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Review Article

The effectiveness of interprofessional education in healthcare: A systematic review and meta-analysis

Salman Yousuf Guraya [a,*], **Hugh Barr** [b]

[a] *Department of Clinical Sciences, College of Medicine, University of Sharjah, Sharjah, United Arab Emirates*
[b] *St George's University of London, Cranmer Terrace, London, UK*

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Abstract Interprofessional education (IPE) emphasizes collaborative practice that aims at promoting the working relationships between two or more healthcare professions. However, there is paucity of literature about the effectiveness of IPE program in the healthcare. This systematic review and meta-analysis aims to objectively determine the effectiveness of IPE in that field in terms of the improvement of students' knowledge, skills and attitudes. The databases of OVID, ISI Knowledge of Science, and Medline (PubMed) were searched for the full-text English language articles published during 2000–2016 using the MeSH terms "interprofessional education" AND "healthcare professionals" AND "multi-professional" AND "impact" AND "effectiveness" OR "collaborative practice" OR "medical students" in Endnote X7. A systematic search finally selected 12 articles for detailed review and meta-analysis. The effect summary value of 1.37 with confidence interval of 0.92–1.82 identifies statistically significant effectiveness of intervention by IPE program in healthcare. The Z test value of 5.99, significant at 5% level of significance, also shows a significant impact of IPE intervention as calculated by the random-effects model. This meta-analysis shows a positive impact and effectiveness of educational intervention by IPE program in various disciplines of healthcare. However, analysis of further clinical trials may be helpful in identifying the effect of IPE program on the students' clinical competence.
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* Corresponding author. Department of Clinical Sciences, College of Medicine University of Sharjah, PO Box 27272, Sharjah, United Arab Emirates.
E-mail address: salmanguraya@gmail.com (S.Y. Guraya).

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Introduction

Interprofessional education (IPE) refers to "occasions when two or more professionals learn with, from and about each other to improve collaboration and the quality of care" [1]. This contrasts with multi-professional education where health professionals learn alongside one another in a parallel manner [2]. Several studies have shown that IPE promotes interdisciplinary collaboration and teamwork [3,4], reduces the barriers and preconceptions prevailing among various healthcare groups and promotes professional competencies [5]. This approach of engaging multiple health workers from different professional backgrounds working together with patients, families and communities has been shown to provide the highest quality of patient care [6]. Literature is deeply divided about a standard teaching pedagogy that can be successfully tailored to match goal setting and desired outcomes of an IPE program [7]. Some researchers have argued that a standard IPE module can be delivered during pre-qualification [8], while others have indicated that it can be taught both before and after qualification [9]. In the quest for a standard educational strategy, Freeth et al. have coined a five-point taxonomy of IPE learning strategies; problem-based, exchange-based, simulation-based, observation-based and practice-based [10]. Traditionally, the Interdisciplinary Education Perception Scale IEPS has been tested as an instrument to objectively evaluating the students' attitudes before, during and after incorporating IPE programs [11]. However, this instrument has been used to measure one or more IPE-based outcomes as outlined by Freeth et al.; practice-based learning [12], problem based learning [4] or simulation-based learning [13].

The complexity of teaching dynamics in different healthcare disciplines poses special challenges to the introduction of IPE modules such as crowded timetables and the logistical problems related to large numbers of students required to undertake same learning activities simultaneously [14]. However, several accreditation bodies have embedded interprofessional educational strands within their educational domains, prompting a growing number of medical curriculum committees to explore the possibility of introducing and developing IPE in their institutional practice [15]. However, there are limited reports in literature that have elaborated the effectiveness of IPE teaching in pre-post status of various healthcare disciplines. This systematic review and meta-analysis objectively analyses the effectiveness and impact of teaching and developing IPE modules in healthcare. This may provide an insightful stimulus to educators for the development and incorporation of IPE in healthcare system.

