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RESEARCH ARTICLE

Comprehensive Evaluation of Medical Students' Teamwork Skills

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ABSTRACT

Background: Teamwork plays a pivotal role in patient care and safety promotion. "TeamSTEPPS Teamwork Attitudes Questionnaire" (T-TAQ) aims to the assessment of attitudes of care providers regarding teamwork when enrolled in a series of TeamSTEPPS-based scenarios; among them, cooperation in mass casualty scenarios, medical error simulations, and other virtual learning experiences. However, the use of T-TAQ could be expanded into the evaluation of medical students' collaboration capacity in a series of educational tasks such as the management of a simulated clinical scenario within the context of a university course.

Aim: To prospectively explore teamwork performance of Greek medical students in simulated clinical scenarios in the undergraduate course of Ophthalmology.

Methods: This is a prospective, descriptive study. All fifth-year medical students attending the undergraduate course of Ophthalmology were asked to form teams, each one had to select a simulated clinical ophthalmological scenario and present the outcomes of their project. Scenarios were case reports from patients that visited the outpatients' service of the Department during the previous six months. A custom Greek version of the T-TAQ containing 29 5-scale Likert-type items in five subscales (team structure, leadership, situation monitoring, mutual support and communication) was used to evaluate students' attitudes on the overall procedure. T-TAQ scores were evaluated with gender, residence and other parameters.

Results: 102 students participated in this project. Students presented average total T-TAQ score (3.48±0.99) with non-significant differences regarding gender ($p=0.38$) and residence ($p=0.58$). Non-significant differences were detected for all subscale scores, as well (all $p>0.05$). Significant correlation was detected between team project performance and team structure ($R^2=0.375$, $p=0.04$), mutual support ($R^2=0.463$, $p=0.02$), and total T-TAQ score ($R^2=0.349$, $p=0.05$). Additionally, readiness to form teams showed significant correlation with total T-TAQ score ($R^2=0.512$, $p<0.01$) and project performance ($R^2=0.444$, $p=0.01$). However, non-significant correlation was identified between T-TAQ score and students' final grades in the Ophthalmology course ($R^2=0.015$, $p=0.28$).

Conclusion: Greek medical students demonstrated average T-TAQ scores. Medical schools should also focus on the development of collaboration skills for their medical students and possibly enroll teamwork initiatives to their curricula.

Keywords: Medicine; Medical Education; Communication; Leadership; Collaborative Learning; Patient Simulation

Introduction

It is a truism that teamwork plays a pivotal role in patient care and safety promotion[1]. There is no doubt that effective team communication and coordination can improve patient outcomes[2,3]. World Health Organization (WHO) suggests that poor communication among health care professionals constitutes one of the primary causes of medical errors[4]. According to the 1999 US Institute of Medicine (IOM) report To Err Is Human, annual patient deaths from medical errors in the USA were estimated between 44,000 and 98,000[5]. Medical error fatalities have steadily risen and in 2013 they were estimated to 400,000[6]. Further to the potential devastating impact on patients' health, medical errors' economic impact on National Healthcare Systems (NHS) is equally important. The International Society for Pharmacoeconomics and Outcomes Research (ISPOR) reported that, in 2009, the total annual cost of measurable medical errors in the US was over $1 billion and the mean cost per error to the hospitals was $892[7].

As a result, introducing strategies that improve the structure and quality of information exchange is of vital importance for NHS settings[8-10]. The organization and training of innovative multidisciplinary teams of physicians, nurses and other paramedical staff is necessary[11]. The efficiency and performance of these multidisciplinary teams can be evaluated with specific tools and methods. For instance, the Mayo High Performance Teamwork scale (MHPTS) is a 16-item scale that measures in a brief, practical and reliable way crisis resource management (CRM) skills to assess the teamwork performance as well as the effectiveness of team training[12]. Other self-assessment instruments for the evaluation of the behaviour of multidisciplinary teams of care providers are available, as well[11,13-14].

