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1 **Simulation in psychiatry for medical doctors: a systematic review and**
2 **meta-analysis.**

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ABSTRACT

CONTEXT: Most medical doctors are likely to work with patients experiencing mental health conditions. However, there are often limited educational opportunities for medical doctors to achieve professional development in the field of psychiatry. Simulation training in psychiatry may be a useful tool to foster this development.

OBJECTIVES: To assess the effectiveness of simulation training in psychiatry for medical students, post-graduate trainees, and medical doctors.

METHODS: For this systematic review and meta-analysis, we searched 8 electronic databases and trial registries up to August 31, 2018. We manually searched key journals and the reference lists of selected studies. We included randomised and non-randomised controlled studies and single group prepost-test studies. Our main outcomes were based on Kirkpatrick levels. We included data only from Randomised Controlled Trials (RCTs) using random-effects models.

RESULTS: From 46 571 studies identified, we selected 163 studies and combined 27 RCTs. Interventions included simulation by role-play (n=69), simulated patients (n=72), virtual reality (n=22), manikin (n=5) and voice simulation (n=2). Meta-analysis found significant differences at immediate post-test for simulation compared with active and inactive controls on attitudes (SMD=0.52 (95%CI [0.31; 0.73]; I²= 0%) and 0.28 (95%CI [0.04; 0.53]; I²= 52%), respectively); on skills (SMD=1.37 (95%CI [0.56; 2.18]; I²=93%) and 1.49 (95%CI [0.39; 2.58]; I²= 93%), respectively); on knowledge (SMD=1.22 (95%CI [0.57; 1.88]; I²= 0%) and 0.72 (95%CI [0.14; 1.30]; I²= 80%), respectively); and on behaviours (SMD= 1.07 (95%CI [0.49; 1.65]; I²=68%) and 0.45 (95%CI [0.11; 0.79; I²=41%), respectively. Significant differences were found at three-month follow-up for patient benefit and doctors' behaviours and skills.

CONCLUSIONS: Despite heterogeneity in methods and simulation interventions, our findings demonstrate the effectiveness of simulation training in psychiatry training.

Registration: This study is registered in PROSPERO (CRD42017078779).

1 INTRODUCTION

2 Working with people suffering from mental health needs and training in psychiatry requires
3 specific knowledge, skills, and attitudes, which cannot simply be memorized and need
4 development through experiential learning. While most doctors have to work with patients
5 experiencing mental health conditions, for example somatic problems or interacting mental
6 and physical health needs, opportunities for learning how to work with these patients are
7 limited. Throughout medical training, experiences of working in psychiatry and mental
8 healthcare are minimal, and available experiences provide insight into only part of this field.
9 ^{1,2} Yet, over the past decade higher rate of mental health conditions, with its physical and
10 mental health comorbidities and increased mortality, demonstrate a growing economic and
11 social burden for society, including social stigmatization, professional exclusion, and
12 poverty.³ Undoubtedly, efforts to improve the knowledge, skills, and attitudes of doctors are
13 required to address the international burden of mental health conditions.

14
15 Simulation training may facilitate the acquisition of knowledge, skills, and attitudes that are
16 required to address this challenge and bridge the gap between theory and practice.⁴
17 Simulation training is widely used in several medical specialties and recognised as an
18 effective approach to enhance medical error management, patient safety, and teamwork in
19 healthcare, among other positive clinical and workforce outcomes.^{5,6} Although role-play (RP)
20 has a strong history in psychiatry, especially for teaching psychotherapy and training
21 psychiatric nurses, the use of simulation training is less advanced than for other
22 specialties.^{2,4,7} Simulated or standardised patient (SP) training has been progressively
23 developed,⁸ as have voice simulation (VS), virtual reality (VR), and manikin training more
24 recently.⁷