Materials and methods

Search design

This systematic review and meta-analysis was conducted to explore the impact of interprofessional education (IPE) in healthcare using OVID, ISI Knowledge of Science, and Medline (PubMed) database. The Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) protocol [16] were applied in selecting those articles that used empirical pre-post design criteria in exploring the impact of IPE in healthcare system with reported average and standard deviation. In April 2017, the full-text English language articles published during 2000—2016 were searched by connecting MeSH major topic terms of "interprofessional education" AND "healthcare professionals" AND "multi-professional" AND "impact" AND "effectiveness" OR "collaborative practice" OR "medical students" in Endnote X7. This search initially retrieved 8453 citations as shown in Figure. 1. Only the pre-post original studies were included that compared the effectiveness of IPE by quantitative analysis. Review and editorial articles, commentaries, personal opinions, and conference proceedings were excluded from this review.

Quality assurance

Two independent reviewers objectively reviewed the selected studies and reached consensus by matching the inclusion criteria and key words. The barriers and challenges in the published articles were identified and then the differences were discussed until consensus was reached and concerns were resolved. In addition, controversies and disparities during selection of studies were resolved by general consensus among researchers.

Data extraction

During the data synthesis, 7133 studies were excluded due to duplication and publication prior to 2010. Another 1253 studies were excluded after reviewing the titles and abstracts as these studies did not meet the inclusion criteria. While only 55 studies were found to be relevant as they empirically explored the effectiveness of IPE on healthcare system. During the full text analysis of these 55 relevant studies, another 43 articles were excluded due to inappropriate data for meta-analysis. This meta-analysis and systematic review finally selected 12 relevant studies that matched the inclusion criteria of this study.

The following 12 studies were finally selected for this meta-analysis;

- Examining the influence of professional identity formation on the attitudes of students towards interprofessional collaboration [17].
- Effectiveness of interprofessional education by on-field training for medical students, with a pre-post design [6].
- Minding the gap: interprofessional communication during inpatient and post discharge chasm care [18].
- Building interdisciplinary research models through interactive education [19].
- Teaching the teachers: faculty development in interprofessional education [20].
- Getting a head start: high-fidelity, simulation-based operating room team training of interprofessional students [21].
- An interprofessional communication training using simulation to enhance safe care for a deteriorating patient [22].

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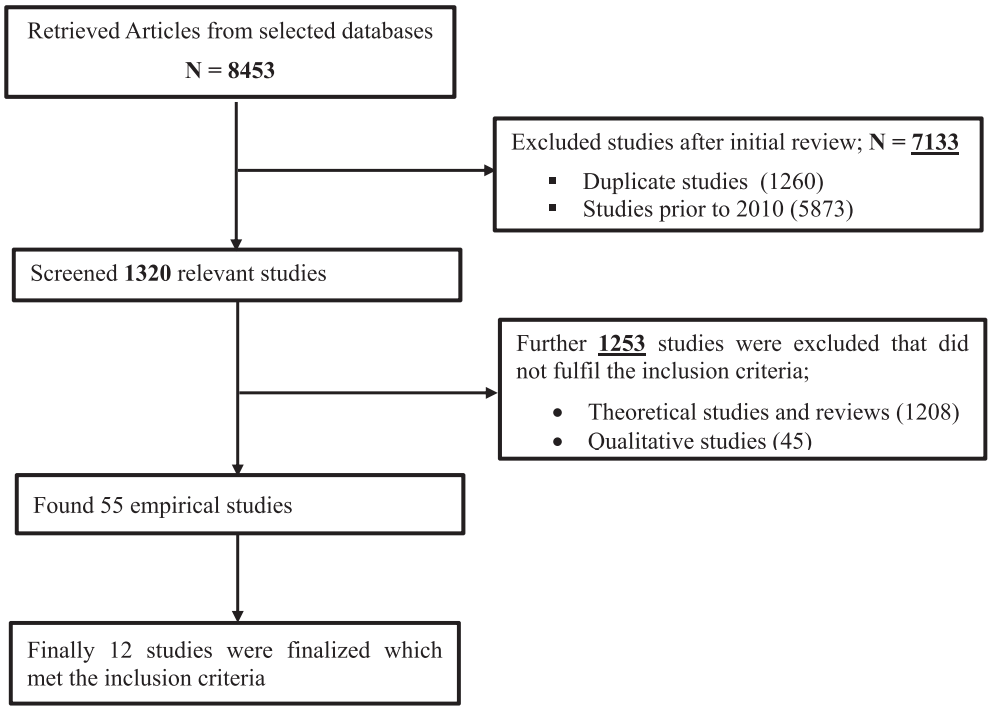

Figure 1. Flow diagram showing step-wise selection of studies in this systematic review.

