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Inter-Professional Education, Inter-Professional Practice and Team Science: Learning Together; Working Together

Fatimah Lateef

Department of Emergency Medicine, Singapore General Hospital, SINGAPORE

Dukes-NUS Graduate Medical School and Yong Loo Lin School of Medicine, National University of Singapore, SINGAPORE

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ABSTRACT

Inter-professional education (IPE) takes place when students from two or more professions learn about, from and with each other to enable and facilitate effective collaboration, healthcare delivery and quality health outcomes. Inter-professional practice (IPP), on the other hand, takes place when multiple healthcare personnel from different professional backgrounds work together with patients, families, caregivers and the community to deliver wholesome quality care. Both IPE and IPP bring diverse groups of professionals together. They are integrated by principles and frameworks from their various disciplines but need to work as a united and cohesive unit in tending to patients with complex healthcare issues. To be able to learn and work together, the right mindset must be inculcated from an early stage. Individuals must understand their professional identity and the roles, responsibilities and partnerships between the various professionals. The mutual trust, respect, communications and accountability are crucial elements for the synergistic work outcomes. Misperceptions and assumptions about each others' profession and discipline can be unhealthy. Inter-professional players will have to approach IPE and IPP with a committed and open mind. This paper discusses the continuum of IPE into IPP, and shares the views on high performance teams, team competencies as well as some thoughts on team science and their impact on patient care and patient safety. Finally the concept of ***interprofessionality*** is also introduced.

CORRESPONDING AUTHOR

Professor Fatimah Lateef, Senior Consultant/Director of Training and Education, Department of Emergency Medicine, Singapore General Hospital, Outram Rd, 169608 Singapore | Email: fatimah.abd.lateef@singhealth.com.sg

INTRODUCTION

Human societies today face complex challenges in health and healthcare delivery. The practice of Medicine has moved and evolved from a solo endeavour, towards group and inter-professional management as well as team-based care. One physician alone, very rarely can meet the needs of a patient in the current model of care. A wholesome therapeutic alliance between healthcare providers and patients now comprise of providers from various disciplines and specialties, as well as those seeking care, their families and caregivers. Therefore, during the early

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undergraduate years, education has to take an inter-professional approach as well (1–3). Students will start to realise how they are interdependent on other disciplines and personnel, to really function and excel in their work, in the real world. Studying separately in different schools and then having to come and work together, may not be sufficient or optimal. Some level of shared interprofessional work and projects, with a formal cross institution curriculum becomes important. Senior medical students are now doing interprofessional community-based projects with students from nursing schools, allied health schools, dental schools and even social work schools. It is becoming more apparent that inter-professional care and management is a necessity in the management of the majority of illnesses and medical problems. It is a "many helping hands approach", with all necessary "hands on deck". The closely inter-linked and inter-woven processes in healthcare makes it necessary to work together. In short, healthcare delivery today is a choreography between many professions.

Inter-professional education (IPE) takes place when students from two or more professions learn about, from and with each other to enable and facilitate effective collaboration, healthcare delivery and quality health outcomes. Regardless of healthcare professions, there is an urgent need to prepare students for the complexities of working a multi-faceted healthcare system (4–8).

Inter-professional practice (IPP), on the other hand, takes place when multiple healthcare personnel from different professional backgrounds work together with patients, families, caregivers and the community to deliver wholesome quality care.

Both IPE and IPP bring diverse groups of professionals together. They are integrated by principles and frameworks from their various disciplines but need to work as a united and cohesive unit in tending to patients with complex healthcare issues. The main difference of IPP from multidisciplinary or interdisciplinary care is that the latter will see multiple professionals working together but they retain and remain grounded in their respective ideologies and thinking (5, 8–13). In fact the current way of looking at this from the field of improvement science is that new methodologies are required to address problems in healthcare and healthcare delivery, sustainably (12, 14).

