

# A Systematic Review of Educational Interventions and Their Impact on Empathy and Compassion of Undergraduate Medical Students

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## Research article

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# Abstract

## Background

A compassionate and patient-centred care leads to improved clinical outcomes. Promoting empathy and compassion of medical students is a forerunner of their wellbeing, emotional stability, and a patient-centred care. However, there is slender evidence about best educational interventions that can inculcate empathy and compassion skills. Our objective was to conduct a systematic review of research evaluating the associations between spectrum, effectiveness, frequency of teaching modalities and their outcomes on compassion and empathy to highlight best practices.

## Methods

We searched the Web of Science, PubMed, Scopus, and EBSCO Host. Selected studies were required to have used unique educational interventions for promoting empathy and compassion of medical students.

## Results

We analysed 24 articles from the initial yield of 2,861. Twenty-two were quantitative studies with a mean of 12.8 on MERSQI. Twelve were randomized controlled trials while 5 measured outcomes with single group pre- and post-tests. There was no association found between duration, frequency and complexity of an educational intervention and its effectiveness. Twenty used multimodality curricula, and of those 18 reported statistically significant positive improvement in empathy, while 3 of 4 single modality were effective. Only three studies looked for long-term effects of educational interventions. Fourteen studies evaluated Kirkpatrick's level one (self-reported knowledge), 2 level three (behaviour), and 6 level four (patient outcomes). We identified six major educational constructs of teaching empathy and compassion; communication, mindfulness, early clinical exposure, technology-enhanced learning, comics and arts and culture.

## Conclusion

Our review couldn't identify a standard teaching construct in place and highlighted that different teaching tools carry similar impact in promoting compassion and empathy and a sustainable program rather than a single training activity is essential.

## Introduction

The quality of the interaction between physicians and patients influences patient outcomes in clinical settings. A fundamental pillar of healthcare mission is based upon compassionate care that forecasts greater patient trust and satisfaction, superior patient-physician connections, and better patient outcomes.[1] Within healthcare organizations, compassionate care entails diverse responsibilities of healthcare professionals in explaining their roles, establishing rapport, and in spending time on attentively listening to the patients' concerns.[2] Compassionate healthcare is characterized by reflections of others' concerns, respect for persons, and contextualized understanding of the patient as a key player of health systems.

The two leading elements of patient centred care include empathy and compassion. Empathy refers to "the ability to understand the feelings of another person".[3] In the medical field, empathy pertains to a multifaceted strand with moral, cognitive and behavioural enlightenment.[4] When applied with objective reasoning, empathy promotes the impact of medical care and facilitates physician-patient communication.[5] Both empathy and compassion are generally considered to be interchangeable terms. However, empathy (understanding of patient feelings) is necessary to trigger compassion (emotional response including actions to alleviate patient sufferings).[6]

There is a compelling evidence in literature that treating patients without compassion can lead to deleterious outcomes.[7] An absence of compassionate care results in poor quality of care and higher risk of complications through medical errors. Unfortunately, despite an explicit emphasis on the vital role of compassionate patient care, healthcare professionals often miss opportunities to be compassionate, rather they pay attention to biomedical data and management plans. From another perspective, sustaining compassion in medicine is hard as compassion fatigue prevails in approximately 20 to 70 % of healthcare professionals.[8] Educators have argued that a great majority of medical students enter health care with a strong set of espoused ideals for providing high-quality, patient-centred care.[9] Unfortunately, during their training, medical students witness dissonance between the personal and professional conducts of their faculty and clinical teachers, students become more frustrated, less empathic and more distanced from patients.[3]

By and large, the ethos of most health care professional curricula uses typical biomedical models that primarily focus on teaching, training, and practice of clinical medicine with less emphasis on patient's' psycho-social well-being. Thus, medical and health sciences students start their educational journey with idealism but tend to end up with being cynical and less compassionate. This has been rightly termed as compassion crisis in healthcare systems.[10] In the absence of integration of biomedical knowledge with understanding of human behaviours will potentially further detach medical and health sciences students and healthcare professionals from the patient's emotions and contextualized perspectives.[11]

The analysis of existing body of literature underscores a need to inculcate standard teaching modalities within medical curricula that can enrich traits of empathy and compassion in undergraduate medical students. Currently, there is scarce evidence of a horizontal or vertical integration of teaching programs of empathy and compassion in undergraduate medical curricula. Furthermore, there is little evidence about the effectiveness and quality of teaching programs for empathy and compassion. We conducted this systematic and integrative review of the literature to summarize and report the published work on educational interventions for empathy and/or compassion curricula in undergraduate medical students. This review also aims to highlight best practices to implement an evidence-based empathy and/or compassion curriculum in undergraduate medical training.

## Materials And Methods

In our study, we used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[12] The PRISMA tool provides an evidence-based minimum set of data for a standard reporting in systematic reviews and meta-analyses.

### *Literature search strategy*

We searched four major electronic databases of Web of Science, PubMed, Scopus and EBSCO Host for the English-language articles, published during 2015-2020. Our search strategy was adapted from a previously published systematic review on education for compassion and empathy.[13] We tweaked this work further to explicitly focus on medical students. The final search was performed on July 22<sup>nd</sup>, 2020 and a detailed search strategy is attached as **Appendix 1**. We looked into three core concepts and their associated Medical Subject Headings (MeSH) terms and keywords: Compassion and empathy, medical students, and educational interventions (Compassion OR Empathy OR Caring AND Medical students AND Education OR Training OR Workshop OR Simulation). A hand search of reference lists of the relevant articles yielded some more studies which were included in the final list of selected articles.

### *Data collection, eligibility criteria and selection of articles*

We included original research studies that i) carried out research on undergraduate medical students; and ii) showed a clear educational intervention for empathy and/or compassion; and iii) measured educational outcomes about compassion and/or empathy. These articles showed educational outcomes after training interventions to improve empathy (the understanding component) and compassion (i.e. the action component). The original studies included controlled trials, randomized controlled trials, pre/post-test and post-test only designs. Review and editorial articles, commentaries, experts' opinion, short communications, and letter to the editor were excluded from our search. One reviewer (PM) screened all titles and abstracts. Then SSG reviewed titles and abstracts of the selected articles to standardize the search process of this study.

### *Data extraction and data synthesis*

Two researchers (PM and SSG) thoroughly scanned the full text of articles that met inclusion criteria and then using a standard data extraction form charted the required information. The researcher SYG independently reviewed the entire process and filled gaps in data mining, data extraction and synthesis. We considered the following components during data extraction; types and designs of studies, primary objectives of studies, quality of studies, invitees' study level, response rate, self-reported or objective measurements in each study, and type, duration, frequency, skills taught and modality of educational interventions. We also recorded the outcomes according to the following four levels of the Kirkpatrick's model [14];

1. Self-reported changes in knowledge, skills and attitude
2. Changes in knowledge
3. Changes in behaviour
4. Patient- reported outcomes

We identified and classified the primary outcomes of the selected studies according to Kirkpatrick's level. A number of studies assessed multiple competencies such as empathy and compassion and self-compassion, and the highest-level outcome was considered as the primary outcome. While, in the studies where the primary outcomes did not relate to compassion or empathy, we used the highest-level empathy-specific variable as the primary outcome (**Box 1 and 2**)

**Box 1: The checklist used for screening abstracts to determine the eligibility of studies for their full-text analysis.**

**Population**

\*Does this study look at medical students? YES/NO

*If NO exclude*

**Intervention**

Does this study use compassion/empathy/caring training? YES/NO

*If NO exclude*

Does this study train medical students to compassionate or empathetic strategies? YES/NO

*If NO exclude*

Does this study include information regarding the content of the compassion or empathy or caring training? YES/NO

*If NO exclude*

**Outcomes**

Does this study include outcome measures related to the compassion/empathy/caring training? YES/NO

*If NO exclude*

Does this study isolate the outcomes for medical students? YES/NO

*If NO exclude*

**Box 2: The data mining rubric used in our study to record characteristics of each study (n=24)**

**First Author**

**Title**

**Year of Publication**

**Country**

**Study Design**

- Pre-post curriculum evaluation
- Randomized controlled trial
- Quasi-experimental study
- Other

**Population**

- Number of students
- Year of students

**Curriculum**

- Hours
- Number of sessions

**Pedagogical approach**

- Didactics
- Small group discussions
- Written/verbal reflections
- Simulation
- Standardized patient practice
- Apprenticeship/mentoring/service learning
- Video/Demonstration
- Other (Virtual hangouts, blogs, hot spotting etc.)

