-type scale of team cohesion, with items compiled by Graetz et al. (2014) from a large number of items developed by Ohman-Strickland et al. (2007) to measure attributes of organizations. Team cohesion was loosely defined as a resource for change in organizations. The 4-item tool has a reported Cronbach alpha coefficient reliability of 0.83 (Graetz et al., 2014). These four items are written at a global rather than specific level, for example, "Our team members have constructive work relationships." We hypothesized that our construct of teamness, as measured by the ACE-15, and the construct of team cohesion are similar but not identical because they were derived from different theoretical frameworks and are defined differently. The construct of teamness resulted from the work of the IOM Committee about clinicians practicing in clinical teams, while team cohesion was based on a global organizational and change theory framework.

Results

Evidence of content validity of the ACE-15, addressed in step 1, was derived from two credible sources: an expert panel and a sample of clinicians from team-based practices. Subsequently, the results of psychometric tests of the tool in steps 2 and 3 demonstrate incremental evidence of construct validity as reflected in the internal structure of the tool and in the relation of the tool to another similar variable.

An initial exploratory factor analysis using maximum likelihood estimation resulted in a two factor solution, with one strong factor (eigenvalue = 6.74, 45% of variance explained) and one weaker factor with an eigenvalue just above 1.0 (eigenvalue = 1.29, 8.6% of the variance explained). Applying an oblimin (oblique) rotation to facilitate interpretation revealed a likely method factor with the three reverse-coded items loading separately onto the second factor (factor correlation = 0.61). We decided to test the single-factor solution given the likely method factor and the relative weakness of the second extracted factor. Table 3 shows the results from a single factor model accounting for 45% of the variance in the item set (RMSEA = 0.09, SRMR = 0.06). The RMSEA was

Table 3. Single factor solution from maximum likelihood factor analysis (n = 192).

15 Items	Standardized factor loading	SE	p-value
#1. Set and evaluate goals	0.60	0.05	<0.001
#2. Culture of mutual learning	0.70	0.04	<0.001
#3. Continuously improves communication	0.68	0.04	<0.001
#4. Supported by overall organization	0.56	0.05	<0.001
#5. Fail to appreciate values and diversity[1]	0.58	0.05	<0.001
#6. Appreciate other's roles and expertise	0.68	0.04	<0.001
#7. Have autonomy	0.60	0.05	<0.001
#8. Assign and implement admin tasks	0.65	0.05	<0.001
#9. Do not feel safe bringing up concerns[1]	0.63	0.05	<0.001
#10. All voices heard and valued	0.69	0.04	<0.001
#11. Pays attention to personal/ professional connections	0.69	0.04	<0.001
#12. Active listeners	0.76	0.03	<0.001
#13. Routine, frequent, meaningful evaluation	0.76	0.03	<0.001
#14. Tend not recognize own limitations[1]	0.37	0.06	<0.001
#15. Constructively manages disagreements	0.58	0.05	<0.001

[1] Indicates items that are reverse scored.

Table 4. Descriptive statistics of items and overall score (n = 192).

	All respondents (n = 192)		
15 Items (item scores: 1–4)	Mean (SD)	Median	Range
#1. Set and evaluate goals	3.3 (0.6)	3	1–4
#2. Culture of mutual learning	3.3 (0.6)	3	1–4
#3. Continuously improves communication	3.3 (0.6)	3	2–4
#4. Supported by overall organization	3.2 (0.7)	3	1–4
#5. Fail to appreciate values and diversity	3.2 (0.8)	3	1–4
#6. Appreciate other's roles and expertise	3.4 (0.6)	3	2–4
#7. Have autonomy	3.3 (0.6)	3	1–4
#8. Assign and implement admin tasks	3.1 (0.6)	3	2–4
#9. Do not feel safe bringing up concerns	3.1 (0.7)	3	1–4
#10. All voices heard and valued	3.2 (0.7)	3	1–4
#11. Pays attention to personal/professional connections	3.1 (0.7)	3	1–4
#12. Active listeners	3.3 (0.6)	3	2–4
#13. Routine, frequent, meaningful evaluation	3.0 (0.7)	3	1–4
#14. Tend not recognize own limitations	3.0 (0.7)	3	1–4
#15. Constructively manages disagreements	3.0 (0.5)	3	1–4
Overall score (possible score: 15–60)	47.7 (6.4)	47.5	28–60