A prevalent teamwork-training program is the TeamSTEPPS® (Strategies and Tools to Enhance Performance and Patient Safety)[15]. This program was developed in 2006 by the Agency for Healthcare Research and Quality (AHRQ) in collaboration with the Department of Defense (DoD)[16]. The TeamSTEPPS® was designed to improve participant knowledge, attitudes and skills in different core areas in order to reduce medical errors and promote patient safety. Within this context, a specific tool, named "TeamSTEPPS Teamwork Attitudes Questionnaire" (T-TAQ) was constructed to measure attitudes towards the core components of teamwork in healthcare that are captured within TeamSTEPPS®[17]. Specifically, this questionnaire consists of five core components: team structure, leadership, situation monitoring, mutual support, and communication[17,18].

T-TAQ use in clinical settings aims to the assessment of attitudes of care providers regarding teamwork when enrolled in a series of TeamSTEPPS-based scenarios; among them, cooperation in mass casualty scenarios, medical error simulations, and other virtual learning experiences[19,20]. Consequently, the T-TAQ can be used to evaluate particular needs within health units or health care institutions as well as the effectiveness of the TeamSTEPPS intervention programs[21].

However, apart from the assessment of attitudes in clinical settings, the use of T-TAQ could be expanded into the evaluation of medical students' collaboration capacity in a series of educational tasks such as the management of a simulated clinical scenario within the context of a university course[11,18,22,23]. In order to address successfully the clinical scenario, medical students working in groups should present a number of skills. Professionalism, demonstration, and ingenuity as well as creativity consist some of the most important skills that should be presented. Additionally, other skills are critical as well; among them verbal and visual communication, credence and confidence, teamwork and the collaborative effort[24]. Unfortunately, the majority of medical schools' curricula primarily focus on the development of clinical skills and professional conduct for their medical students and neglect the cultivation of communication skills and team-working spirit. Therefore, the majority of medical doctors have actually no systematic training in their undergraduate studies in order to become an efficient member of medical or multidisciplinary team in a hospital setting. Within this context, primary objective of this study was to explore teamwork performance of Greek medical students in a simulated clinical scenario in the undergraduate course of Ophthalmology and explore potential correlations with demographic and other parameters.

Materials and Methods

Settings

This is a prospective, descriptive study that was conducted at the Department of Ophthalmology in the University Hospital of Alexandroupolis, in Greece, between December 2018 and May 2019.

Participants

All fifth-year medical students attending the undergraduate course of Ophthalmology at the Medical School of Democritus University were enrolled in the study. Students were assigned a compulsory project, explained as follows (figure 1):

a) students were asked to form twenty teams of five or six participants,

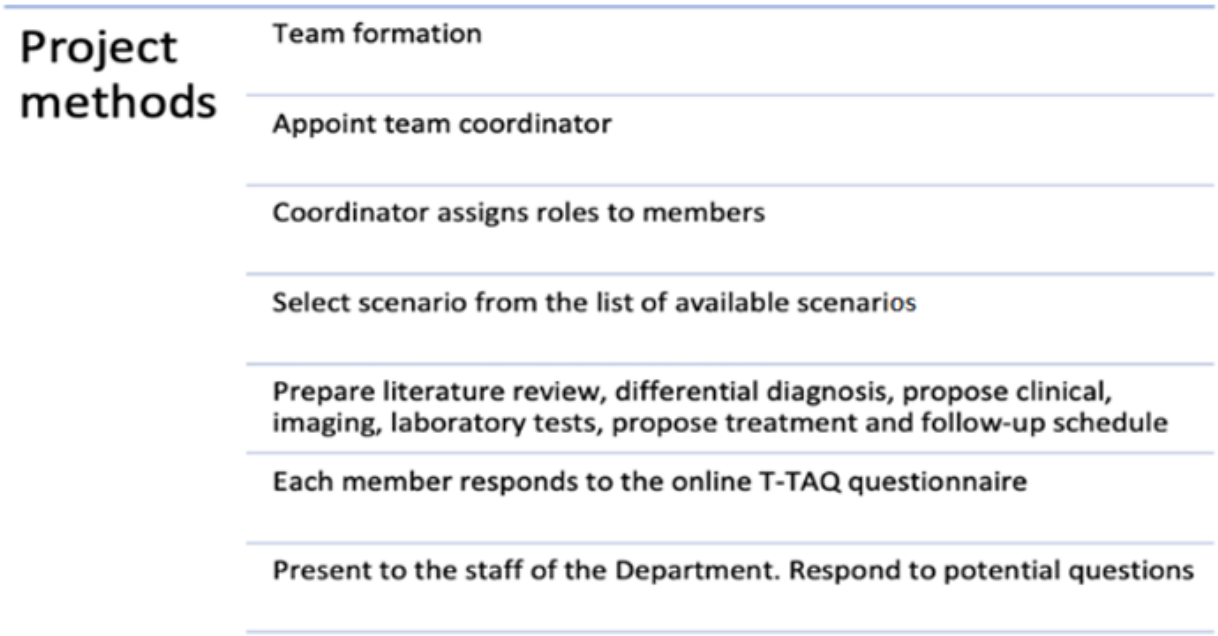
b) each team had to appoint a team coordinator,