To be able to learn and work together, the mindset must be inculcated from an early stage. Individuals must understand their professional identity and the roles, responsibilities and partnerships between the various professionals. The mutual trust, respect, communications and accountability are crucial elements for the synergistic work outcomes. Misperceptions and assumptions about each other's profession and discipline can be unhealthy. Inter-professional players will have to approach IPE and IPP with a committed and open mind. The appropriate knowledge, skills and attitude need to be nurtured. In fact, leaders of the institution must lead by example in order to garner maximum buy-in from all. IPP requires a relationship with honesty, integrity, open communications and willingness to understand each other. It is also about managing egos and being a collaborative team player. If team members can work and rely on each other, teach and learn from one another and practice together for the best patient outcomes, this can bring on a higher level of individual and team satisfaction as well. IPP is also a commitment for institutions to have an operational framework that will need resources, innovation and technology to promote IPP and team-based care delivery (10–18).

AN IPP SURVEY FINDINGS

During a recent IPP training workshop attended by 250 healthcare personnel, a simple two question survey was conducted.

The 250 personnel included: 148 (59.2%) nurses, 42 (16.8%) doctors across all levels of seniority, 48 (19.2%) allied health professionals, and 12 (4.8%) administrative staff. The two questions asked were as follows:

A. Do you have to work with different professionals in your daily tasks of taking care of patients?

B. What is the most frequent challenge you face in the course of working with these different professionals?

For Question A, there was a 100% "yes" response. This showed that no one profession really works in isolation when caring for patients in an academic medical centre. Each profession may have their own practice guidelines, code of ethics and practice as well as competencies. True IPP does not just mean these different professions coming together to see and manage a patient, and sharing some core values. It involves a philosophical stand and mindset to work collaboratively for seamless delivery of care to the patient. Optimally, there must be purposeful interactions not just amongst the different professions, but also with service users and their care-givers. Being members of the inter-professional team requires commitment and energy. It is more than just working in proximity with others or being on the same shift. It encompasses elements of altruism, mutual respect and striving together for excellence in care and outcomes. IPP needs:

1. Effective leadership and governance
2. Supportive team dynamics, with shared mental models, culture and goals; and
3. Clear roles, responsibilities and ownership processes

For Question B, the top challenges include:

1. Communications issues: 176/250 (70.4%)
2. Mindset and attitude of team members: 37/250 (14.8%)
3. Time constraints and inadequate time: 12/250 (4.8%)
4. Lack of knowledge of IPP; 11/250 (4.4%)
5. Others: 14/250 (5.6%)

For the communications issues, some of the detailed sharing included inadequate sharing of information on IPP, miscommunications for a variety of reasons, delays in sharing information, lack of listening to members of the team, especially members from a different profession. Profession specific jargon also needed to be addressed.

On the mindset front, many were concerned about the ability to migrate appropriately from individual profession thinking to team thinking. They felt there were deficiencies in generating a collaborative mindset which is sustainable and thus this leads to misalignment and misunderstanding at times. Differences in opinion and practices were also brought up as challenges. Many also linked the ability to manage attitude and behaviour in IPP to the ease of building cordial, positive relationships with other professions on the team, without fear of the loss of identity or control.

Lack of dedicated time to train together, differences in schedules, shifts work hours, difficulty in getting a common time for all members to be available and attend training or meetings were also highlighted.

Other factors brought up included the blurring of lines between the practice of the different professions and specialties as well as challenges in getting buy-in from certain departments. Respect and level of confidence with each other is also important.

Barriers and Challenges to IPE/IPP

Following the simple survey above, a review to assess some of the barriers and challenges revealed certain observations.