on the border of acceptable model fit and the SRMR values indicated good fit. Cronbach's alpha, a measure of internal consistency of the 15 items, was high at 0.91 (95% CI = 0.87, 0.94). We assessed the decrease in Cronbach's alpha with each item deleted, and values stayed at or above 0.90, indicating strong internal consistency. The item-total correlations range from 0.38 (item 14) to 0.75 (items 12 and 13).

The single factor solution and high internal reliability justified summing the 15 items to create an overall score for each respondent. Scores ranged from 28 to 60 with a mean of 47.7, a median of 47.5, and a standard deviation of 6.4, and followed a roughly normal distribution except for mild negative skewness. There were no significant differences in scores between males and females, $F(1, 188) = 0.45$, $p = 0.50$, or based on length of time on the team, $F(3, 185) = 2.22$, $p = 0.09$. There were also no significant differences between the four largest professional groups (physicians, nurse practitioners, dentists, RNs), $F(3, 98) = 0.53$, $p = 0.66$; sample sizes of the other professions were too small for statistical comparison. Item level ranges indicated good variability, with a 1–4 range for 11 of the 15 items and a 2–4 range for the remainder (Table 4).

Analysis of data from only those linked to specific clinical teams (121 individuals from 16 clinical teams) showed mean team scores ranging from 43.6 to 58. Within team standard deviations, an indication of the extent to which members within teams reported similar total scores (Klein, Conn, Smith, & Sorra, 2001), ranged from a low of 1.73 to a high of 7.47. Each team was characterized by a mean score and a within-team standard deviation, where a higher mean score and a lower standard deviation indicated more teamness and less internal disagreement. Figure 1 shows these results graphically with the size of each dot pictorially representing the number of members on the team. "Ideal" teams are in the upper left quadrant of this plot with high teamness and low intra-team disagreement.

Finally, with respect to positive evidence for convergent validity, the ACE-15 was significantly correlated with the team cohesion scale ($r = 0.81$, $p < 0.001$). Internal reliability was strong for both the ACE-15 (Cronbach's alpha = 0.92) and the team cohesion scale (Cronbach's alpha = 0.85).

Discussion

As interprofessional education moves from classroom to clinical settings, it is important to identify teams with optimal teamwork qualities to be environments for training. Health professions educators need tools to help identify these teams across settings, including inpatient and community, and urban and rural. To date, few relatively brief tools with evidence of feasibility and validity across professions and clinical settings are available to aid in this process. The ACE-15 is one such tool.

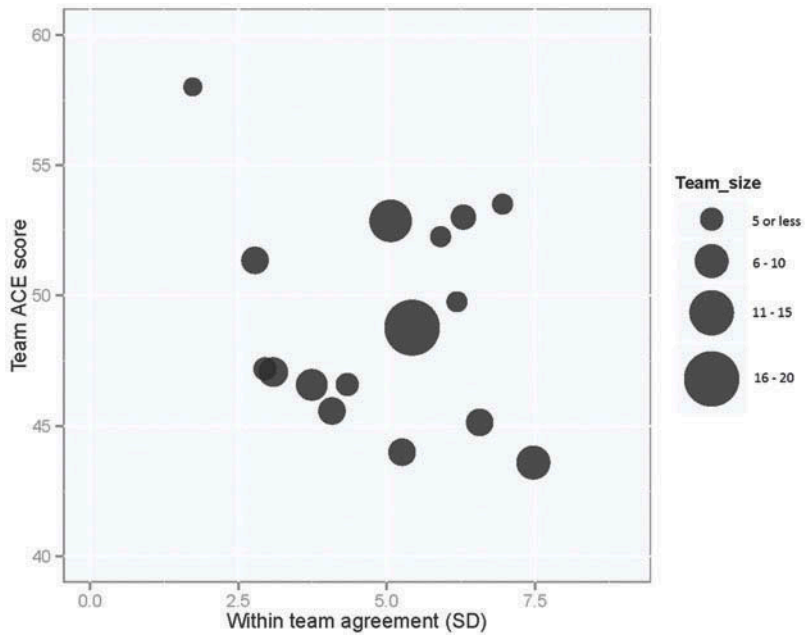

Figure 1. Team mean scores and within team agreement (N = 16 teams).