25
26 Several reviews have demonstrated the effectiveness of simulation training.^{6,9-13} However the
27 effectiveness of this training modality in psychiatry has not been addressed. Indeed, the
28 interpersonal authenticity and fidelity of simulation in psychiatry have been questioned
29 alongside the ability of SPs to accurately portray the cognitive, affective, and behaviour
30 complexity and symptomatology of mental health conditions.¹⁴⁻¹⁶ Moreover, while learners
31 need a secure and well-defined frame to develop reflective practice in simulation, challenges
32 can be presented by the blurred boundaries between the non-reality of simulation and the, at
33 times, transversal for reality of mental health conditions and symptoms, for example
34 delusions.¹⁴ Concurrently, due to the complexity of mental health conditions and personal
35 experience, the ability to provide phenomenologically accurate portrayals of psychosis – for
36 example, may be more complex than portraying physical illnesses such as diabetes.
37 Furthermore, due to the high personal involvement required to make simulation more real,
38 psychiatric simulations may generate phenomena such as role adherence and symptom
39 induction.¹⁷⁻²⁰ This raises ethical issues when depicting a patient with suicidal ideation, for
40 example,^{21,22} and may demand specific SP recruitment criteria, careful de-rolling after
41 simulations, specific follow-up or care, and additional training and support.²³ The opportunity
42 to have real patients- simulating scenarios raises other issues. Training real patients may be
43 challenging, for example, some patients may develop a detached style resistant to any acting
44 and rehearsal training, while others may chose to describe their own opinions rather than
45 portray symptoms, such as about their preferences for psychotropic medication²⁴. There may
46 also be a risk of psychological consequences, such as decompensating or retraumatising. In
47 addition, clinical practice in psychiatry requires enhanced interpersonal and communication
48 skills, the methods to develop which remain unclear.¹⁴ Finally, fears, assumptions, and stigma
49 towards psychiatric patients still exist among health professionals, which also creates a lack

1 of self-confidence in assessing and providing appropriate care towards these patients,^{1,25-28}
2 and questions quality of care and patient safety. Consequently, a safe and structured
3 environment in which to challenges these issues is highly valuable.
4

5 Recent reviews have suggested the potential of simulation training in psychiatry across a
6 range of situations: training of undergraduate nursing students;^{25,29,30} improving psychiatric
7 knowledge among medical students;³¹ assessing the benefit of objective structured clinical
8 examination (OSCE) for medical students,³² motivational interviewing training;³³ and using
9 manikin³⁴ or voice simulation³⁵ training. Since the first and only global review on simulation
10 in psychiatry published in 2008,² the number of studies has increased considerably. To our
11 knowledge, no recent global systematic review on simulation training in psychiatry has been
12 conducted since, and no meta-analysis has ever been performed. Hence, we conducted an
13 extensive systematic review on simulation training in psychiatry for medical students, post-
14 graduate trainees, and qualified doctors to assess its effectiveness on learners' change of
15 satisfaction, attitudes, skills, knowledge, behaviours and patient benefit, based on
16 Kirkpatrick's Training Evaluation Model, which WHO consider to be the standard reference
17 for assessment of learning.^{36,37}
18
19

20 **METHODS**

21 This systematic review and meta-analysis is reported according to the PRISMA Statement
22 (supplemental eTable 1).³⁸ Our study protocol was registered in PROSPERO
23 (CRD42017078779 (supplemental eText 1 for protocol amendment) and subsequently
24 published (supplemental eText 2 for article).³⁹

25 **Search strategy**

26 We searched the following electronic databases: MEDLINE via PubMed, EMBASE, Scopus,
27 CINAHL, PsychINFO, ERIC, the Cochrane Library (Cochrane Database of Systematic
28 Reviews and Cochrane central register of controlled trials (CENTRAL)), and Web of Science
29 (Science and Social Sciences Citation Index) from inception to August 31 2018 with no
30 language restriction. The search algorithm (reported in supplemental eText 3) combined
31 keywords and free-text words on simulation and mental health conditions, and were overseen
32 by an experienced research librarian and senior epidemiologist specialising in systematic
33 reviews.

34 We then manually searched the table of contents from the last ten years of ten journals
35 specialising in medical education and simulation. We searched clinical trial registries through
36 the International Clinical Trials Registry Platform (supplemental eTable 2) and each registry
37 website. Finally we screened all reference lists for further additional references.