Sunguya et al. (19) summarised the top 10 challenges to implementing IPE/IPP, succinctly, as follows:

1. Curriculum
2. Leadership
3. Resources
4. Stereotypes
5. Student diversity
6. IPE/IPP concept
7. Teaching and training
8. Enthusiasm
9. Professional jargon and
10. Accreditation

Despite all these challenges and barriers, there are many academic centres whereby IPE/IPP seem to flourish and work well. A conscious effort and call to change must have taken place in these institutions. Various disciplines and professions must have come to the realisation of their interdependence in managing complex healthcare issues. It may not be easy to come together and work together. Thus, such teams would have taken the effort to define their goals and expectations, inculcate the decision-making processes which can be practicalised with some degree of flexibility as well as establish open and closed loop communications (6, 9, 13, 18). Others may have gone further to even develop a team dashboard to include measurables. Management and leadership in these institutions too would have played a critical role to get buy in. Teams like these must also possess some conflict resolution skills as these are bound to occur, now and then (1, 12, 20).

Looking at some of the challenges in more detail, below are some of the suggested ways of viewing these with an objective towards resolution strategies (in italics) (10–12, 14–23).

1. Lack of alignment/coordination between competencies and certification. Need for policy (IP teamwork and infrastructure) enhancement to overcome administrative barriers as there is already a traditional compartmentalisation of regulating bodies.
   (*The need for review and re-organisation of policies for implementing IPE/IPP is important in order to reap maximal benefit. Management and administration in silos must be upgraded to facilitate optimal IPE/IPP. An interprofessional team can be set up to restructure and align competencies and some common curricular, including the provision of adequate collaborative training utilising multi-modalities. Some of these may be between two disciplines or professions whereas others may be multilateral, across several professions. There is no better way to prepare to manage our patients than to train together, repetitively, identify the gaps and flaws, and correcting them as we move along. For IPE/IPP to be integrated into organisation structure, it must encompass governance, education, research, strategic planning, models and standards of care, programme performance and evaluation as well as team assessment and resources made available.*)

2. The organisational infrastructure does not support or is not condusive for IPP performance enhancement.
   (*Usually this is not a major issue and there may not be a need to invest excessive amounts of funds on infrastructure. This is where software (inter-professional mindset, collaboration, buy-in from stakeholders and agreement together) can trump hardware. However, individual academic centres and institutions may have to review their set-up to see if any physical changes may facilitate IPE/IPP further.*)

3. Resources limitation e.g. Curriculum mapping and coordination, funding support. Also, a paucity of evidence based shared resources for teaching IP professionalism, ethics, communications etc.
   (*When an institution decides to take on IPE/IPP in a serious and widespread way, dedicated teams or taskforce can be appointed to look into certain issues*

e.g. curriculum, financing. It may not be necessary to have new funds and investments but more of a matter of reorganising the utilisation of the currently available funds. Also, looking into commonly utilisable e-learning and educational resources is also useful. This way, duplication can be avoided, more lean practices can be implemented, and shared resources becomes the norm across departments. Even scenario writing committees can be formed. There is real value in sharing resources and learning together.)

4. The challenge of cultural change, with the lack of research, support and targeted educational programmes. There is a major need for enhanced interaction in education and practice. This can be associated with faculty resistance.
(*This is a matter of mindset, getting buy-in and the willingness to change and evolve the methodology of medical education, pedagogy and andragogy.*)

5. Logistical challenges of scheduling across disciplines, professions and schools.
(*Commitment from leadership and heads of different departments that have to work together is crucial. Also, we have found that appointing IPE/IPP champions within the department can be instrumental to achieving success.*)

6. Lack of clarity on the part of the various parties involved. Insufficient good "train the trainers" programmes.
(*This is where good communications network, sharing of information, regular meet-ups and briefing plays a critical role for inculcating understanding and buy-in. Coming together, and also through the appointed task force, good and solid instruction programmes and training in centralised, common facilities, can be planned and coordinated.*)

7. Lack of psychometrically sound tools to assess team skills in individuals and teams.
(*This area is work in progress. There are already available team-based assessment tools and skills sets, but this is an area which will continue to develop further as we delve into topics like team science and team dynamics and practices.*)