c) team coordinators had to assign exact tasks (roles) for each group member. The tasks for each member were literature review, presentation development in Keynote or Powerpoint, oral presentation, critical review of project.

d) teams had to select a simulated clinical scenario from a predefined pool of twenty scenarios of equal difficulty. Scenarios were case reports from patients that visited the outpatients' service of the Department during the previous six months. Student teams had to provide detailed information on the differential diagnosis, testing, therapeutic proposal, and a literature review of the underlying disease. For example, "a 20-year-old female, contact lens user visited our service with red eyes and itching".

e) teams had to present the outcomes of their project to the staff of the department in a Powerpoint or Keynote presentation and respond to potential questions.

Figure 1. Project methods



Teams were allowed a maximum of five days to declare at the Department's Secretariat their team formation, team coordinator and member roles. Only then, they were allowed to select a simulated scenario. When a team selected a scenario, it was removed from the pool of available scenarios. The earlier the teams registered to the Secretariat and selected their project, the higher their readiness to form teams was considered.

Data collection – Instrument

All teams were allowed 3 weeks to complete their projects. Each team's performance was evaluated by the staff of the department in a scale from 1 to 10 (excellent). Prior to the team presentation, each team member was provided with a webpage link that directed to an online survey regarding his/her attitudes on the overall procedure. The survey was based on a custom Greek version of the T-TAQ that contained 29 5-scale Likert-type items in five subscales: team structure (6 items), leadership (7 items), situation monitoring (6 items), mutual support (6 items), and communication (4 items). T-TAQ total and subscale scores were evaluated with gender, permanent residence, scenario score, final grade in the course of Ophthalmology and readiness to form their team.

Statistical analysis

All data were collected in a database (Excel, Microsoft, Redmond, WA, USA) and analysed statistically with the SPSS software version 20.0 for Windows (SPSS Inc., IBM Corp. Chicago, Illinois, USA). Data distribution was evaluated using Shapiro-Wilk test. Normally distributed data were assessed with independent samples Student's t-test. Non-normally distributed data were assessed with Mann–Whitney U test. All statistical tests were two-tailed. P-values lower than 0.05 were considered statistically significant.

Results

All one hundred and two fifth-year medical students who registered for the undergraduate ophthalmology course participated in the groups' formation and completed the project. Detailed demographic data of students are presented in table 1.