**Compassion/empathy related Outcomes**

- Self-reported changes in knowledge, skills and attitudes
- Knowledge
- Behaviours
- Patient outcomes

*Effectiveness of educational interventions*

To identify best educational practices for teaching compassion and/or empathy, we determined the effectiveness of interventions in the selected studies, where effective was defined as a statistically significant improvement in primary educational outcomes as measured by *p* value or effect size, where applicable.

*Quality assessment*

We used Medical Education Research Study Quality Instrument (MERSQI), a tool designed for evaluation of quantitative educational research studies [15]. The MERSQI checklist has 10 items in 6 domains: study design, sampling, type of data, validity evidence, data analysis, and type of outcomes with a maximum score of 3 in each domain. A study can have a maximum MERSQI score of 18 (highest quality). PM and SSG individually scored each study and in case of score discrepancies, SYG assessed the scoring and discussed and made the final decision.

*Quality assurance*

All researchers (PM, SSG and SYG) objectively reviewed the workflow of selection of studies. In case of discrepancies, the researchers reached consensus by comparing the studies with inclusion criteria and key words. The discrepancies, inconsistencies and controversies were resolved with consensus until all the concerns were resolved.

## Results

**Figure 1** outlines the workflow and algorithm of studies selection in this study. Our initial search yielded 2,861 studies. After removing duplicates, we screened 754 titles and abstracts. This led to identification of 244 articles for a detailed full-text review. This helped us to exclude another 227 articles whose content did not meet the inclusion criteria. A hand search of reference lists of remaining articles along with 15 review articles identified 7 additional articles for inclusion. Finally, authors agreed on a list of 24 articles [16-39], that had used 24 unique educational interventions either *de novo*, validated or adapted from previous publications and explicitly met inclusion criteria of our research. The summarized and comprehensive information about each article is presented in **Table 1**.

A maximum number of 9/24 (37.5%) articles were published in 2017 (**Figure 2**), while 11/24 (45.8 %) studies originated from the USA (**Figure 3**). The sample size varied greatly across the selected studies, ranging from 10 to 299 participants. Our research included a total of 2,657 respondents with a mean of 110. **Table 2** outlines the range of study designs that were used in the selected 24 studies. Most studies (21/24; 87.5%) were single-center, 11 (50%) were randomized controlled trials [20, 22, 23, 25, 26, 29, 30, 34, 37, 38], 4 (16.6%) controlled trials [16, 18, 27, 31] Five (20.8%) studies measured outcomes with single group pre- and post-tests [24, 28, 32, 33, 35] Our research identified 22/24 studies with their reported quantitative data that allowed us to calculate their MERSQI scores as shown in **Table 3**. All studies used statistical means to evaluate effectiveness. Collectively all studies have a total MERSQI score of 283 with a mean of 12.8. The study by Adriana Foster et al. [26] secured the highest MERSQI score of 17 from a maximum of 18. Finally, 10/22 (45.5%) studies scored greater or equal to 13 on MERSQI checklist.

Most curricula (20/24, 83.3%) used multiple educational modalities and 90% of studies turned out to be effective in achieving their primary outcomes (**Table 4**). A variety of teaching modalities were employed; didactics [19, 25, 27, 28, 30, 32, 36, 37, 39], small-group discussions [22-24, 27, 29, 32-34], reflection exercises [17, 22, 24, 32, 36] and simulations [19, 23, 25, 28, 32, 34, 38] Likewise, virtual hangouts and technology-enhanced interventions [18, 24, 26, 35] were also significantly effective. A great majority of studies were conducted in multiple sessions within one academic year.

Only one study instituted the Balint training groups [23], while four studies [20, 25, 30, 37] used adapted mindfulness based curricular tools (75% effective ratio) developed by Kabat-Zinn [40] We did not observe any clear association between duration, frequency and complexity of an educational intervention and its effectiveness. For example, 75% (3/4) of single modality curricula were effective while multimodality curricula turned out to be effective in 90% (18/20) of the selected studies. Likewise, 80% (4/5) of single cross-sectional curricula were effective than 75% (3/4) of longitudinal curricula.

According to the four-level outcome-based Kirkpatrick model, 14/24 (58.3%) studies had a primary outcome pitching on level one; self-reported changes in attitudes and behaviour [17, 19-22, 24, 27, 28, 30, 31, 33, 36, 37, 39] as illustrated in **Figure 4**. Two (4.8%) studies evaluated level three outcome (behaviour), while six (25%) studies evaluated level four (patient outcomes) either by standardized or simulated patients or by a third party observation [16, 23, 26, 29, 32, 38] **Table 5** outlines an inventory of the validated instruments for outcome assessments used in the selected studies. The most commonly used self-assessment outcome tool was the Jefferson's Scale of Empathy by 15/24 (62.5%) studies [18-20, 22-24, 27-29, 31, 33, 35-38] that recruited 1,973 students. Conversely, 6/24 (25%) studies [20, 22, 25, 30, 35, 37] used a combination of tools to probe the impact of their interventions on behaviours and attitudes of medical students towards empathy and/or compassion and to determine the impact of self-compassion on behaviour change [25] Only three studies looked for the long-term effects of educational interventions [19, 28, 37]

**Figure 5** illustrates the leading constructs used in education interventions that showed positive impact on empathy and compassion of medical students in our study. A maximum of 10 studies used communication skills [19, 20, 22, 23, 26, 28, 29, 32, 37, 38], followed by mindfulness by 5 studies [20, 25, 30, 37], early clinical exposure by four [16, 17, 21, 31], technology-enhanced learning by virtual patient hangouts, computerized tasks, hot spotting by another four [18, 24, 26, 35], and comics [36], and arts and culture [27]

## Discussion

Our study elucidates major findings of 24 studies that have collected data from 2,657 medical students using educational interventions on empathy and compassion. Overall, there is a positive impact of a range of teaching modalities on understanding and application of empathy and compassion in medical field. The body of evidence from our research has deduced that effective communication skills, mindfulness, early clinical experience, comics, arts and culture, and technology-enhanced learning by virtual patients, hangouts and hot spotting are essential elements for effective teaching of empathy and compassion.

In our study, a substantial body of evidence has stressed on empathetic communication for better patient outcomes [16, 23, 26, 29, 32, 38] Communication is the foremost determinant of a safe clinical practice and ensures satisfaction of both patients and healthcare providers [41] The outright benefits of timely and professional communication in the medical field are far ranging; greater patient understanding and compliance, superior clinical outcomes, improved patient safety and alleviation of patient stress [42] Kelley et al. have argued that verbal communication between a healthcare professional and a patient enacts an empathetic connection to the patient that carries a powerful transformative and healing power [43] Pity, sympathy, fellow-feeling, comfort, commiseration, assuagement, and reflexive encouragement constitute effective strands of practicing empathy and compassion. Identification of compassionate opportunities, conformation, and appreciation with pursuit provide patient's empathy and compassion. In the study by Beard et al., the researchers measured patients' satisfaction about clear communication by medical students comparing the Veterans Affairs Longitudinal Undergraduate (VALUE) program with a control group of patients matched with disease severity [16] The results were analysed by longitudinal student involvement using VALUE group (patient education, communication, and collaboration) and a control group without the VALUE program. The VALUE students showed significant improvement in care coordination among their patients and physicians. Educators should provide regular and sustainable opportunities to

medical students to develop and validate their interpersonal communication skills that can potentially improve empathetic communication. LaSasso et al., have studied the impact of SALTED (Set-up, Ask, Listen, Type, Exceptions, Documentation) technique and role-plays in a case controlled trial on medical students.[29] At the start and end of clerkships, both groups completed the JSE. While faculty and standardized patients examined and graded students' history-taking and communication skills as well as their empathic behaviours using the Jefferson Scale of Patient Perceptions of Physician Empathy (JSPPE) at the end of clerkships. The mean scores of JSE of both groups increased from pre-test to post-test. This analysis reflects the use of a wide range of tools and techniques (VALUE, SALTED, JSE, JSPPE) by different studies for incorporating, measuring and enhancing empathy and compassion in medical students.