8. Lack of good research on the relationship between performance in simulation and performance in practice as well as robust evaluation strategies to objectively demonstrate the impact of IPE on healthcare quality and safety.
(*This is a continually moving and evolving space and work continues to be done and published. It is also important to note observations and findings can be country and ethnic group specific as culture has a significant influence on team-based work, interaction and communications. At the regional and global levels, having Communities of Practice, Thought Leadership Groups on IPE/IPP and other relevant global networks can be very useful as well.*)

TEAM SCIENCE, HIGH PERFORMANCE TEAMS AND IPP

Team management is the standard of care in healthcare organisations today. High performance teams are now widely recognised as essential for a more patient-centric, coordinated and effective healthcare delivery system (24–28). A team is now viewed as a problem-solving and decision-making mechanism in organisations and institutions. This however, does not imply that the entire group must always make all decisions as a group all the time. Relevance and appropriateness must be applicable, but it is also important to realise that choices individual team members make can impact the team as a whole and influence its functions (24–30). Understanding team science will certainly help in planning and implementing strong and solid IPE/IPP programmes and training. The goal, after all, is to have high performance inter-professional teams in our institutions and academic medical centres (24, 29).

Team science refers to the study of the effects that leverage experiences for various disciplines. They also represent the team values, team dynamics and addresses the issue of team ownership. The science of team science framework has four concepts (27–30):

1. **Readiness for collaboration:** This involves mindsets, the openness to work together, the realisation that good and high performance teams have values like respect, inclusivity, strong communications skills and mutual support. They look forward to working together and know that they are inter-dependent, to achieve a positive outcome.

2. **Shared mental model:** The team members come together readily to interpret, explain, analyse and predict what is happening in terms of patient care and management. The team members know their own responsibilities as well as those of the other members.

3. **Management and planning by the team:** This involves highly professional practice, with proper management, decision making, documentation, clear objectives and goals and also proper data collection as needed.

4. **Virtual readiness:** This requires user-centric technology that enables members to discuss, support and collaborate virtually before actually physically coming together at times, to create and form the intellectual space. Even virtual training, e-learning and serious gaming can apply these days for training and mastery development.

These factors are the ones to be considered in our formation and training of teams in healthcare. They are also the values and principles which will help is handling some of the challenges and barriers discussed earlier.

Team science and team interaction research, e.g. related to human factors engineering, team dynamics, will help deepen understanding in this important area. This is also the area that is developing at an exciting new pace, integrating team theories, methodologies, frameworks of working cohesively. Team competencies and dynamic models of working are also highly relevant (31–36).

A high-performance team is dependent on how well the members work together to achieve shared goals. These teams must embody characteristics such as a common sense of purpose, clear understanding of the objectives, mutual respect and trust amongst team members, open communications with supportive team dynamics and the ability for members to realise each others' strengths and weaknesses. These are also the same elements that should underlie IPP. The specialty of Emergency Medicine (EM) has set the stage for good models of IPP. This is an area where seamless, rapid and accurate care must be provided for patients presenting with a broad spectrum of undifferentiated acute problems. Working at the front line, EM need high performance teams and inter-professional teams, to manage complex issues and diagnoses, many of which are time-sensitive in their management. Take the example of a Trauma team or a Stroke Team, which require rapid activation of different professions, once the emergency department receives a suitable patient (37). Here is where the characteristics and requirements of a high performance IPP teams are tested. Review and reflection of team performance and outcomes for patients is the acid test for team members to fill the gaps and enhance practices to meet key performance indicators (20, 25, 35).

High performance inter-professional teams are assets to institutions. They increase the efficiency, productivity and at the same time, they are able to embrace diversity.