38 **Eligibility criteria and selection process**

39 We included studies evaluating all forms of simulation training in psychiatry, including role-
40 play, simulated patients, manikin, virtual reality, and voice simulation training versus other
41 interventions or no training on Kirkpatrick's levels (learners' satisfaction, attitude, skills,
42 knowledge, behaviours and patient benefit).³⁹ Patient benefit reflects to what degree targeted
43 outcomes occur in clinical practice as a result of the training event and subsequent
44 reinforcement.³⁶ We included randomised controlled trials (RCT), non-randomised controlled
45 studies (non-RCT), and single group pre/post-test (PPT) studies. For this study, we focused on
46 training for medical students, post-graduate trainees, and medical doctors.

47 Two authors independently screened all titles and abstracts retrieved by the search before

1 proceeding to full text review using Covidence.⁴⁰ Discussions were conducted on 1 512
2 articles of the 46 571 articles screened. Any disagreements were resolved through discussion
3 with a third reviewer to reach consensus.

4 In case of unclear eligibility or lack of full-text article, the corresponding author was
5 contacted for further information by email with two reminders, before the article was
6 automatically excluded if clarifications had not been provided (supplemental eTable 3).

7 **Data extraction**

8 Two authors independently conducted data extraction. Inter-rater agreement for the 10
9 main data points extracted are reported in eText 4. A standardised data extraction
10 template was developed in Microsoft Excel (supplemental eTable 4) to extract data for each
11 study on general characteristics, objectives, participant characteristics, design, simulation
12 format, outcomes and results. More details are reported in the study protocol (supplemental
13 eText 2).³⁹

14 The methodological quality of included studies was evaluated by the Medical Education
15 Research Study Quality Instrument (MERSQI),⁴¹ and by the Risk of bias (ROB) tool
16 for RCTs developed by Cochrane.⁴² We also evaluated presence of key features that are
17 associated with effective learning in simulation training; such as presence of feedback or
18 multiple learning strategies.^{5,6,13}

19 Only English and German language articles were found, understood by both reviewers,
20 needing no further translation.

21 Where data was missing or unclear, the corresponding author was contacted for further
22 information by email with two reminders.

23 **Data analysis**

24 Meta-analyses (MA) were only performed for RCTs to limit bias as recommended in the
25 Cochrane handbook.⁴³ Intervention effect was estimated with standardized mean difference
26 (SMD) for quantitative variables.⁴⁴ When missing, we imputed mean and SD if enough data
27 were available.⁴³ For RCTs reporting changes from baseline, we extracted only post-test
28 means and SDs to limit the rate of imputed outcome.⁴³

29
30 RCTs with unclear outcome reports were not included in meta-analyses. For each outcome,
31 we separately combined comparisons versus active (other training as intervention) or inactive
32 (no other pedagogy) control. We considered two time-points of interest: immediate post-test
33 (until one month after training end) and three months post-test (from two to four months
34 follow-up). When we had an adequate number of studies (more than 5 studies per meta-
35 analyses), subgroup analyses were conducted on trainees' level (medical students, post-
36 graduate and completed post-graduate training) and simulation format (RP, SP, VR, VS and
37 manikin).

38 Due to heterogeneity in participants and simulation interventions, we used random effects
39 meta-analysis models. We assessed statistical heterogeneity by visually inspecting the forest
40 plots and through I^2 statistic.⁴³ Assessment of small study effect was planned for meta-
41 analyses including ten studies or more by funnel plots (to investigate asymmetry) and Egger
42 test. To explore the impact of risk of bias, we planned sensitivity analyses when meta-
43 analyses included more than five studies, by excluding trials at high or unclear risk of bias
44 (defined as at least one domain at high or unclear risk of bias according to the ROB tool),

1 according to profession (we excluded from analysis studies with participants mixing with
2 other healthcare professionals), pedagogical design (we excluded from analysis studies with
3 adjuvant pedagogy in addition to simulation training) and pedagogical quality (we excluded
4 from analysis studies with MERSQI scores inferior to 12, reported in a previous meta-analysis
5 on simulation training as a high quality score).⁶

6
7 Significant difference was considered when $P < 0.05$, and Cohen effect size classification⁴⁵
8 was used to assess clinical significance: >0.8 for large; 0.5 to 0.8 for medium; <0.5 for small.
9 RevMan software V.5.3 was used for all meta-analyses.