In clinical practice, a compassionate care has shown a strong association between improved clinical outcomes, quality of life and well-being.[44] Among health professionals, empathetic and compassionate care helps in mitigating the risk of burnouts.[45] From the neuroscience perspective, a study on the functional magnetic resonance imaging has shown that empathy activates distinct pain centres of the brain; whereas focusing on compassion activates the reward pathways.[46] These findings propound that a synchronous teaching and practice of empathy and compassion enhance patient and clinician well-being. Such outcomes may be accomplished with great success if educators can inculcate structured training programs for empathy and compassion in undergraduate and residency programs. However, there is a compelling evidence of empathy decline during the course of educational and training programs[47] and there is an urgent need for developing evidence-based curricula that can secure a sustained change in attitudes and behaviours[48] Historically, the Balint groups have been used to facilitate physicians and students in promoting and sustaining their empathy skills[7] The study by Céline Buffel du Vaure et al.[23] used the Consultation And Relational Empathy Measure (CARE) scale in a two-site randomized controlled trial on medical students in a weekly Balint group forum for two months. Results of this group were compared with the group of routine education. This study endorsed the impactful efficacy of the Balint groups using CARE to improve the humanistic dimensions of empathetic skills among medical students.

In our research, a great majority of studies have measured self-reported changes in knowledge and skills of participants and only two studies could tap into behavioural changes after an intervention.[25, 35] Sustained training sessions are essential for achieving such paradigm change in behaviours. Although literature has shown some controlled trials on empathy, a precursor for compassion, but there is scarce information on compassion training of medical students or healthcare professionals.[49] One such compassion enhancing training exercise is provided by mindfulness, "a continuous awareness of present moment experience in a calm and non-judgmental manner".[50] Mindfulness is a multi-factorial construct that contains healthy lifestyle, health education, wellness, empathy, compassion, good quality of life, regular exercise, sleep and hygiene, yoga and guided imagery.[51] Training for enhancement of mindfulness can potentially enhance compassionate care in clinical practice[52], close physician-patient relationship and can help alleviate physician burnout.[53] Mindful meditation, attention to breathing, didactic learning, reflection, mindful walking, journalism, and sitting meditation are some of the most popular mindfulness training exercises that have shown to enhance empathy and compassion in medical students and healthcare workers[25] In the study by van Dijk et al.,[37], the authors incorporated a stress reduction training curriculum based on mindfulness strategies to improve the mental health of medical students during clinical clerkships. This intervention led to an insignificant betterment of mental health of students which was followed up longitudinally over a 20-month period. However, the researchers could not detect a difference in JSE at 12 months in the studied cohort of students. Such findings necessitate the incorporation of a sustained empathy training program, particularly empathetic communication, for undergraduate medical students.

Technology-enhanced learning has gained popularity in several branches of medical education. Likewise, virtual patients (VPs) and standardized patients (StPs) are used as attractive alternatives to real patients with promising results.[24] Unfortunately, research has shown an empathy decline in medical students', particularly in the third year of medical school.[54] At this stage, medical students enter clinical clerkships that witness their encounters with patients and their relatives. A suitable ramification to sustain empathy and compassion is the use of VPs and StPs that can provide a constant source for medical students' experiential learning and behavioural development without endangering patient safety. Experiential learning such as patient shadowing or wellness programs can potentially enhance cognitive and behavioural dimensions of empathy. The long-lasting impact of experiential learning is further endorsed by a study conducted by Modi et al., which showed that volunteering students had better empathy than the non-volunteered medical students[31], who showed a decline in empathy over time. The intelligent use of arts, culture and humanities in medical education is an emerging and promising approach that can revitalize the declining empathy in medical students.[36] Comics "the combined use of images and text, sequentially, to tell a story, where the images complement and/or enhance the text"[55] is a powerful means of portraying complexities of medical knowledge. Graphical illustration with juxtaposed texts, depicts stories in a tangible manner which help to amalgamate the pictorial and textual cues highlighting an innovative use of technology enhanced learning and comics. Our research has shown some evidence that comics may serve as a distinct tool to promote empathy in medical education[56]. Finally, interprofessional education and practice carries great potential to promote empathy and compassion by alleviating anxiety, stress and burnout associated with medical education.[57, 58]

Our results highlight educational interventions pitching at improvement of knowledge outcomes can be significantly effective, followed by behaviours and, finally, patient outcomes. This is understandable for some reasons; medical students are attuned to work hard to acquire knowledge which can be easily measured as an educational outcome. Behavioural change in students and improvement in patient outcomes demand a sustained interplay of generic and acquired traits and, therefore, it's hard to achieve. Another interesting finding of our research springs from the fact that frequency, duration and teaching modalities didn't have any bearing on the effectiveness of the educational intervention. Even single session interventions were as effective as longitudinal curricula and such curricula did not have a sustained and long-lasting impact. However, experiential learning drills lead to emotional and behavioural remodelling that can result in durable personality developments.

## Study Limitations

In our systematic review, the identified 24 studies evaluated empathy and/or compassion curricula for undergraduate medical students. Though we aimed at highlighting best practices in teaching empathy and/or compassion, this turned out to be difficult due to profound heterogeneity in the educational interventions, measurement tools used and the types of accomplished outcomes.

## Conclusion

In this study, we have recognized major educational constructs of communication, mindfulness, early clinical exposure, technology-enhanced learning, comics and arts and culture for teaching empathy and compassion. Duration and frequency of a range of educational interventions have no impact on quality and effectiveness. In order to mitigate the risk of decline of empathy and compassion, a sustainable program rather than a single training activity is essential. Our research could not secure a single best-evidence teaching modality for empathy and/or compassion and the current evidence advocates the use of a blend of constructs for teaching empathy and compassion in undergraduate medical students.

## Declarations

### Consent for publication

Not applicable

### Availability of data and materials

All data generated or analysed during this study are included in this submitted article.

### Competing interests

The authors declare that they have no competing interests.

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### Authors contributions

SS made a substantial contribution to the conception of the work, created the search strategy, conducted the literature search, hand searched and screened the titles and abstract, extracted the data collected, analysed and interpreted the data, drafted the initial manuscript. Other team members SYG and MSBY critically evaluated the search strategy and revised the manuscript for important intellectual content. All members (SS, SYG and MSBY) approved the final version, and agreed to be accountable for all aspects of the work.

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## References

1. Duarte J, Pinto-Gouveia J. Empathy and feelings of guilt experienced by nurses: A cross-sectional study of their role in burnout and compassion fatigue symptoms. *Applied Nursing Research*. 2017;35:42-7.
2. Tehranineshat B, Rakhshan M, Torabizadeh C, Fararouei M. Compassionate care in healthcare systems: a systematic review. *Journal of the National Medical Association*. 2019;111(5):546-54.
3. Maben J. How compassion can be eroded in the NHS. *Journal of Holistic Healthcare*. 2014;11(3).
4. Williams J, Stickley T. Empathy and nurse education. *Nurse education today*. 2010;30(8):752-5.
5. Sinclair S, Norris JM, McConnell SJ, Chochinov HM, Hack TF, Hagen NA, et al. Compassion: a scoping review of the healthcare literature. *BMC palliative care*. 2016;15(1):6.
6. Engelen E-M, Röttger-Rössler B. Current disciplinary and interdisciplinary debates on empathy. *Emotion Review*. 2012;4(1):3-8.
7. Wear D, Zarconi J. Can compassion be taught? Let's ask our students. *Journal of General Internal Medicine*. 2008;23(7):948-53.
8. Markwell AL, Wainer Z. The health and wellbeing of junior doctors: insights from a national survey. *Medical Journal of Australia*. 2009;191(8):441-4.
9. Shield RR, Tong I, Tomas M, Besdine RW. Teaching communication and compassionate care skills: an innovative curriculum for pre-clerkship medical students. *Medical teacher*. 2011;33(8):e408-e16.
10. Jacobson JM. Compassion fatigue, compassion satisfaction, and burnout: Reactions among employee assistance professionals providing workplace crisis intervention and disaster management services. *Journal of Workplace Behavioral Health*. 2006;21(3-4):133-52.
11. Díaz-Narváez VP, Alonso-Palacio LM, Caro SE, Silva M, Arboledacastillo J, Bilbao J, et al. Compassionate care" Component of the construct empathy in medical students in Colombia and Dominican Republic. *Acta Medica*. 2017;33:101.