There is often a correlation between high performance teams, strong IPP and a high-performance institution or hospital. Below are some of the characteristics they have (35):

1. Positive organisational culture
2. Receptive and responsive senior management and leadership
3. Effective performance monitoring
4. Capability to build and maintain a proficient workforce
5. Has strong expertise driven practice
6. Patient and family centric
7. Solid high performance, inter-professional teams and teamwork

INTER-PROFESSIONAL COMPETENCIES (IPC)

IPC in healthcare represents the integration of knowledge, skills and behaviour that define working together across professions, with other healthcare staff, patients and their families, as well as the community, for improved health outcomes (26, 38, 39). In setting these competencies institutions often set a generic list as a guide for allowing some degree of flexibility within certain professions, to customise accordingly. Faculty in each profession can build on and strategise to contextualise as appropriate. Other institutions may categorise the competencies as common competencies, individual professional competencies and collaborative competencies (39, 40). The latter are the ones that IPP teams need to ascribe to.

The general or common competencies are often outcomes and process driven, relationship focused and strongly linked to learning activities and continuum. These core competencies are necessary to guide professional curricular development of learning approaches and assessment strategies (40). They should provide the positive foundation for the learning trajectory of the staff. It will also embed the essential content in a healthcare professionals education. Collaborative competencies allow the practitioner to understand his role and the roles of other professions, in the team (role clarification). This knowledge is used to help the team establish patient centric management goals (40–43).

Core competencies are needed in order to create a coordinated effort across healthcare professions, to embed essential contents and implement these in the curricular of practice. They will help guide learning approaches and assessment strategies for more productive outcomes. It is also important to acknowledge that evaluation and research are part of the team activities which will strengthen the scholarship on the subject matter.

Besides the knowledge and skills aspects of competencies, good IPP also requires critical behavioural components. The following are six categories of behaviour deemed to be essential (38):

1. Communications
2. Respect
3. Altruism and caring
4. Excellence
5. Ethics
6. Accountability

Each competency can be integrated into every new experience, without compromising the others. Interprofessional collaborative practice requires a consistent culture between learning and practice that supports interprofessional collaboration competencies. There is value in groups that work together to train together and it is also part of building the esprit de corps. Today, there are various options available for teams training. Use of simulation-based training, role playing with standardised patients, partial and complex task trainers, integrated

simulators and even hybrid models are some examples. The practice to handle common team-based cases as well as rare or high risk, low volume cases is becoming standard of team practice. IP collaboration has had positive impact on healthcare in the area of patient safety as well. Thus, there is real value in optimising IPP on the broadest perspective possible (44–48).

In reviewing IPE and IPP, collaborative practice and even high performance teams, one will find many commonalities in terms of terminologies, requirements, characteristics and essential behaviour. In a more practical sense, what is important is not so much what it is called or termed as, but the execution and how it works out in practice to assist seamless healthcare delivery eventually. In many institutions, ongoing performance delivery is key and some even have incentives for meeting KPIs and targets.

Therefore, the important elements would have to be:

1. Continuous review and refinement of practice and strategies.

   This is where there needs to be a balance between academic versus practical execution. Trial period or pilot studies by end providers and faculty is crucial, as well as allowing some reflection period. Feedback will enable gaps to be addressed and capabilities to be mapped adequately, to match a set IPE/IPP standard of practice. The collection of data and inputs for scholarly study and publications will be helpful to share best practices and provide platforms for discussion.

2. A collaborative mindset, with strong bonds and thought leadership. This is getting the professions involved, listening to inputs and coming to a consensus and alignment. It can be the most challenging, yet the most critical step to ensure the final product meets the needs of all concerned.

INTERDEPENDENCE BETWEEN IPE AND IPP

Both IPE and IPP are developing fields and there are dynamic changes happening in the industry. As practice changes and evolve, education has to align appropriately. This is due to the fact that IPE and IPP are very closely linked in healthcare and the two cannot be viewed and planned in isolation. It requires alignment and tagging to patient and community as well as societal needs. As such, the term *interprofessionality* is an emerging concept today (49). It represents both the fields of IPE and IPP. The IPE part is to enhance learners' experience and outcomes, whilst the IPP is to enhance patient care outcomes. The goal of IPE is to prepare a "collaborative practice ready" work force in healthcare, driven by the local health needs and local healthcare systems. It is also about nurturing students who will come out to practice and be ambassadors who will break down professional silos and help enhance collaborative and non-hierarchical relationships in efficient and effective teams.