Table 1. Study participants	
Parameters	
Students (*n*)	102 (41 men, 61 women)
Age (years) (mean ± SD)	23.5 ± 0.7
Residence (*n*)	Urban: 28, Rural: 74
Exam score in the course of Ophthalmology (range 0-10) (mean ± SD)	7.94 ± 0.75

n: number of students; SD: Standard Deviation

Overall project score, total T-TAQ and subscale scores are presented in table 2. Students presented average total T-TAQ score (3.48 ± 0.99) with non-significant differences regarding gender (p = 0.38) and residence (p = 0.58). Non-significant differences were detected for all subscale scores, as well (all p > 0.05). Correlations of the total T-TAQ and subscale scores with team's project performance are presented in table 3. Significant correlation was detected between team project performance and team structure (R^2 = 0.375, p = 0.04), mutual support (R^2 = 0.463, p = 0.02), and total T-TAQ score (R^2 = 0.349, p = 0.05).

Table 2. T-TAQ scores according to sex and residence (mean ± SD)						
Parameters	**Gender**			**Residence**		
	Male	**Female**	**p value**	**Urban**	**Rural**	**p value**
Project performance score	6.65 ± 0.74	7.06 ± 0.76	0.16	7.02 ± 0.71	6.90 ± 0.80	0.70
Team structure score	3.23 ± 1.04	3.53 ± 0.73	0.34	3.26 ± 0.92	3.51 ± 0.81	0.44
Leadership score	3.37 ± 1.14	3.82 ± 0.27	0.24	3.59 ± 0.60	3.73 ± 0.71	0.61
Situation monitoring score	3.28 ± 1.07	3.43 ± 0.72	0.65	3.33 ± 0.60	3.40 ± 0.91	0.83
Mutual support score	3.22 ± 1.12	3.42 ± 0.84	0.57	3.11 ±0.90	3.45 ± 0.93	0.35
Communication score	3.42 ± 0.94	3.53 ± 0.93	0.76	3.36 ± 0.88	3.55 ± 0.95	0.60
TOTAL T-TAQ score	3.33 ±1.01	3.58 ± 0.60	0.38	3.39 ± 0.64	3.55 ± 0.78	0.58

SD: Standard Deviation; T-TAQ: TeamSTEPPS Teamwork Attitudes Questionnaire

Table 3. Correlation between T-TAQ scores and project performance score		
	Project performance score	
	R^2	p value
Team structure score	0.375	0.04[a]
Leadership score	0.054	0.85
Situation monitoring score	0.134	0.62
Mutual support score	0.463	0.02[a]
Communication score	0.127	0.29
TOTAL T-TAQ score	0.349	0.05[a]

T-TAQ: TeamSTEPPS Teamwork Attitudes Questionnaire

[a]P ≤ 0.05

Readiness to form teams showed significant correlation with total T-TAQ score (R^2 = 0.512, p < 0.01) and project performance (R^2 = 0.444, p = 0.01). In fact, the first five teams which registered at the Department's Secretariat had significantly better total T-TAQ (3.74 ± 1.21, 3.17 ± 0.86, p = 0.03), team structure (3.91 ± 0.83, 3.01 ± 1.21, p = 0.04), mutual support (3.72 ± 1.06, 2.99 ± 1.23, p = 0.01) and communication scores (4.02 ± 0.75, 3.03 ± 0.99, p = 0.01) than the last five ones (table 4).

Table 4. T-TAQ scores according to the readiness to form teams (mean ± SD)			
Parameters	Groups 1-5	Groups 15-20	p value
Project performance score	7.65 ± 0.89	6.35 ± 1.02	0.01[b]
Team structure score	3.91 ± 0.83	3.01 ± 1.21	0.04[b]
Leadership score	3.62 ± 1.01	3.44 ± 0.95	0.14
Situation monitoring score	3.42 ± 0.85	3.28 ± 1.02	0.23
Mutual support score	3.72 ± 1.06	2.99 ± 1.23	0.01[b]
Communication score	4.02 ± 0.75	3.03 ± 0.99	0.01[b]
Total T-TAQ score	3.74 ± 1.21	3.17 ± 0.86	0.03[b]

SD: Standard Deviation; T-TAQ: TeamSTEPPS Teamwork Attitudes Questionnaire

[b]P ≤ 0.05

However, non-significant correlation could be identified between students' total T-TAQ score and their final grades in the course of Ophthalmology (R^2 = 0.015, p = 0.28).