12. Guraya SY, Chen S. The impact and effectiveness of faculty development program in fostering the faculty's knowledge, skills, and professional competence: A systematic review and meta-analysis. *Saudi journal of biological sciences*. 2019;26(4):688-97.
13. Patel S, Pelletier-Bui A, Smith S, Roberts MB, Kilgannon HJ, Trzeciak S, et al. Curricula and methods for physician compassion training: protocol for a systematic review. *BMJ Open*. 2018;8(9):e024320.
14. Smidt A, Balandin S, Sigafoos J, Reed VA. The Kirkpatrick model: A useful tool for evaluating training outcomes. *Journal of Intellectual and Developmental Disability*. 2009;34(3):266-74.
15. Reed DA, Cook DA, Beckman TJ, Levine RB, Kern DE, Wright SM. Association between funding and quality of published medical education research. *Jama*. 2007;298(9):1002-9.
16. Beard AS, Candy AE, Anderson TJ, Derrico NP, Ishani KA, Gravely AA, et al. Patient Satisfaction With Medical Student Participation in a Longitudinal Integrated Clerkship: A Controlled Trial. *Academic Medicine*. 2020;95(3):417-24.
17. Chrisman-Khawam LM, Manzi JA. Empathy in Medicine. *J Am Osteopath Assoc*. 2020;120(4):263-72.
18. Collins L, Sicks S, Hass RW, Vause-Earland T, Ward J, Newsome C, et al. Self-efficacy and empathy development through interprofessional student hotspotting. *Journal of Interprofessional Care*. 2020:1-4.
19. D'souza PC, Rasquinha SL, D'souza TL, Jain A, Kulkarni V, Pai K. Effect of a single-session communication skills training on empathy in medical students. *Academic Psychiatry*. 2019:1-6.
20. Danilewitz M, Bradwejn J, Koszycki D. A pilot feasibility study of a peer-led mindfulness program for medical students. *Canadian medical education journal*. 2016;7(1):e31.
21. Davison E, Lindqvist S. Medical students working as health care assistants: an evaluation. *The clinical teacher*. 2020;17(4):382-8.
22. Demirören M, Saka MC, Şenol Y, Şentürk V, Baysal Ö, Öztuna D. The impact of reflective practices on medical students' attitudes towards mental illness. *Anatolian Journal of Psychiatry/Anadolu Psikiyatri Dergisi*. 2016;17(6).
23. du Vaure CB, Lemogne C, Bunge L, Catu-Pinault A, Hoertel N, Ghasarossian C, et al. Promoting empathy among medical students: A two-site randomized controlled study. *Journal of psychosomatic research*. 2017;103:102-7.
24. Duke P, Grosseman S, Novack DH, Rosenzweig S. Preserving third year medical students' empathy and enhancing self-reflection using small group "virtual hangout" technology. *Medical teacher*. 2015;37(6):566-71.
25. Fernando AT, Skinner K, Consedine NS. Increasing compassion in medical decision-making: can a brief mindfulness intervention help? *Mindfulness*. 2017;8(2):276-85.
26. Foster A, Chaudhary N, Kim T, Waller JL, Wong J, Borish M, et al. Using virtual patients to teach empathy: a randomized controlled study to enhance medical students' empathic communication. *Simulation in Healthcare*. 2016;11(3):181-9.
27. Graham J, Benson LM, Swanson J, Potyk D, Daratha K, Roberts K. Medical humanities coursework is associated with greater measured empathy in medical students. *The American journal of medicine*. 2016;129(12):1334-7.
28. Kataoka H, Iwase T, Ogawa H, Mahmood S, Sato M, DeSantis J, et al. Can communication skills training improve empathy? A six-year longitudinal study of medical students in Japan. *Medical teacher*. 2019;41(2):195-200.
29. LoSasso AA, Lambertson CE, Sammon M, Berg KT, Caruso JW, Cass J, et al. Enhancing student empathetic engagement, history-taking, and communication skills during electronic medical record use in patient care. *Academic Medicine*. 2017;92(7):1022-7.
30. Mascaro JS, Kelley S, Darcher A, Negi LT, Worthman C, Miller A, et al. Meditation buffers medical student compassion from the deleterious effects of depression. *The Journal of Positive Psychology*. 2018;13(2):133-42.
31. Modi A, Fascelli M, Daitch Z, Hojat M. Evaluating the relationship between participation in student-run free clinics and changes in empathy in medical students. *Journal of primary care & community health*. 2017;8(3):122-6.
32. Ruiz-Moral R, de Torres LP, Monge D, Leonardo CG, Caballero F. Teaching medical students to express empathy by exploring patient emotions and experiences in standardized medical encounters. *Patient Education and Counseling*. 2017;100(9):1694-700.
33. Schweller M, Ribeiro DL, Celeri EV, de Carvalho-Filho MA. Nurturing virtues of the medical profession: does it enhance medical students' empathy? *International Journal of Medical Education*. 2017;8:262.
34. Singh SP, Modi CM, Patel CP, Pathak AG. Low-fidelity simulation to enhance understanding of infection control among undergraduate medical students. *The National Medical Journal of India*. 2017;30(4):215.
35. Smith KE, Norman GJ, Decety J. The complexity of empathy during medical school training: evidence for positive changes. *Medical Education*. 2017;51(11):1146-59.
36. Tsao P, Catherine HY. "There's no billing code for empathy"-Animated comics remind medical students of empathy: a qualitative study. *BMC medical education*. 2016;16(1):1-8.
37. van Dijk I, Lucassen PL, Akkermans RP, Van Engelen BG, van Weel C, Speckens AE. Effects of mindfulness-based stress reduction on the mental health of clinical clerkship students: a cluster-randomized controlled trial. *Academic medicine*. 2017;92(7):1012-21.
38. Wünderlich M, Schwartz C, Feige B, Lemper D, Nissen C, Voderholzer U. Empathy training in medical students—a randomized controlled trial. *Medical teacher*. 2017;39(10):1096-8.
39. Yu EH, Choi EJ, Lee SY, Im SJ, Yune SJ, Baek SY. Effects of micro-and subtle-expression reading skill training in medical students: a randomized trial. *Patient education and counseling*. 2016;99(10):1670-5.

40. Kabat-Zinn J. An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General hospital psychiatry*. 1982;4(1):33-47.
41. Dean S, Zaslawski C, Roche M, Adams J. "Talk to Them": Teaching communication skills to students of traditional chinese medicine. *Journal of Nursing Education and Practice*. 2016.
42. Bensing J, Rimondini M, Visser A. What patients want. *Patient education and counseling*. 2013;90(3):287-90.
43. Kelley KJ, Kelley MF. Teaching empathy and other compassion-based communication skills. *Journal for nurses in professional development*. 2013;29(6):321-4.
44. Trzeciak S, Roberts BW, Mazzarelli AJ. Compassionomics: Hypothesis and experimental approach. *Medical hypotheses*. 2017;107:92-7.
45. Thomas MR, Dyrbye LN, Huntington JL, Lawson KL, Novotny PJ, Sloan JA, et al. How do distress and well-being relate to medical student empathy? A multicenter study. *Journal of general internal medicine*. 2007;22(2):177-83.
46. Lamm C, Decety J, Singer T. Meta-analytic evidence for common and distinct neural networks associated with directly experienced pain and empathy for pain. *Neuroimage*. 2011;54(3):2492-502.
47. Roff S. Reconsidering the "decline" of medical student empathy as reported in studies using the Jefferson Scale of Physician Empathy-Student version (JSPE-S). *Medical Teacher*. 2015;37(8):783-6.
48. Guraya SY, Norman RI, Roff S. Exploring the climates of undergraduate professionalism in a Saudi and a UK medical school. *Medical teacher*. 2016;38(6):630-2.
49. Riess H, Kelley JM, Bailey RW, Dunn EJ, Phillips M. Empathy training for resident physicians: a randomized controlled trial of a neuroscience-informed curriculum. *Journal of general internal medicine*. 2012;27(10):1280-6.
50. Fernando A, Consedine N, Hill AG. Mindfulness for surgeons. *ANZ journal of surgery*. 2014;84(10):722-4.
51. Van der Riet P, Rossiter R, Kirby D, Dluzewska T, Harmon C. Piloting a stress management and mindfulness program for undergraduate nursing students: Student feedback and lessons learned. *Nurse Education Today*. 2015;35(1):44-9.
52. Weng HY, Fox AS, Shackman AJ, Stodola DE, Caldwell JZ, Olson MC, et al. Compassion training alters altruism and neural responses to suffering. *Psychological science*. 2013;24(7):1171-80.
53. Krasner MS, Epstein RM, Beckman H, Suchman AL, Chapman B, Mooney CJ, et al. Association of an educational program in mindful communication with burnout, empathy, and attitudes among primary care physicians. *Jama*. 2009;302(12):1284-93.
54. Hojat M, Vergare MJ, Maxwell K, Brainard G, Herrine SK, Isenberg GA, et al. The devil is in the third year: a longitudinal study of erosion of empathy in medical school. *Academic Medicine*. 2009;84(9):1182-91.
55. Green MJ, Myers KR. Graphic medicine: use of comics in medical education and patient care. *Bmj*. 2010;340.
56. Williams IC. Graphic medicine: comics as medical narrative. *Medical Humanities*. 2012;38(1):21-7.
57. Al-Qahtani MF, Guraya SY. Measuring the attitudes of healthcare faculty members towards interprofessional education in KSA. *Journal of Taibah University Medical Sciences*. 2016;11(6):586-93.
58. Guraya SY, Barr H. The effectiveness of interprofessional education in healthcare: A systematic review and meta-analysis. *The Kaohsiung journal of medical sciences*. 2018;34(3):160-5.