REFERENCES

1. Nester J. The importance of interprofessional practice and education in the era of accountable care. North Carolina Med J. 2016;77(2):128–32. https://doi.org/10.18043/ncm.77.2.128

2. Owen JA, Schmitt MH. Integrating interprofessional education into continuing education: a planning process for continuing interprofessional education programs. J Contin Edu Health Prof. 2013;33(2):109–17. https://doi.org/10.1002/chp.21173

3. Lee B, Celetti F, Makino T, Matsui H, Watanabe H. Attitudes of medical schools deans towards IPE in western pacific region countries. J Interprof Care. 2012;26:479–83.

4. Rotz ME, Dueñas GG, Grover AB, Headly A, Parvanta CF. Exploring first year pharmacy and medical students experiences during a longitudinal interprofessional education program. Pharm Teach Learn. 2015;7:302–11. https://doi.org/10.3109/13561820.2012.706336

5. Phillips JB. Social work and interprofessional education in healthcare: a call for continued leadership. J Soc Work Educ. 2016;52:18–29. https://doi.org/10.1016/j.cptl.2014.12.002

6. Devonshire L, Worzniak H. Working together: developing e-learning activities to promote interprofessional learning. Synergy. 2006;23:25–7. https://doi.org/10.1080/10437797.2016.1112629

7. Samarasekera DD, Ooi S, Yeo SP, Hooi SC. Medical education in Singapore. Med Teach. 2015;37(8):707–13. https://doi.org/10.3109/0142159X.2015.1009026

8. Bansal P, Jamkar A. Faculty development in health professional education – the health sciences university models – interprofessional leadership in action. In: Forman D, Jones M, Thistlethwaite, editors. Leadership development for interprofessional education and collaborative practice. London: Palgrave Macmillan; 2014. p. 151–61.

9. Guraya SY, Barr H. The effectiveness of interprofessional education in healthcare: a systematic review and meta-analysis. Kaohsiung J Med Sciences. 2018;34:160–5. https://doi.org/10.1016/j.kjms.2017.12.009

10. Stull CL, Blue CM. Examining the influence of professional identity formation on the attitudes of students towards interprofessional collaboration. J Interprof Care. 2016;30:90–6. https://doi.org/10.3109/13561820.2015.1066318

11. Guraya SY, Guraya SS, Almaramhy HH. The legacy of teaching medical professionalism for promoting professional practice: a systematic review. Biomed Pharmacol J. 2016;9:809–17. https://doi.org/10.13005/bpj/1007

12. Framework for action on IPE and collaborative practice. World Health Organization, 2010 [cited 9 January 2019]. Available at: http://www.who.int/hrh/nursing_midwifery/en/

13. Bridges DR, Davidson RA, Odegard PS, Maki IV, Tomkowiak J. Interprofessional collaboration: three best practice models of interprofessional education. Med Educ Online. 2011;16:6035. https://doi.org/10.3402/meo.v16i0.6035

14. Banfield V, Lackie IC. Performance-based competencies for culturally responsive interprofessional collaborative practice. J Interprof Care. 2009;23:611–20. https://doi.org/10.3109/13561820902921654

15. Herath C, Zhou YF, Gan Y et al. A comparative study of interprofessional education in global healthcare: a systematic review. Medicine. 2017;96(38):e7336. https://doi.org/10.1097/MD.0000000000007336

16. Watters C, Reedy G, Ross A, Morgan NJ, Handslip R, Jaye P. Does interprofessional simulation increase self-efficacy: a comparative study. BMJ Open. 2015;5(1):e005472. https://doi.org/10.1136/bmjopen-2014-005472

17. Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, et al. Health professionals for a new century: transforming education to strengthen healthcare systems in an interdependent world. Lancet. 2010;376(9756):1923–58. https://doi.org/10.1016/S0140-6736(10)61854-5

18. Reese CE, Jeffries PR, Engum SA. Learning together using simulation models. Nursing and medical student's collaboration. Nurs Educ Perspectives. 2010;31(1):33–7.