10
11 We assessed quality of evidence with the Grading of Recommendations Assessment,
12 Development and Evaluation (GRADE).⁴⁶

13
14 The analysis of pre/post-test and non-RCTs was qualitative because of differences in study
15 design and expected heterogeneity.⁴³ We took into account in decreasing order: effect size;
16 statistical significance; and simple increase, decrease or difference observed on data when no
17 other calculation are reported.

18 19 20 **RESULTS**

21 22 **Search results**

23 Figure 1 shows a flowchart of study selection process. Our search identified 46 571 studies
24 for title and abstract screening, from which 1 414 were eligible for full text review. Of these,
25 163 met inclusion criteria (including 10 560 participants) with 27 RCTs combined in meta-
26 analyses (including 2 351 participants).

27 28 **Study characteristics**

29 Study characteristics are reported in supplemental eTable 5, summarized in eTable 6, with
30 key simulation features reported in supplemental eTable 7. Studies were mainly from USA
31 (97, 59.5%) and UK (26, 16%) (see supplemental eText 5 for other countries). There were
32 114 (69.9% of studies included) publications since the first and only global review on
33 simulation training in psychiatry was published in 2008.² Study quality and risk of bias for
34 RCTs are reported in supplemental eTable 8 and 9. We did not assess reporting bias by
35 examining funnel plots and Egger test because no meta-analysis included ten or more studies.
36 We found only one study judged as low risk of bias.⁴⁷ Thus we did not perform sensitivity
37 analysis on risk of bias. We performed sensitivity analysis only for one meta-analysis on
38 skills outcome as it included more than 5 studies. GRADE quality of evidence was found to
39 be between "moderate" and "very low" (supplemental eTable 10). Forest plots of each
40 outcome are reported in figure 2 (and in supplemental eFigure 1 with complete data, subgroup
41 and sensitivity analysis).

42 43 **Findings**

44 ***Satisfaction***

45 Satisfaction was reported in eight studies (753 participants). There was a significant
46 difference in one RCT (104 medical students),⁴⁸ and in three out of the five non-RCTs (355
47 medical students), but not in the single PPT.²⁴

48 49 ***Attitudes***

1 Attitude outcomes were reported in 103 studies (6 380 participants), including belief, self-
2 confidence, self-efficacy, anxiety and attitudes towards patients and psychiatry as outcomes.
3 A significant medium effect size was found in a meta-analysis of five studies comparing
4 simulation to an active control at immediate post-test (SMD=0.52; 95%CI [0.31; 0.73]) with
5 no heterogeneity ($I^2=0\%$). A significant small effect size was found in a meta-analysis of five
6 studies between simulation and inactive control at immediate post-test (SMD=0.28; 95%CI
7 [0.04; 0.53]) with heterogeneity at 52%. No significant difference was found in a meta-
8 analysis of two studies with active control at three months follow-up (SMD=0.19; 95%CI [-
9 0.22; 0.60]). From the seven RCTs not included in MA (308 participants), three RCTs⁴⁹⁻⁵¹
10 found significant differences between simulation and control groups. Among the 15 non-
11 RCTs (1 655 participants) assessing attitudes, eight (688 participants) showed significant
12 differences between intervention and control groups; maintained at 2 months in two study,^{52,53}
13 and six months in one study.⁵⁴ From the 70 PPTs (3 267 participants), 49 (2 768 participants)
14 reported significant differences between pre and post-test; maintained at one month in two
15 studies,^{55,56} three months in two study,^{57,58} four months in one study,⁵⁹ six months in two
16 studies,^{60,61} ten months in one study,⁶² one year in two study,^{63,64} with effect sizes between
17 0.25 and 2.30 in eight studies.⁶⁵⁻⁷²