## Tables

**Table 1: A tabulated summary of the 24 studies in this systematic review**

Study	Study Population	Study Design	Curriculum Design	Empathy Topics Addressed	Primary Outcome (Effect size and P value where available) <sup>a</sup>	Quality Assessed (MERSQI) <sup>b</sup>
Albertine S. Beard, 2020	<b>N:</b> 10 <b>Level of training:</b> Third Year	Controlled Trail 2 groups	<b>Modality:</b> Longitudinal Integrated Clerkships – VALUE <b>Frequency/Duration:</b> 10 months	A respect for a patient's values and preferences /a clear patient physician communication/A well-coordinated care	<b>Patient outcome-</b> A greater sense of satisfaction reported by VALUE patients with their health care providers in terms of explanations provided, knowledge of patients' history, and their best interests ( $P < .05$ )	16.5
Lauren Collins, 2020	<b>N:</b> 45 <b>Level of training:</b> Third and fourth year	Controlled Trial (control-no intervention)	<b>Modality:</b> Student Hot spotting/ IPE/ Apprenticeship/Supervision <b>Frequency/Duration:</b> 6 months	Patient centred approach/Partnership for a personalized self-management plan	<b>Knowledge:</b> ATHI, JSE; A higher post-test score in terms of self-efficacy and empathy (participants Vs controls) ( $P=.05$ ).	10.5
Elizabeth Davison, 2019	<b>N:</b> 170 <b>Level of training:</b> First Year	Single group, post-test only	<b>Modality:</b> Student supervision by an HCA* mentor in an early clinical exposure curriculum <b>Frequency/Duration:</b> 3 days	Incorporate human values while underpinning Interprofessional practice (IPP)	<b>Self-report:</b> Reflections narrated more able to empathize, better equipped and confident and appreciate IPP.	11
Leanne M. Chrisman-Khawam, 2019	<b>N:</b> 64 <b>Level of training:</b> Undergrad students	Single group, post-test only (qualitative)	<b>Modality:</b> Service-learning experience – student run free clinic – socialization - mentorship - reflective practice <b>Frequency/Duration:</b> Weekly winter season clinics	Model of patient-physician Relationships/Interprofessional relationships/Professional identity formation	<b>Self-report:</b> More introspective and a sense of connection to patients on a human level.	NA
Prima Cheryl D'souza, 2019	<b>N:</b> 82 <b>Level of training:</b> Second Year	RCT	<b>Modality:</b> Didactic PowerPoint, video clips, and roleplay and simulation <b>Frequency/Duration:</b> Single session -2 hours	Empathetic communication	<b>Self-report:</b> JSE: A difference in empathy score (control vs intervention) ( $p = 0.014$ ) with a decline at 3-week follow-up ( $p = 0.020$ )	12
Hitomi Kataoka, 2018	<b>N:</b> 69 <b>Level of training:</b> Year 1-6	Single group, pre and posttest	<b>Modality:</b> Didactics case-based discussions; simulation with standardized patients, feedback provisions <b>Frequency/Duration:</b> Three 4-hours workshops over a period of two years	Communication skills and medical interviewing	<b>Self-report:</b> JSE: An immediate significant increase (SD=10.0) in post-test mean score ( $p<0.0001$ ), however, the mean score bounced back to the pre-test level in year 5 (SD=12.9) and year 6 (SD=13.8)	10
Anita Modi, 2017	<b>N:</b> 188 <b>Level of training:</b> First to Third Year	Controlled Trial (control- no intervention)	<b>Modality:</b> Service learning experience – student run free clinic – socialization - mentorship <b>Frequency/Duration:</b>	Early and consistent exposure to poor and underserved Patients – hidden curriculum – implicit to explicit	<b>Self-report:</b> JSE: A drop in mean empathy scores for both volunteers (2.2 points) ( $P = 0.07$ , effect size =0.20),	10

			Weekly student run clinics over a period of 3 years		and non-volunteers (3.1 points) ( $P = 0.009$ , effect size $>0.25$ ).	
Antonio T. Fernando, 2017	<b>N:</b> 83 <b>Level of training:</b> Third Year	RCT	<b>Modality:</b> Didactics - Mindfulness based exercises – Simulation – Role play <b>Frequency/Duration:</b> 2 hours single session	Emotions and clinical decision making/Self-compassion/Mindfulness/speech on civic service	<b>Behaviors; Objective:</b> A varying fluctuations of time allocated to each patient by participants with lower self-compassion vs a consistent time allocation to each patient by persons with high self-compassion. <b>Self-report:</b> SCS, MCSF-C, TMS, B-DES, VAS - Mindfulness led to an increased patient liking and caring in persons with lower self-compassion vs a greater helping behaviour in persons with a higher self-compassion. A promising enhancement of compassionate responses in medical students after a brief mindfulness induction ( $P < 0.05$ )	15
Celine Buffel du Vaure, 2017	<b>N:</b> 299 <b>Level of training:</b> Fourth Year	RCT	<b>Modality:</b> Simulation of interpersonal problems - Balint group <b>Frequency/Duration:</b> 7 weekly sessions over a period of 2 months	Solution to interpersonal problems during physician patient interaction.	<b>Patient outcome:</b> CARE : Non significant difference in mean CARE score (Intervention vs control groups) ( $P = 0.49$ ). <b>Self-rate-JSE:</b> An increase in score for intervention vs a decrease in score for control from baseline to follow-up [ $P = 0.031$ ].	16.5
Ing Van Dijk, 2017	<b>N:</b> 167 <b>Level of training:</b> First year of clinical clerkships (second/third year)	RCT	<b>Modality:</b> Didactic class room teaching <b>Frequency/Duration:</b> Eight weekly two-hour sessions	<b>MBSR :</b> Stress awareness and mindfulness: Communication, work life balance and recognizing boundaries	<b>Self-report-</b> BSI, MHC-SF, LiSat-9, JSE, FFMQ, IBI, MBSR group – a small reduction of psychological distress ( $P = .03$ ) and dysfunctional cognitions ( $P = .05$ ), while a moderate increase of positive mental health ( $P = .002$ ), life satisfaction ( $P = .01$ ), and mindfulness skills ( $P = .05$ ) vs CAU over a 20-month follow up. No significant change	13

					on empathy ( $P=0.18$ ).	
Karen E. Smith, 2017	<b>N:</b> 122 <b>Level of training:</b> First Year – third year	Single group pre and post-test	<b>Modality:</b> Online surveys and computerized tasks <b>Frequency/Duration:</b> At start and end of each academic year for first 3 years of medical school	Pain Visual Analogue Scales, being sensitive to others' pain and how to understand others' emotions, (video ratings of individuals expressions of pain and RMET)	<b>Behavior-</b> RMET; An significant improvement in accuracy in recognizing others' emotional states, and a decrease in reaction time in longitudinal measurements ( $p < 0.001$ ) <b>Self-report-</b> JSE score decreased over training ( $p < 0.01$ ) while QCAE revealed an improvement in different empathy components; cognitive (perspective taking,) and affective (emotion contagion) ( $p < 0.05$ )	15.5
M. Wundrich, 2017	<b>N:</b> 158 <b>Level of training:</b> Third Year	RCT	<b>Modality:</b> Videos, simulation and OSCE <b>Frequency/Duration:</b> 2 sessions (2.25 hours each)	Physician–patient relationship, empathy skills and behaviours	<b>Patient outcome-</b> by standardized patients and experts, significantly higher empathy score and ratings as compared to control group. ( $p < 0.05$ ) <b>Self-report-</b> JSE: no significant difference ( $p=0.13$ )	16
Marcello Schweller, 2017	<b>N:</b> 166 <b>Level of training:</b> First Year	Single group, pre and posttest	<b>Modality:</b> Patients and physicians' interviews, , role modelling, supervised hospital visits, analysis of videotaped simulated consultations <b>Frequency/Duration:</b> Weekly session over 4 months	Health and Medicine (H&M): Professional identity formation by incorporating desired Vvalues and virtues	<b>Self report-</b> JSE: Improved mean empathy scores (117.9 vs 121.3) ( $p<.001$ .)	9.5
Roger Ruiz-Moral, 2017	<b>N:</b> 115 <b>Level of training:</b> Third Year	Single group, pre and posttest	<b>Modality:</b> Multiple didactic, reflective, and interactive workshops and simulated patients encounters. <b>Frequency/Duration:</b> 6 weeks course	Contextual and emotional clues/empathetic response tailoring/communication process to identify the feeling produced by the empathetic responses.	<b>Patient outcome-</b> Progressive improvements over longitudinal period of time spanning all the domain and skills of communications by both OE (32.4%) and SP (38.3%) ( $p < 0.001$ )	13.5
Suman P. Singh, 2017	<b>N:</b> 93 <b>Level of training:</b> Second Year	RCT 2 tests (CDG and VSG) and 1 control	<b>Modality:</b> Low-Fidelity Simulation Techniques (Case Discussions and a	Emotional, social and financial consequences of HAI on patients and their families	<b>Knowledge-</b> significant change in knowledge test score ( $p=0.016$ ) among the groups <b>Self-report-</b>	12.5