Discussion

Team is defined as a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by others as an intact social entity embedded in one or more larger social systems and who manage their relationships across organizational borders[25]. Different kinds of teams are found in Healthcare Systems; among them, the project (ie. quality improvement teams) and the

management teams (ie. geriatric medicine teams)[26].

On the other hand, teamwork in care delivery systems is defined as the "interaction or relationship of two or more health professionals who work interdependently to provide care for patients"[10]. Teamwork implies that all team members are mutually, but not necessarily equally accountable to provide care[27]. Therefore, physicians should identify themselves as members of a team that: are mutual dependent, are working collaboratively for patient-centered care, and share information, which leads to shared decision-making.

Care provision in the 21st century has undergone tremendous development. In clinical settings, high-end technology is used for the prevention, the diagnosis and the therapy of diseases. In order to address the mandates of modern medicine, physicians depend heavily on other physicians, nurses, operators, clerks and the rest of care providers. Inability of any physician to become an effective collaborator increases the risk of medical error and contributes significantly to suboptimal outcomes[28].

Furthermore, due to the rising prevalence of patients with chronic conditions that need multiple dimensions of care, healthcare professionals should be able to work in teams properly. These patients need to be treated holistically by different professionals, whose collaboration is vital in order to achieve the best outcomes for the patient[28].

Literature suggests that specific competencies that promote collaboration can be learned[29,30]. Unfortunately, the majority of medical schools focuses almost solely on the clinical skills development for their students and neglect the cultivation of collaboration competencies[31,32]. As far as medical students' communication skills are concerned, they are taught extensively how to communicate with patients but they receive no guidance on how to cooperate with peers[28].

Within this context, primary objective of this study was to evaluate the capacity of a series of teamwork competencies in our Medical School's fifth-year students who were assigned a compulsory project in the undergraduate course of Ophthalmology. Each project constituted a simulated scenario of a patient seeking care in an outpatient's ophthalmology setting. We selected the T-TAQ questionnaire since it is a prevalent tool for assessing teamwork performance in clinical settings.

Certain interesting conclusions derive from the outcomes of our study. Medical students presented average scores in all subscales and in the total T-TAQ scores. Non-significant differences could be identified between men and women and between urban or rural residents. Aforementioned outcomes were expected, since no specific teamwork course exists in our schools' curriculum.

However, teams that presented higher T-TAQ scores presented also better scores in their compulsory project. Consequently, this fact proves that better teamwork performance was associated with improved overall management of the scenario they selected. The primary contributors for the improved

performance were the team structure and the mutual support. It is known that team structure is a fundamental prerequisite for effective team performance. In our case, students were freely allowed to populate teams based on their own criteria. For those teams that all their student-members were voluntary enrolled, group coherence was ensured, and coordinator appointment and task assignment became an easy and fast process. These teams were the first to register to the Department's Secretariat and select their project. For the remaining teams, group formation, coordinator selection and tasks assignment were not an easy process, so these teams were the last to register. The latter teams presented significant lower scores in T-TAQ, in almost all subscale scores, and in project performance.

It should be mentioned that no significant correlation could be detected between the student's overall grade in the course of Ophthalmology and his/her T-TAQ score. Aforementioned finding indicates that the syllabus structure and the examination of course is solely based on the student's individual effort and performance and does not take into account potential collaboration competencies.

Nevertheless, the curriculum of the medical schools should foster group dynamics and mutual support, develop critical thinking, improve communication, leading and, in general, teamwork skills, as well as motivate learners to explore their hidden capacities of self-confidence and self-directed learning[33-35]. In order to achieve this outcome, a collaborative environment within medical school should be created where ideas are shared and discussed. Without teamwork skills cultivation during medical school, students can develop a competitive and individualistic behaviour, which could affect their future patients' care. It is demonstrated that the educational program of medical schools should be enriched with methods that promote student collaboration in order to create future physicians who are able to cooperate effectively[28].