- Exposure and attitudes toward interprofessional teams: a three-year prospective study of longitudinal integrated clerkship versus rotation-based clerkship students [23].
- The value of community-focused interprofessional care in Peru for developing cultural competency in health professions students [24].
- Understanding interprofessional relationships by the use of contact theory [25].
- A multi-professional evidence-based practice course improved allied health students' confidence and knowledge [26].
- Interprofessional education at Niigata University of Health and Welfare [27].

Statistical analysis

This meta-analysis was conducted using the Forest plot that graphically illustrates consistency and reliability results of selected studies in a meaningful way. The Forest plot was programmed through Review Manager 5.3 software that is developed by Cochrane Library [28]. In this plot, the effect size of each study was computed as an outcome and pooled effect size. Q test was used to measure heterogeneity in selected studies using the null hypothesis that "all studies are identical". The I squared (I^2) statistical tool is an excellent strategy to validate the quantity of heterogeneity in terms of percentage and this is another scientific reflection of the consistency of results from the selected studies [29]. After carefully analyzing the heterogeneity, the application of appropriate models, fixed summary effects or random effects, were sought. In case of low heterogeneity, the application of fixed summary effects model is recommended, while in case of greater heterogeneity the random effects model is commonly used. The Tau squared (Tau^2) estimates the relation between study variance in random effects model. The level of significance in this study is 5% ($p < 0.05$).

Results

The Forest plot in Figure. 2 illustrates a series of estimates and their confidence intervals at 95% level. Each individual study's effect size (outcome) is shown by a square per box and their confidence intervals are represented through horizontal lines. This plot shows wider confidence intervals and inconsistent response rates that indicates clear heterogeneity among the selected studies. In order to confirm heterogeneity statistically, Q test, I^2 and Tau^2 statistic were applied. The results in the Forest plot show that Conchre Q ($Chi^2 = 400.62$) test is significant at 5% thus rejecting the proposed null hypothesis; all studies are identical. The I^2 value of 97% signals the presence of significant heterogeneity among the selected studies. On the basis of significant heterogeneity, random effects model seemed appropriate for this meta-analysis. The effect summary is represented by a diamond that has standardized mean difference (SMD) of 1.37 with confidence interval ranging from 0.92 to 1.82. This finding statistically confirms significant effectiveness of intervention by IPE in healthcare as it exceeds the critical value of 0.8, as recently suggested by Cohen [30]. Only one study, by Stull and Blue [17] has SMD ratio less than 1, while the rest of the studies are lying on the line or on its right side with one level difference and represent positive impact of IPE in healthcare system. The Z test with a value of 5.99 is also significant at 5% level of significance and deduces that there was a significant impact of IPE intervention as calculated by random-effects model.