			Video Show), interactive lectures, video show and demonstration were used		TEQ: significant difference in post-test	
			<b>Frequency/Duration:</b> 4 sessions in a week (4.5 hours)		empathy scores among the groups (p=0.026).  CDG (p=0.011), VSG (p=0.046) had significantly better empathy scores vs control group	
Adriana Foster, 2016	<b>N:</b> 70 <b>Level of training:</b> First year	RCT  2 tests and 1 control	<b>Modality:</b> online text-based interface for virtual patient (VP) interaction  <b>Frequency/Duration: Single session</b>	Empathetic Communication and Feedback VP:  (1) Depression portrayed by control VP  (2) A VP with a simulation backstory of patient shadowing, or  (3) An immediate empathy-feedback VP	<b>Patient outcome-</b> StP ratings; A significantly higher scores on empathy-feedback and backstory VP groups vs control VP group (P < 0.0001)  Trained assessors: A promising response of students in eliciting empathetic opportunities in empathy-feedback VP group vs backstory VP and control VP groups (P = 0.0005)	17
Alisa Alfonsi LoSasso[39], 2016	<b>N:</b> 70 <b>Level of training:</b> Third Year	RCT	<b>Modality: Small group</b> discussion of EMR use, the SALTED technique (Set-up, Ask, Listen, Type, Exceptions, Documentation), and role-plays.  <b>Frequency/Duration:</b> 1 hour	Training in EMR Specific Communication: empathetic engagement while history-taking and doctor patient interaction.	<b>Patient outcome-Significantly higher mean SP</b> ratings for intervention vs control group (P = .05)  <b>Self-report- JSE:</b> Non significant change in mean empathy score for intervention (P = .57) vs control group (P = .41)	16
Eun Ho Yu, 2016	<b>N:</b> 82 <b>Level of training:</b> First and Second Year	RCT	<b>Modality:</b> Didactic  <b>Frequency/Duration:</b> 1-hour class	Interpreting micro and subtle facial expressions	<b>Self-report-</b> significant post intervention increase of mean METT (29.3% ) and SETT (36.2%) scores (P < 0.001)	12
Jennifer S. Mascaro, 2016	<b>N:</b> 32 <b>Level of training:</b> Second Year	RCT  (control-wait list)	<b>Modality:</b> Didactic CBCT course, guided audio recordings, at home meditation practice  <b>Frequency/Duration:</b> 1.5 h once per week for 10 weeks.	Compassion meditation protocol – stability of mind, insight to inner world of thoughts and feelings, self-compassion, equanimity, appreciation and gratitude cultivation, empathy and compassion for others	<b>Self-report-</b>  CLHS; R-UCLA, DASS; PSS; SUI - increased compassion, decreased loneliness and depression (paired t-tests, p > 0.05)	11.5
Jeremy Graham, 2016	<b>N:</b> 68 <b>Level of training:</b> NR	Controlled Trial (Control- no intervention)	<b>Modality: Didactic</b> seminars, in class discussions, about films and art  <b>Frequency/Duration:</b> 10 in class contact hours in an elective course	Humanities course: Sociocultural studies, history of western medicine, and visual arts and literature	<b>Self-report- JSE</b>  Favourable empathy scores after humanities course (P=0.03)	10
Marlon Danilewitz,	<b>N:</b> 30	RCT	<b>Modality:</b> Medical student led peer program,	Adapted MBSR program: Stress awareness and mindfulness:	<b>Self report-</b> DASS; JSE; FFMQ; SCS;	11.5

2016	<b>Level of training:</b> First and Second Year	(Control-wait list WL)	homeworks <b>Frequency/Duration:</b> 8, 1.15 hours weekly sessions	Communication, work life balance and recognizing boundaries	AAS – MMP; a significant pre/post-test reductions in levels of stress ( $p=.019$ ), increase in self-compassion ( $p=.024$ ) and altruism ( $p=.033$ ) and changes in two facets of mindfulness: describe ( $p=.05$ ) and non-react ( $p=.034$ ). Significantly higher MMP vs WL post-test scores on FFMQ ( $p=.026$ )	
Meral Demiroren, 2016	<b>N:</b> 190 <b>Level of training:</b> Fourth and Fifth Year	RCT	<b>Modality:</b> Small group case-based discussions, Guided written and verbal reflections <b>Frequency/Duration:</b> 2.5 weeks course	Appropriate professional values and behavior; Patient-physician interaction	<b>Self-report-</b> BMI; JSE; PSCOM-PQ; BPTI; a statistically significant impact of training on conscientiousness ( $p=0.003$ ), openness to experience ( $p=0.033$ ), compassionate care ( $p=0.018$ ) and standing in the patient's shoes ( $p=0.036$ ); while students reported verbal reflections more beneficial vs written.	13.5
Pamela Tsao, 2016	<b>N:</b> 25 <b>Level of training:</b> First and Second Year	Single group post-test only  (qualitative)	<b>Modality:</b> Didactics, online study material, comic video recordings, in class guided written reflections and focus group discussions <b>Frequency/Duration:</b> 4-hour single session	Struggles of diabetes patient; how to bring behavioral change, reduce burnout, address fear of insulin initiation, avoid guilt, curb denial and frustration with complications	<b>Self-report-</b> Assessment of personal reflections revealed more empathy, better able to reflect and make meaning from work  JSE: mean JSPE scores baseline (116.4) and after watching comic videos, reflections (117.2) and focus group discussions (119.6)	NA
Pamela Duke, 2015	<b>N:</b> 259 <b>Level of training:</b> Third Year	Single group, pre- and posttest	<b>Modality:</b> Virtual hangouts - tutorials, small group discussion, reflections, blogs on VCR, LMS and SM <b>Frequency/Duration:</b> Virtual meetings every 8-12 weeks over 1 year	Appropriate professional values and behavior; empathy and self-reflection	<b>Self-report-</b> JSE no change in pre/post-test mean score, while a statistically significant increase in GRAS scores ( $p<0.001$ )  Assessment of blogs highlighted that sharing of personal narratives  foster reflective ability and reflective practice.	10.5

Abbreviations: VALUE : Veterans Affairs Longitudinal Undergraduate Medical Education, HCA: Health Care Assistant, JSE: Jefferson Scale of Empathy, SCS: Self-Compassion Scale, MCSF-C : Marlowe- Crowne Short Form C, TMS: Toronto Mindfulness Scale, B-DES: Brief Differential Emotions Scale, VAS: Visual Analogue Scale, CARE : Consultation And Relational Empathy Measure, BSI: Brief Symptom Inventory, MHC-SF: Mental Health Continuum-Short Form, LiSat-9: Life Satisfaction Questionnaire, FFMQ: Five Facet Mindfulness Questionnaire, IBI: Irrational Beliefs Inventory, MBSR: Mindfulness Based

Stress Reduction Training, CAU: Clerkships As Usual, QCAE: Questionnaire of Cognitive and Affective Empathy, OE: External observer, SP: Simulated patients, HAI: Healthcare Associated Infections, CDG: Case Discussion Group, VSG: Video Show Group, EMR: Electronic Medical Records, METT: Micro Expression Training Tool, SETT: Subtle Expression Training Tool, CBCT: Cognitively-Based Compassion Training, CLHS: Compassionate Love for Humanity Scale, R-UCLA: UCLA Loneliness Scale, DASS: Depression Anxiety and Stress Scale, PSS: Pittsburgh Sleep Scale, SU: Substance Use Inventory, MMP: Mindfulness Meditation Program, AAS: Adapted Altruism Scale, BMI: Beliefs towards Mental Illness Scale, PSCOM-PQ : Penn State College of Medicine Professionalism Questionnaire Student Form, BPTI: Basic Personality Traits Inventory, GRAS: Groningen Reflection Ability Scale, VCR: Virtual Classrooms, LMS: Learning Management system SM: Social Media;

<sup>a</sup>A bold outcome indicates that a statistically significant positive effect on the primary outcome was reported.