Literature review returned no studies with similar methods, so we cannot directly compare our outcomes with former reports. However, TeamSTEPPS® training of health professional students followed by different medical error simulation sessions has been reported. The T-TAQ has been used to evaluate changes in the attitudes of participants toward teamwork before and after training and simulation scenarios. According to Motycka *et al*[22], significant improvement in medical, nursing and pharmacy students' attitudes was observed after training in all five teamwork categories (team structure, leadership, situation monitoring, mutual support and communication). Additionally, in another study[23], a presentation of the TeamSTEPPS® curriculum in a Virtual Learning Environment and the completion of three scenarios by health professional (nursing, occupational therapy, medical, and social work) students took place. Significant changes were found in students' attitudes in the four categories of leadership, situation monitoring, mutual support and communication ($p < 0.05$)

between the answers in the T-TAQ prior to and after the completion of the scenarios.

Another simulated scenario regarding obstetric emergency involving the management of dystocia and hemorrhage in a young woman has been described[36]. Thirty-five transdisciplinary women's health students including nurse practitioner and physician assistant students, undergraduate nursing, medical students, and obstetrics-gynecology residents collaborated with each other. Following the scenario completion, a significant increase in collaborative attitudes for mutual support and communication was observed in comparison with the pretest scores. However, no significant increase was found in attitudes for structure, situation monitoring and leadership. Finally, a significant improvement in a large-scale interprofessional TeamSTEPPS-based training involving four student professions has been reported[37]. Specifically, team structure, situation monitoring, mutual support and communication among TeamSTEPPS® skills showed a significant attitudinal increase compared to preassessment scores.

Conclusion

Among the objectives of the present study was to explore the teamwork performance among medical students, and provide data that could be used both for similar comparative trials in other Schools and to determine the efficacy of integrated teamwork courses. Greek medical students demonstrated average T-TAQ scores. As a result, it seems that further to the development of clinical skills, medical schools should focus on the development of collaboration skills for their medical students and possibly enroll teamwork initiatives to their curricula.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this paper.

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References

1. Manser T. Teamwork and patient safety in dynamic domains of healthcare: a review of the literature. *Acta Anaesthesiol Scand.* 2009; 53:143–151.
doi: 10.1111/j.1399-6576.2008.01717.x.

2. Davenport DL, Henderson WG, Mosca CL, Khuri SF, Mentzer RM Jr. Risk adjusted morbidity in teaching hospitals correlates with reported levels of communication and collaboration on surgical teams but not with scale measures of teamwork climate, safety climate, or working conditions. *J Am Coll Surg.* 2007;205:778–784.
doi: 10.1016/j.jamcollsurg.2007.07.039.

3. Risser DT, Rice MM, Salisbury ML, Simon R, Jay GD, Berns SD. The potential for improved teamwork to reduce medical errors in the emergency department. The Med Teams Research Consortium. *Ann Emerg Med.* 1999; 34:373–383.
doi: 10.1016/s0196-0644(99)70134-4.

4. World Health Organization. Medication Errors: Technical Series on Safer Primary Care. Geneva: World Health Organization; 2016. Licence: CC BY-NC-SA 3.0 IGO. Accessed August 13, 2022.
https://apps.who.int/iris/bitstream/handle/10665/252274/9789241511643-eng.pdf?sequence=1&isAllowed=y.

5. Kohn LT, Corrigan JM, Donaldson MS. To err is human: Building a safer health system. Washington, DC: National Academy Press, Institute of Medicine, 1999

6. James JT. A new, evidence-based estimate of patient harms associated with hospital care. *J Patient Saf.* 2013;9:122–128.
doi: 10.1097/PTS.0b013e3182948a69.

7. David G, Gunnarsson CL, Waters HC, Horblyuk R, Kaplan HS. Economic measurement of medical errors using a hospital claims database.*Value Health.* 2013;16:305–310.
doi: 10.1016/j.jval.2012.11.010.