ACE-15 mean scores, both at the individual respondent and the team level, were somewhat negatively skewed (i.e. more people scoring high on the tool), possibly reflecting social desirability and/or sampling bias towards higher functioning clinicians and clinical teams. Some clinical teams showed larger standard deviations that reflect low within-team agreement. Intra-team disagreement raises important considerations for use of the tool. First, how an educator invites student reflection about a team with a higher level of disagreement may differ, for example, by using more probing questions about signs of disagreement. Thus, in considering the learning environment for trainees, a teamness score alone may be less informative than examining both the score and the standard deviation in combination.

Second, intra-team disagreement has implications for team development. In fact, over the course of this study, an interest in the tool for team development was often expressed by teams themselves given the pressure they are under for improving collaborative practice. And, as often pointed out in the psychometric and psychological literature, any assessment is by nature a type of intervention since the very process of tool or survey completion raises respondents' awareness of a situation; this is called the "question–behaviour effect" (Godin, Sheeran, Conner, & Germain, 2008; McCambridge, 2015). In this instance, taking even the 5 minutes required to complete the ACE-15 seemed to stimulate an interest in enhancing teamness.

Since clinical sites for IPE students are not static entities but rather dynamic groups of clinicians who invariably fall across such continua as stability, turnover, and developmental stage of teamness proficiency, a brief survey that motivates teams towards self-reflection and development may be useful. The recent Institute of Medicine report (2015) on measuring the impact of interprofessional education on collaborative practice notes that professional culture is an important enabling or interfering factor in interprofessional learning environments, a point that suggests the importance of team development. Thus, an incidental aspect of the ACE-15 is its potential utility for professional development and systems improvement by clinical teams themselves, and assessing this role for the ACE-15 is a direction for further study.

One goal for the ACE-15 was that the tool be acceptable to busy clinicians. Both the brevity of the final scale at 15 items requiring just 5 minutes to complete and the very low rates of missing data indicate this goal was met. One might wonder whether a simple 4-item scale, such as the team cohesion tool used in this study to test convergent validity, might do just as well as the new scale. Both tools are brief, which is an advantage of each. But because the team cohesion scale was developed from an organizational rather than individual framework, and given the IOM Committee's careful effort to ground the construct of teamness in empirical evidence from practicing teams, the ACE-15, with its more robust coverage of the theoretical construct of interest should provide better overall information for IPE educators.

There are a number of limitations to this psychometric study. The sample of clinical teams in which it has been tested to date is small, and there are gaps in types of clinical teams, such as the absence of surgical and rehabilitation teams. The only approach to reliability assessment has been Cronbach's alpha internal consistency reliability; we have not assessed test–retest reliability nor determined how sensitive the tool might be in a pre-test intervention post-test design. Future research with larger samples may be able to take advantage of modern item response theory (IRT) methods to explore whether the present tool could be shortened further. We note as well that the tool has not yet been studied in clinical settings that already have pre-licensure interprofessional learners. Finally, the tool was designed to measure teamness in stable teams. Many teams are unstable for a variety of reasons, such as code teams and larger teams with built-in high turnover. Such environments can be excellent clinical training environments for IPE learners, and further study on the utility of the ACE-15 in unstable teams is warranted.

In its recent report on IPE, the IOM (2015) urged greater alignment of education with the healthcare delivery systems in which graduates will practice. Educating students together in clinical settings is likely to positively influence their future collaborative practice behaviours and, ultimately, improve patient outcomes. It concluded that without a purposeful effort of engaging health professions educators, students, and high-functioning clinical teams, efforts to evaluate the impact of IPE will be difficult. The ACE-15 is one effort that aims to forge this link by deliberately planning interprofessional student placements to maximize their exposure to the teamwork qualities we want them to learn.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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