<sup>b</sup>The MERSQI is scored out of a possible 18, with higher scores indicating higher-quality studies.

**Table 2: The range of study designs used in the selected studies about empathy and compassion in medical students (n=24)**

Study Design	Number (percentage)	Publications references
Single group, post-test only	3 (12.5%)	[17, 21, 36]
Single group, pre- and post-test	5 (20.8%)	[24, 28, 32, 33, 35]
Controlled trials	4 (16.6%)	[16, 18, 27, 31]
Randomized controlled trials	12 (50%)	(8, 10, 11, 13, 14, 17, 18, 22, 25, 26)
Two or more institutions	3 (12.5%)	[22, 23, 35]

**Table 3: The quality of the 22 quantitative studies as measured by the Medical Education Research Study Quality Instrument (MERSQI).**

Quality Assessment	Value	Publications references
Mean MERSQI score	12.8	[16, 18-35, 37-39]
MERSQI of the articles with a score of 13 and above	10	[16, 22, 23, 25, 26, 29, 32, 35, 37, 38]
Highest MERSQI score	17	[26]
Lowest MERSQI score	9.5	[33]

NB. Scores on the MERSQI can range from 5 to 18, with a higher score indicating a higher-quality research study.

**Table 4: Educational interventions with frequency and duration used in the selected studies (n=24)**

Teaching modalities	No. (percentages) of studies		Publications references	
	Total no. (%)	Effective no. (%) <sup>a</sup>	<sup>a</sup> Effective	<sup>b</sup> Ineffective
Single modality	4/24 (16.6%)	3/4 (75%)	[26, 35, 39]	[37]
Multimodality (Didactics, workshops, simulation, reflection)	20/24 (83.3%)	18/20 (90%)	[16-18, 20-25, 27, 29-34, 36, 38]	[19, 28]
Didactics (lectures, presentations, power-point, assessments, seminars, discussions)	9/24 (37.5%)	6/9 (66.6%)	[25, 27, 30, 32, 36, 39]	[19, 28, 37]
Small group/Case-based discussion/ workshops	8/24 (33.3%)	7/8 (87.5%)	[22-24, 27, 29, 32-34]	[28]
Simulation	7/24 (29.1%)	5/7 (71.4%)	[23, 25, 32, 34, 38]	[19, 28]
Role modelling/mentorship /interprofessional education	6/24 (25%)	6/6 (100%)	[17, 18, 21, 31, 33] [16]	
Reflective exercises (verbal or written)	5/24 (20.8%)	5/5 (100%)	[17, 22, 24, 32, 36]	
Technology enhanced learning (virtual patients, virtual hangouts, computerized tasks, hot spotting)	4/24 (16.6%)	4/4 (100%)	[18, 24, 26, 35]	
Meditation exercises	4/24 (16.6%)	3/4 (75%)	[20, 25, 30]	[37]
Early clinic exposure (student run clinic and experiential learning)	4/24 (16.6%)	4/4 (100%)	[16, 17, 21, 31]	
<b>Frequency and duration</b>				
One session (1-2 hours)	5/24 (20.8%)	4/5 (80%)	[25, 29, 36, 39]	[19]
One half day or full day session	1/24 (2.4%)	1/1 (100%)	[26]	
Two-to-six sessions in an academic year	7/24 (29.1%)	7/7 (100%)	[18, 21, 22, 27, 30, 34, 38]	
More than six sessions in an academic year (e.g., a course, block rotation, longitudinal curriculum over a year)	7/24 (29.1%)	6/7 (85.7%)	[17, 20, 23, 24, 32, 33]	[37]
More than six sessions in multiple academic years (multiyear longitudinal curriculum)	4/24 (16.6%)	3/4 (75%)	[16, 31, 35]	[28]

<sup>a</sup>Effective indicates that a statistically significant positive effect on the primary outcome was reported. <sup>b</sup> Ineffective indicates that the reported effect was not statistically significant or statistical analysis was not reported.

NB. Individual studies used multiple types of educational interventions; therefore, number of studies are greater than 24 and percentages add to greater than 100.

**Table 5: An inventory of the validated instruments for outcome assessments used in the selected studies (n=24)**

Research instrument	Publications references
<b>Empathy</b>	
Jefferson's Scale of Physician Empathy	[18-20, 22-24, 27-29, 31, 33, 35-38]
Consultation and Relational Empathy Measure	[23]
Toronto Empathy Questionnaire	[34]
Questionnaire of Cognitive and Affective Empathy	[35]
<b>Attitude</b>	
Penn State College of Medicine Professionalism Questionnaire	[22]
Life Satisfaction Questionnaire	[20]
Beliefs towards Mental Illness Scale	[22]
Attitudes Toward Homelessness Inventory	[18]
Basic Personality Traits Inventory	[22]
Adapted Altruism Scale	[20]
<b>Students health and well-being</b>	
Brief Differential Emotions Scale	[30]
Groningen Reflection Ability Scale	[24]
Brief Symptom Inventory	[20]
Mental Health Continuum-Short Form	[20]
Five Facet Mindfulness Questionnaire	[20]
Irrational Beliefs Inventory	[20]
Toronto Mindfulness Scale	[25] [30]
Marlowe-Crowne Short Form C	[30]
Self-Compassion Scale	[30]
Irrational Beliefs Inventory	[37]
Depression Anxiety and Stress Scale	[20]
UCLA Loneliness Scale	[30]
Pittsburgh Sleep Scale	[30]
Substance Use Inventory	[30]
<b>Behaviour</b>	
Micro Expression Training Tool	[39]
Subtle Expression Training Tool	[39]
Visual Analogue Scale	[25]

## Figures

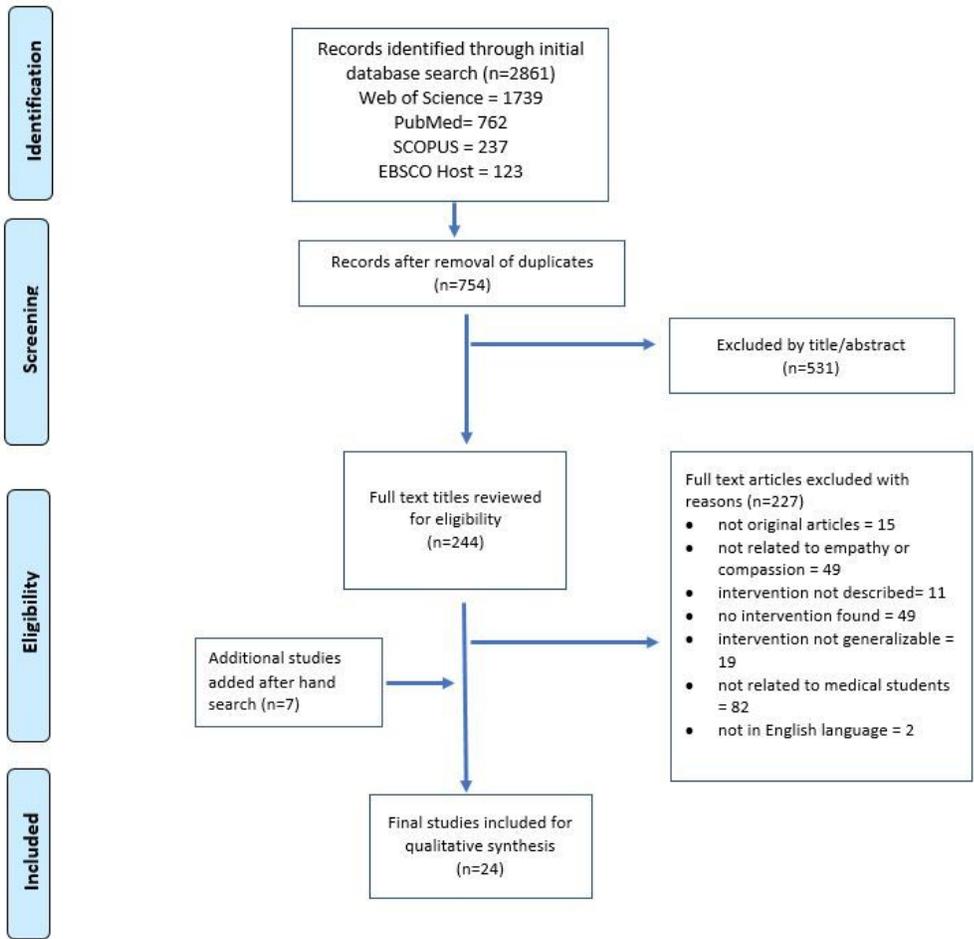


Figure 1  
 Flow diagram of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines for the selection of articles in this study.