8. Bhutta ZA, Chen L, Cohen J, et al. Education of health professionals for the 21st century: a global independent Commission. *Lancet.* 2010;375:1137–1138.
doi: 10.1016/S0140-6736(10)60450-3.

9. Mochan E, Nash DB. Weaving quality improvement and patient safety skills into all levels of medical training: an annotated bibliography. *Am J Med Qual.* 2015;30:232–247. doi: 10.1177/1062860614528568. Epub 2014 Mar 31.

10. Institute of Medicine (US) Committee on the Health Professions Education Summit; Greiner AC, Knebel E, editors. Health Professions Education: A Bridge to Quality - *Washington (DC): National Academies Press (US), 2003*

11. Gordon CJ, Jorm C, Shulruf B, et al. Development of a self-assessment teamwork tool for use by medical and nursing students. *BMC Med Educ.* 2016;16:218.
doi: 10.1186/s12909-016-0743-9.

12. MalecJF, Torsher LC, Dunn WF, et al. The mayo high performance teamwork scale: reliability and validity for evaluating key crew resource management skills. *Simul Healthc.* 2007;2:4–10.
doi: 10.1097/SIH.0b013e31802b68ee.

13. Weller J, Frengley R, Torrie J, et al. Evaluation of an instrument to measure teamwork in multidisciplinary critical care teams. *BMJ Qual Saf.* 2011;20:216–222. doi: 10.1136/bmjqs.2010.041913.

14. Weller J, Shulruf B, Torrie J, et al. Validation of a measurement tool for self-assessment of teamwork in intensive care. *Br J Anaesth.* 2013;111:460–467. doi: 10.1093/bja/aet060.

15. Agency for Healthcare Research and Quality. About *TeamSTEPPS*. Accessed August 13, 2022. https://www.ahrq.gov/teamstepps/about-teamstepps/index.html.

16. King HB, Battles J, Baker DP, et al. TeamSTEPPS™: team strategies and tools to enhance performance and patient safety. In: Henriksen K, Battles JB, Keyes MA, Grady ML, eds. Advances in patient safety: New directions and alternative approaches. Vol. 3 Performance and Tools. Rockville, MD: Agency for Healthcare Research and Quality (US), 2008

17. Baker DP, Amodeo AM, Krokos KJ, Slonim A, Herrera H. Assessing teamwork attitudes in healthcare: development of the TeamSTEPPS teamwork attitudes questionnaire. *Qual Saf Health Care.* 2010;19:e49. doi: 10.1136/qshc.2009.036129.

18. Baker DP, Krokos KJ, Amodeo AM, TeamSTEPPS® Teamwork Attitudes Questionnaire Manual. Agency for Healthcare Research and Quality. 2008. Accessed August 13, 2022. https://www.ahrq.gov/teamstepps/instructor/reference/teamattitudesmanual.html

19. Lee SH, Khanuja HS, Blanding RJ, et al. Sustaining Teamwork Behaviors Through Reinforcement of TeamSTEPPS Principles. *J Patient Saf.* 2017. [Online ahead of print] doi: 10.1097/PTS.0000000000000414.

20. Dahl AB, Abdallah AB, Maniar H, et al. Building a Collaborative Culture in Cardiothoracic Operating Rooms: Pre and Postintervention Study Protocol for Evaluation of the Implementation of teamSTEPPS Training and the Impact on Perceived Psychological Safety. *BMJ Open.* 2017;7:e017389. doi: 10.1136/bmjopen-2017-017389.

21. Ward MM, Zhu X, Lampman M, Stewart GL. TeamSTEPPS Implementation in Community Hospitals: Adherence to Recommended Training Approaches. *Int J Health Care Qual Assur.* 2015;28:234–244. doi: 10.1108/IJHCQA-10-2013-0124.

22. Motycka C, Egelund EF, Gannon J, et al. Using interprofessional medication management simulations to impact student attitudes toward teamwork to prevent medication errors. *Curr Pharm Teach Learn.* 2018;10:982–989. doi: 10.1016/j.cptl.2018.04.010.