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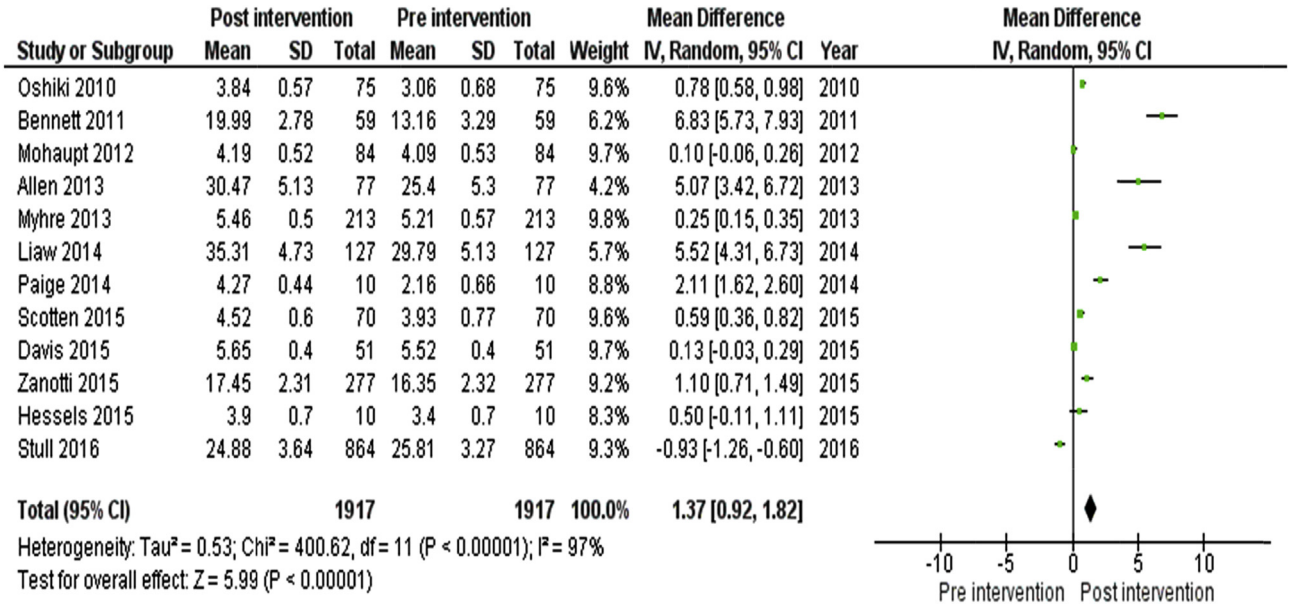

Figure 2. The results of Forest plot showing effect summary from selected studies.

Discussion

IPE in healthcare is being considered as a key factor in providing patient-centred, responsive and high-quality care [31]. The findings of this systematic review and meta-analysis have reported significant improvements in pre- and post-status scores after embedding IPE module in various medical fields as determined by enhanced acquisition of knowledge, skills, and attitudes of learners. This effectiveness of IPE pre-post design has been proposed to carry multi-dimensional gains; IPE has been shown to increase job satisfaction among emergency department nurses and physicians [32], has helped the primary health care practitioners in their approach to resolve complex issues with clients and their ability to utilize other resources [33], and has been instrumental in dispelling stereotypes [34]. Turner has argued that medical and allied health students may pass their courses and programs and may enter their practical careers with certain perceptions or understandings of other professions that may or may not be accurate [35]. Such opinions may persist as profession-specific stereotypes and unchallenged ideas as students might not have been exposed to avenues and conventions that embrace direct interactions with students from other professions. The real essence of IPE at the undergraduate level springs from the fact that students are trained to learn with, from, and about several professions from the start of their studies and this will foster their understanding about the value and significance of other professions. Such platforms fostering collaborative learning in interprofessional environment empowers students in establishing effective working relationships in healthcare profession. At the same time, IPE has the potential of providing a learning forum for practitioners who are not ordinarily offered a structured framework to learn with, from and about one another, and to build professional relationships.

Since IPE incorporates multi-dimensional and diverse topics, several studies has shown to explore its effectiveness on individual educational strategies and disciplines. Cohen at al. compared the knowledge of the US trainees of medicine, nursing, occupational, physical and music therapies, physician assistant, social work trainees vs. the controls, before and after a protocol-driven training program about Parkinson's disease [36]. The results showed statistically significant post-test improvement in all major outcomes including self-perceived ($p < 0.001$) and objective knowledge ($p < 0.001$), understanding role of other disciplines ($p < 0.001$), and attitudes toward health care teams scale ($p < 0.001$). The qualitative analysis has also confirmed a sustained and positive gain in knowledge about Parkinson's disease, team strategies and role of other disciplines, and team attitudes. In another study, Sergeant et al. developed a four 2-h interprofessional communication skills workshops for Nova Scotia Health Professionals and applied a mixed-method evaluation design in assessing the outcomes at pre-post-workshop and follow-up phases [37]. Of a total of 518 professionals from 20 disciplines, pre-post paired *t*-tests showed significant improvements by all workshops ($p \leq 0.05$). As many as 87% of physicians showed positive changes in their patients' responses. The investigators have urged the need to support facilitators by the institutional administration during the implementation and sustainability of IPE program.