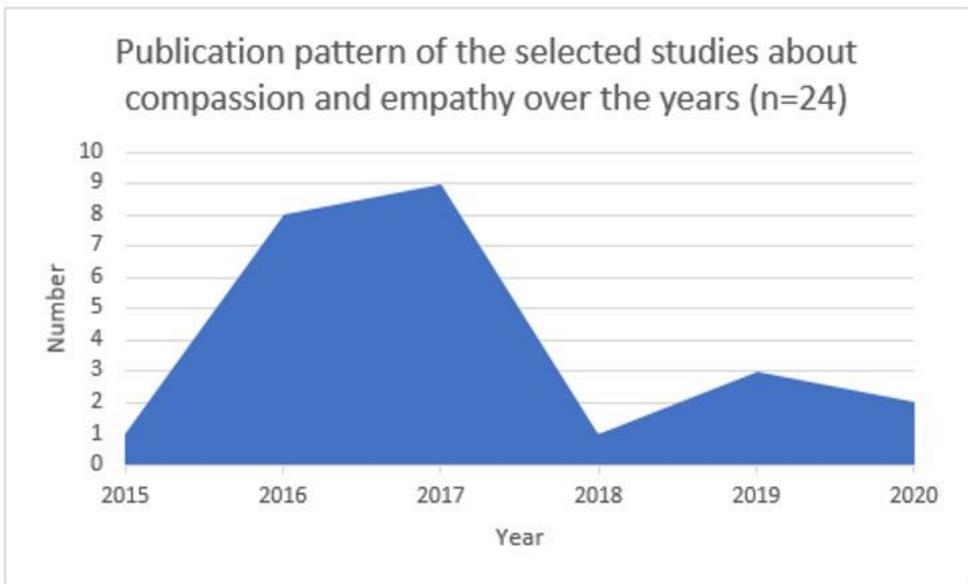


Figure 2  
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The pattern of publications of the selected studies about empathy and compassion over the years from 2015 to 2020 (n=24)

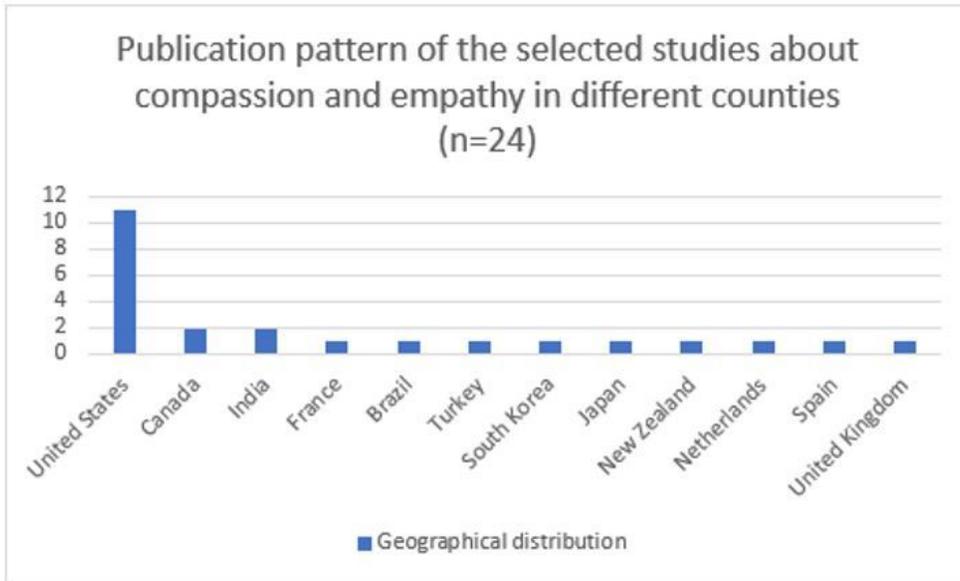


Figure 3

The pattern of publications of the selected studies about empathy and compassion in different counties (n=24)

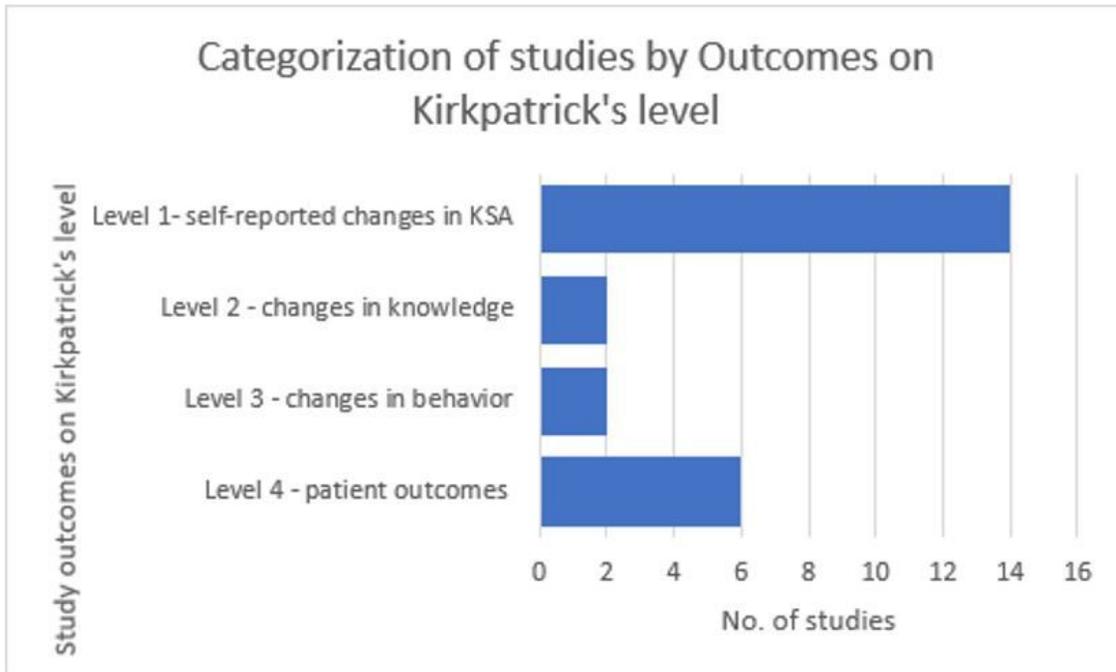
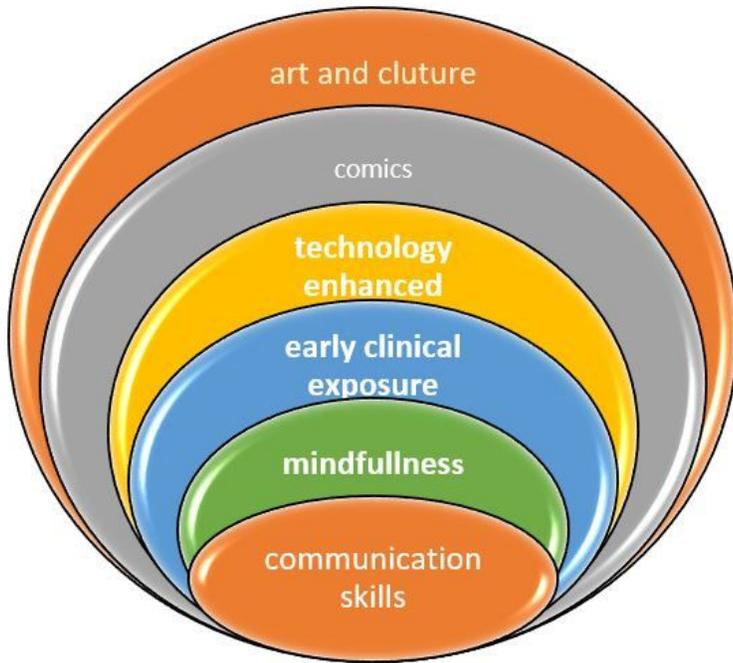


Figure 4

Study outcomes in this study as determined by the Kirkpatrick's model of four levels level According to the four-level outcomes based Kirkpatrick model, patients' outcomes are considered the highest quality and self-reported outcomes (satisfaction and changes in attitudes and behaviors) are considered the lowest quality.



**Figure 5**

Leading constructs that showed positive impact on empathy and compassion of medical students in this study.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Appendix1.docx](#)