23. Sweigart LI, Umoren RA, Scott PJ, et al. Virtual TeamSTEPPS(®) Simulations Produce Teamwork Attitude Changes Among Health Professions Students. *J Nurs Educ.* 2016;55: 31–35. doi: 10.3928/01484834-20151214-08.

24. Pathak A, Le Vasan M. Developing Oral Presentation Competence in Professional Contexts: A Design-Based Collaborative Approach. *Int J Eval Res Educ.* 2015;4:179–184.

25. Cohen SG, Bailey DR. What makes teams work: Group effectiveness research from the

shop floor to the executive suite. *Journal of Management.* 1997;23:238–290. doi.org/10.1177/014920639702300303.

26. Lemieux-Charles L, McGuire W. What do we know about health care team effectiveness? A review of the literature. *Med Care Res Rev.* 2006;63:263–300. doi: 10.1177/1077558706287003.

27. Henneman EA, Lee JL, Cohen JI. Collaboration: A concept analysis. *J Adv Nurs.* 1995;21:103–109. doi: 10.1046/j.1365-2648.1995.21010103.x.

28. Chandrashekar A, Mohan J. Preparing for the National Health Service: the importance of teamwork training in the United Kingdom medical school curriculum. *Adv Med Educ Pract.* 2019;10:679–688. doi: 10.2147/AMEP.S203333.

29. San Martin-Rodriguez L, Beauliey MD, D'Amour D, Ferrada-Videla M. The determinants of successful collaboration: A review of theoretical and empirical studies. *J Interprof Care.* 2005;19 Suppl 1:132-147. doi: 10.1080/13561820500082677.

30. World Health Organisation. Patient Safety - A world alliance for patient safety. WHO Patient Safety Curriculum Guide for Medical Schools. France: WHO; 2009. Topic 4, Being an effective team player. p. 119–140. Accessed August 13, 2022. https://apps.who.int/iris/bitstream/handle/10665/44091/9789241598316_eng.pdf?sequence=1&isAllowed=y.

31. World Health Organization. Health Professions Networks Nursing & Midwifery Human Resources for Health. Framework for action on interprofessional education & collaborative practice. 2010. Accessed August 13, 2022. http://apps.who.int/iris/bitstream/handle/10665/70185/WHO_HRH_HPN_10.3_eng.pdf?sequence=1.

32. Royal College of Physicians. Improving teams in healthcare: resource 1- building effective teams. London. [accessed 2021 Apr 11]. Royal College of Physicians; 2017. Accessed August 13, 2022. https://www.rcplondon.ac.uk/projects/outputs/improving-teams-healthcare-resource-1-building-effective-teams.

33. Jones RW. Learning and teaching in small groups: characteristics, benefits, problems and approaches. *Anaethesia Intensive Care.* 2007;35: 587–592. doi: 10.1177/0310057X0703500420.

34. Nathaniel T, Gainey JC, Williams JA, et al. Impact and educational outcomes of a small group self-directed teaching strategy in a clinical neuroscience curriculum. *Anat Sci Edu.* 2018;11: 478–487. doi: 10.1002/ase.1759.

35. Gwee MC. Problem-based learning: a strategic learning system design for the education of healthcare professionals in the 21st century. *Kaohsiung Journal of Medical Sciences.* 2009; 25: 231–239. doi: 10.1016/S1607-551X(09)70067-1.

36. Posmontier B, Montgomery K, Glasgow MES, Montgomery OC, Morse K. Transdisciplinary teamwork simulation in obstetrics-gynecology health care education. *Journal of Nursing Education.* 2012;51: 176–179. doi: 10.3928/01484834-20120127-02.

37. Brock D, Rish EA, Chiu CR, et al. Interprofessional education in team communication: Working together to improve patient safety. *BMJ Quality and Safety*. 2013;22: 414–423. doi: 10.1136/bmjqs-2012-000952.