19. Sunguya BF, Hinthong W, Jimba M, Yasuoka J. IPE for whom? Challenges and lessons learned from its implementation in developed countries and their application to developing countries: a systematic review. PLoS One. 2014;9(5):e96724. https://doi.org/10.1371/journal.pone.0096724

20. Hammick M, Olckers L, Campion-Smith C. Learning in interprofessional teams: AMEE Guide No 38. Med Teach. 2009;31(1):1–12. https://doi.org/10.1080/01421590802585561

21. Reeves S, Fletcher S Barr H, Birch I, Boet S, Davies N, McFadyen A, Rivera J, Kitto S. A BEME systematic review of the effects of IPE. BEME Guide No. 39. Med Teach. 2016;38(7):656–68. https://doi.org/10.3109/0142159X.2016.1173663

22. Chekwa C, Thomas E. Is interprofessional conflict a death sentence to team building. Int J Bus and Pub Admin. 2013;10(2):30–44.

23. Reedy GB, Lavelle M, Simpson T, Anderson JE. Development of the human factors skills for healthcare instrument: a valid and reliable tool for assessing interprofessional learning across healthcare practice settings. BMJ Simul Technol Enhanc Learn. 2017;3(4):135–41. https://doi.org/10.1136/bmjstel-2016-000159

24. Palaganas JC, Epp SC, Raemer DB. A history of sim-enhanced interprofessional education. J Interprof Care. 2014;28(20): 110–5. https://doi.org/10.3109/13561820.2013.869198

25. Thannhauser J, Russel-Mayhew S, Scott C. Measures of interprofessional education and collaboration. J Interprof Care. 2010;24(4): 336–49. https://doi.org/10.3109/13561820903442903

26. Curran V, Hollet A, Casimirolm et al. Development and validation of the interprofessional collaborator assessment rubric (ICAR). J Interprof Care. 2011;25(5):339–44. https://doi.org/10.3109/13561820.2011.589542

27. Little MM, St Hill CA, Ware KB et al. Team science in interprofessional collaboration research practice: a systematic review of the science of team science literature. J Investig Med. 2017;65(1): 15–22. https://doi.org/10.1136/jim-2016-000216

28. Baker B. The science of team science: an emerging field delves into the complexities of effective collaboration. BioScience. 2015;65:639–44. https://doi.org/10.1093/biosci/biv077

29. Berwick DM. The 'science of improvement'. JAMA 2008;299(10):1182–4. https://doi.org/10.1001/jama.299.10.1182

30. Hall KL, Feng AX, Moser RP, Stokols D, Taylor BK. Moving the science of team science forward: collaboration and creativity. Am J of Prev Med. 2008;35(2):S243–9. https://doi.org/10.1016/j.amepre.2008.05.007

31. Salas E, Diaz Granadas D, Weaver SJ, King H. Does team training work? Principles for health care. Acad Emerg Med. 2008;15(11):1002–9. https://doi.org/10.1111/j.1553-2712.2008.00254.x

32. Zucker D. Develop your career in an age of team science. J Investig Med. 2012;60:779–84. https://doi.org/10.2310/JIM.0b013e3182508317

33. Steer CJ, Jackson PR, Hornbeak H, McKay CK, Sriramarao P, Murtaugh MP. Team science and the physician-scientist in the age of grand health challenges. Ann N Y Acad Sci. 2017;1404(1):3–16. https://doi.org/10.1111/nyas.13498