In a study by Eccott et al. designed and implemented an interprofessional problem-based learning module in a Canadian university and then evaluated students' knowledge, attitudes, and perceptions [38]. The study recruited 24 students from medicine, pharmacy, nursing, physical therapy and occupational therapy and reported that the students' attitudes toward interprofessional teamwork improved from pre-to post-intervention. The qualitative analysis generated themes that signaled students' satisfaction with the module. Students also reported increased knowledge about roles and perspectives, greater confidence to collaborate, and more motivation to engage in intra-curricular IPE. All such studies have shown a remarkable improvement in knowledge, skills

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and attitude of students by introducing IPE module at different stages of their undergraduate studies.

A similar pattern of findings has been observed from the studies selected in this meta-analysis, although, IPE modules were not pitched at a matching stage in the curriculum from selected studies. Despite this discrepancy, all studies have shown a significant impact of IPE educational intervention on students' knowledge, skills and attitudes. A meta-analysis by Reeves et al., published in 2013, evaluated the effectiveness of IPE interventions compared to separate, profession-specific education interventions and the effectiveness of IPE incorporation compared to no intervention [39]. Although selected studies in this meta-analysis showed some positive outcomes, due to certain limitations, this meta-analysis could not draw major inferences about the key elements of IPE and its effectiveness. The authors suggest further randomized controlled trials with qualitative strands and cost-benefit analysis to assess the effects of IPE educational interventions. A recent meta-analysis by Reeves et al., using the modified Kirkpatrick model, has shown a persistently positive response to IPE by students in terms of their attitudes, perceptions, collaborative knowledge and skills [40]. This meta-analysis has endorsed the findings of the current study by showing a growing body of literature endorsing positive changes in behavior, organizational practice, and quality of patient care and related stakeholders. The effectiveness of IPE is perceived to have greater impact when incorporated in work-place based teaching and assessment pedagogies [41].

"The successful implementation of IPE requires leadership at all levels in both academic and practice settings [42]". Competent leaders can successfully exercise core principles of medical professionalism [43] as well as polyprofessionalism [44] and code of ethics [45], while dealing with physicians from a construct of disciplines. The visionary mission of IPE and expected educational outcomes should be well-understood by leaders of academic institutions such as president and vice president/provost of university and deans [46]. These administrative and academic leaders should be supportive in providing expertise and resources for effective delivery of IPE [47]. Clinical leadership can play pivotal role in connecting the interprofessional education to interprofessional practice. Scientifically crafted clinical faculty development program and overcoming the resistance across incurred by departmental barriers can prepare the practicing practitioners for effective delivery of IPE in improving quality of patient care [48]. Incorporating IPE educational strand within teaching pedagogies can be rightly pitched with the students' learning styles [49] The successful implementation of IPE module supported by expert faculty and sufficient resources carries a strong promise of enhancing its effectiveness with consequent improved patient care and safety.

Study limitations

This systematic review and meta-analysis has the limitation of finding insufficient number of studies in one particular discipline in healthcare system. This limitation is reflected by heterogeneity of selected studies in this meta-analysis. However, the summary effect of this meta-analysis has reported significant effectiveness of pre-post design for IPE modules in several disciplines of healthcare. In addition, the quality of evidence on the effectiveness of IPE program is limited to a pre-test and post-test design. Future studies such as randomized controlled trials may shed light on providing more objective analysis by determining students' clinical performance.

Conclusion

This study identified positive outcomes of the educational intervention by teaching and developing IPE courses in various disciplines of healthcare. The effectiveness of pre-post design has been shown to have a positive impact in improving the knowledge, skills, and attitudes of learners about collaborative teamwork. However, managing the growing number of students registered in each semester for these mandatory courses, scheduling, timetabling and allocating sufficient time, and finding appropriate teaching resources to meet cohort needs cohesive efforts by administration and faculty. However, more research is needed to explore other factors that may determine specific educational outcomes of medical students about the effectiveness of IPE program.