34. Mallinson T, Latrecchiano GR, Schwartz LS, Furniss J, Leblanc-Beaudoin T, Lazar D, Falk-Krzesinski HJ. Pilot analysis of the motivation assessment for team readiness, integration and collaboration (MATRIC) using Rasch analysis. J Investig Med. 2016; 64(7):1186–93. https://doi.org/10.1136/jim-2016-000173

35. Qureshi Y, Dhaliwal K. High performance teams: necessary in a healthcare setting? Bangladesh J of Med Sci. 2016;15(1):10–4. https://doi.org/10.3329/bjms.v15i1.27138

36. Puga F, Stevens RR, Patel DI. Adopting best practices from team science in a healthcare improvement research network: the impact of dissemination and implementation. Nurs Res Pract. 2013;2013:814360. https://doi.org/10.1155/2013/814360

37. McHugh M, Neimeyer J, Powell E, Khare RK, Adams JG. Is the ED quality related to other hospital quality domains? Acad Emerg Med. 2014;21;551–7. https://doi.org/10.1111/acem.12376

38. Toronto Academic Health Sciences Network Practice Committee and University of Toronto for Interprofessional Education at the University Health Network. Interprofessional care competency framework and team assessment toolkit. 2017 [cited 9 January 2019]. Available at: https://ipe.utoronto.ca/tools-resources/tools-toolkits

39. McMaster University Programme for IPP, Education and Research. Description of IPE activities and competencies. n.d. [cited 9 January 2019]. Available at http://piper.mcmaster.ca/ipe/

40. Salvati L, Bright D, deVoest M, Meny L, VanLangen K. An approach for the development and implementation of an assessment tool for IPE learning activities. Innovations in Pharmacy. 2017;8(4):1–8. https://doi.org/10.24926/iip.v8i4.930

41. Busari JO, Moll FM, Duits AJ. Understanding the impact of interprofessional collaboration on the quality of care: a case report from a small-scale resource limited health care environment. J of Multidisciplinary Healthcare. 2017;10:227–34. https://doi.org/10.2147/JMDH.S140042

42. Suter E, Arndt J, Arthur N, Parboosingh J, Taylor E, Deutschlander S. Role understanding and effective communications as core competencies for collaborative practice. J Interprof Care. 2009;23(1):41–51. https://doi.org/10.1080/13561820802338579

43. Ahluwalia SC, Damberg CL, Silverman M et al. What defines a high-performing health care delivery system: a systematic review. Jt Comm J Qual Patient Saf. 2017;43(9):450–9. https://doi.org/10.1016/j.jcjq.2017.03.010

44. Taitz JM, Lee TH, Sequist TD. A framework for engaging physicians in quality and safety. BMJ Qual Saf. 2012;21:722–8. https://doi.org/10.1136/bmjqs-2011-000167

45. Pinar G. Simulation-enhanced IPE in healthcare. Creative Educators. 2015;6:1852–59. https://doi.org/10.4236/ce.2015.617189

46. Davis DL, Hercelinsky JG, Jackson LM. Promoting IP collaboration: a pilot project using simulation in the virtual world of second life. J of Research in Interprof Pract and Educ. 2016;6(2):1–15. https://doi.org/10.22230/jripe.2017v6n2a225

47. Kvarnstrom S. Difficulties in collaboration: a critical incident study of IP healthcare teamwork. J of Interprof Care. 2008;22(2):191–203. https://doi.org/10.1080/13561820701760600

48. Wong HWA, Ruppel H, Gang M, Ng G. “The safety dance”: a faculty development workshop partnering IPE and patient safety initiatives using simulation-based education. Associationn of American Medical Colleges. 2016;12:10440. http://dx.doi.org/10.15766/map_2374-8265.10440

49. D’Amour D, Oandasan I. Interprofessionality as the field of IPP and IPE: an emerging concept. J of Interprof Care. 2005;19(Suppl.1):8–20. https://doi.org/10.1080/13561820500081604