References

[1] Zwarenstein M, Atkins J, Barr H, Hammick M, Koppel I, Reeves S. A systematic review of interprofessional education. J Interprof Care 1999;13:417—24.
[2] Barr H, Ross F. Mainstreaming interprofessional education in the United Kingdom: a position paper. J Interprof Care 2006; 20:96—104.
[3] Al-Qahtani MF, Guraya SY. Measuring the attitudes of healthcare faculty members towards interprofessional education in KSA. J Taibah Univ Med Sci 2016;11:586—93.
[4] Cusack T, O'Donoghue G. The introduction of an interprofessional education module: students' perceptions. Qual Prim Care 2012;20:231—8.
[5] Reeves S, Goldman J, Oandasan I. Key factors in planning and implementing interprofessional education in health care settings. J Allied Health 2007;36:231—5.
[6] Zanotti R, Sartor G, Canova C. Effectiveness of interprofessional education by on-field training for medical students, with a pre-post design. BMC Med Educ 2015;15:1.
[7] Horsburgh M, Lamdin R, Williamson E. Multiprofessional learning: the attitudes of medical, nursing and pharmacy students to shared learning. Med Educ 2001;35:876—83.
[8] Freeth D, Reeves S. Learning to work together: using the presage, process, product (3P) model to highlight decisions and possibilities. J Interprof Care 2004;18:43—56.
[9] Rudland JR, Mires GJ. Characteristics of doctors and nurses as perceived by students entering medical school: implications for shared teaching. Med Educ 2005;39:448—55.
[10] Freeth D, Reeves S, Koppel I, Hammick M, Barr H. Evaluating interprofessional education: a self-help guide. 2005.
[11] Williams B, Webb V. Examining the measurement properties of the interdisciplinary education perception scale (IEPS) in paramedic education. Nurse Educ Today 2013;33:981—5.
[12] Hunter JP, Stinson J, Campbell F, Stevens B, Wagner SJ, Simmons B, et al. A novel pain interprofessional education strategy for trainees: assessing impact on interprofessional competencies and pediatric pain knowledge. Pain Res Manag 2015;20:e12—20.

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[13] Baker C, Pulling C, McGraw R, Dagnone JD, Hopkins-Rosseel D, Medves J. Simulation in interprofessional education for patient-centred collaborative care. J Adv Nurs 2008;64:372–9.
[14] Thistlethwaite JE. Interprofessional education: implications and development for medical education. Educ Méd 2015;16:68–73.
[15] Barrett G, Greenwood R, Ross K. Integrating interprofessional education into 10 health and social care programmes. J Interprof Care 2003;17:293–301.
[16] Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev 2015;4:1.
[17] 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.
[18] Scotten M, Manos EL, Malicoat A, Paolo AM. Minding the gap: interprofessional communication during inpatient and post discharge chasm care. Patient Educ Couns 2015;98:895–900.
[19] Hessels AJ, Robinson B, O'Rourke M, Begg MD, Larson EL. Building interdisciplinary research models through interactive education. Clin Trans Sci 2015;8:793–9.
[20] Davis BP, Clevenger CK, Posnock S, Robertson BD, Ander DS. Teaching the teachers: faculty development in interprofessional education. Appl Nurs Res 2015;28:31–5.
[21] Paige JT, Garbee DD, Kozmenko V, Yu Q, Kozmenko L, Yang T, et al. Getting a head start: high-fidelity, simulation-based operating room team training of interprofessional students. J Am Coll Surg 2014;218:140–9.
[22] Liaw SY, Zhou WT, Lau TC, Siau C, Chan SW-C. An interprofessional communication training using simulation to enhance safe care for a deteriorating patient. Nurse Educ Today 2014;34:259–64.
[23] Myhre DL, Woloschuk W, Pedersen JS. Exposure and attitudes toward interprofessional teams: a three-year prospective study of longitudinal integrated clerkship versus rotation-based clerkship students. J Interprof Care 2013:1–3.
[24] Allen CB, Smart DA, Odom-Maryon T, Swain D. The value of community-focused interprofessional care in Peru for developing cultural competency in health professions students. Int J Nurs Educ Scholarsh 2013;10:153–62.
[25] Mohaupt J, van Soeren M, Andrusyszyn M-A, MacMillan K, Devlin-Cop S, Reeves S. Understanding interprofessional relationships by the use of contact theory. J Interprof Care 2012;26:370–5.
[26] Bennett S, Hoffmann T, Arkins M. A multi-professional evidence-based practice course improved allied health students' confidence and knowledge. J Eval Clin Pract 2011;17:635–9.
[27] Oshiki R, Magara A, Hoshino E, Nishihara Y, Masegi S, Watanabe E, et al. Interprofessional education at Niigata university of health and Welfare. Advanced initiatives in interprofessional education in Japan. Springer; 2010. p. 13–21.
[28] Guraya SY. The usage of social networking sites by medical students for educational purposes: a meta-analysis and systematic review. N Am J Med Sci 2016 Jul;8(7):268.
[29] Higgins J, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. Br Med J 2003;327:557–60.
[30] Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, New Jersey: L. Erlbaum; 1988.
[31] Ateah CA, Snow W, Wener P, MacDonald L, Metge C, Davis P, et al. Stereotyping as a barrier to collaboration: does interprofessional education make a difference? Nurse Educ Today 2011;31:208–13.
[32] Searle J. Nurse practitioner candidates: shifting professional boundaries. Aust Emerg Nurs J 2008;11:20–7.
[33] Larivaara P, Taanila A. Towards interprofessional family-oriented teamwork in primary services: the evaluation of an education programme. J Interprof Care 2004;18:153–63.
[34] Oandasan I, Reeves S. Key elements of interprofessional education. Part 2: factors, processes and outcomes. J Interprof Care 2005;19:39–48.
[35] Turner JC. Some current issues in research on social identity and self-categorization theories. Soc Identity Context Commit Content 1999:6–34.
[36] Cohen EV, Hagestuen R, González-Ramos G, Cohen HW, Bassich C, Book E, et al. Interprofessional education increases knowledge, promotes team building, and changes practice in the care of Parkinson's disease. Parkinsonism Relat Disord 2016;22:21–7.
[37] Sargeant J, MacLeod T, Murray A. An interprofessional approach to teaching communication skills. J Contin Educ Health Prof 2011;31:265–7.
[38] Eccott L, Greig A, Hall W, Lee M, Newton C, Wood V. Evaluating students' perceptions of an interprofessional problem-based pilot learning project. J Allied Health 2012;41:185–9.
[39] Reeves S, Perrier L, Goldman J, Freeth D, Zwarenstein M. Interprofessional education: effects on professional practice and healthcare outcomes (update). Cochrane Database Syst Rev 2013;3.
[40] Reeves S, Fletcher S, Barr H, Birch I, Boet S, Davies N, et al. A BEME systematic review of the effects of interprofessional education: BEME guide no. 39. Med Teach 2016:1–13.
[41] Guraya SY. Workplace-based assessment; applications and educational impact. Malays J Med Sci 2015;22:5.
[42] Schmitt MH, Gilbert JH, Brandt BF, Weinstein RS. The coming of age for interprofessional education and practice. Am J Med 2013;126:284–8.
[43] 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.
[44] Guraya SY, Norman RI, Roff S. Exploring the climates of undergraduate professionalism in a Saudi and a UK medical school. Med Teach 2016:1–3.
[45] Guraya SY, London N, Guraya SS. Ethics in medical research. J Micro Ultrastruct 2014;2:121–6.
[46] Khoshhal KI, Guraya SY. Leaders produce leaders and managers produce followers: a systematic review of the desired competencies and standard settings for physicians' leadership. Saudi Med J 2016;37:1061.
[47] Blue AV, Mitcham M, Smith T, Raymond J, Greenberg R. Changing the future of health professions: embedding interprofessional education within an academic health center. Acad Med 2010;85:1290–5.
[48] Hoffman SJ, Rosenfield D, Gilbert JH, Oandasan IF. Student leadership in interprofessional education: benefits, challenges and implications for educators, researchers and policymakers. Med Educ 2008;42:654–61.
[49] Guraya SS, Guraya SY, Habib FA, Khoshhal KI. Learning styles of medical students at Taibah University: trends and implications. J Res Med Sci 2014;19:1155.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.kjms.2017.12.009.

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