18

19 **Skills**

20 Skills outcomes were reported in 59 studies (3 197 participants). A significant large effect
21 size was found in a meta-analysis comparing simulation to active control on seven studies
22 (SMD=1.37; 95%CI [0.56; 2.18]) at immediate post-test, with high heterogeneity at 93%.
23 Results were consistent in the subgroups medical students (SMD=1.38; 95%CI [0.10; 2.66];
24 $I^2=96\%$), post-graduate trainees (SMD=1.39; 95%CI [0.22; 2.57]; $I^2=84\%$) and manikin
25 (SMD=2.65; 95%CI [1.34; 3.96]). But in the subgroups of RP (SMD=1.05; 95%CI [-0.10;
26 2.21]; $I^2=92\%$), SP (SMD=0.69; 95%CI [-0.66; 2.03]; $I^2=87\%$) and VR (SMD=2.00; 95%CI
27 [-1.57; 5.56]; $I^2=98\%$), we found no significant difference. Sensitivity analysis without mixed
28 profession and with high pedagogical quality found consistent results (SMD=1.37; 95%CI
29 [0.56; 2.18]; $I^2=93\%$). Another sensitivity analysis removing studies with blinded learning
30 also found consistent results (SMD=1.56; 95%CI [0.32; 2.80]; $I^2=94\%$).

31 A significant large effect size was found in a meta-analysis comparing simulation to inactive
32 control on five studies (SMD=1.49; 95%CI [0.39; 2.58]) with high heterogeneity at 93%.

33 For three month follow-up, we found a small significant differences in a meta-analysis of four
34 studies comparing simulation with inactive control (SMD=0.34; 95%CI [0.02; 0.66]) with
35 low heterogeneity ($I^2=35\%$).

36 In the six RCTs not included in meta-analyses (271 participants), three⁷³⁻⁷⁵ found significant
37 differences between simulation and control. Among the 16 non-RCTs (1 387 participants) on
38 skills, nine non-RCTs (628 participants) showed significant differences between intervention
39 and control groups, maintained in one study at 5 weeks,⁷⁶ in one study at 2 months,⁵³ and in
40 one study at 7 months;⁷⁷ with effect sizes at 0.61 for one study.⁷⁸ For the 24 PPTs (547
41 participants) assessing skills, 19 studies (481 participants) reported significant differences
42 between pre and post-test; maintained in three studies at one month,^{55,79,80} in another at three
43 months,⁸¹ in another at two years an half,⁸² and not at all at 6 months in two others,^{83, 84} with
44 one effect size at 0.58.⁷⁹

45

46 **Knowledge**

47 Knowledge outcomes were reported in 57 studies (4 064 participants). A significant large and
48 medium effect size was found in meta-analyses comparing simulation to both active
49 (SMD=1.22; 95%CI [0.57; 1.88]; $I^2=0\%$) and inactive (SMD=0.72; 95%CI [0.14; 1.30];

1 $I^2=80\%$) controls respectively at immediate post-test, including 2 and 5 studies in each meta-
2 analysis.
3 In the four RCTs not included in meta-analyses (174 participants), one⁴⁹ found significant
4 differences between simulation and control. Among the 14 non-RCTs (1 577 participants) on
5 knowledge, six non-RCTs (728 participants) showed significant differences between
6 intervention and control groups, maintained at one month for one study,⁸⁵ and at one year for
7 one study,⁸⁶ For the 33 PPTs (1 892 participants) assessing knowledge, 20 studies (956
8 participants) reported significant differences between pre and post-test, with effect sizes
9 between 0.37 and 2.3 for four studies.^{65,69,71,87} Results were maintained at three months in
10 three studies,^{81,88,89} 6 months in one study,⁶¹ ten months in one study,⁶² and one year in one
11 study.⁶⁴
12

13 ***Behaviours***

14 Behaviour outcomes were reported in 36 studies (2 470 participants). A significant large and
15 small effect size was found in meta-analyses comparing simulation to both active
16 (SMD=1.07; 95%CI [0.49; 1.65]) and inactive (SMD=0.45; 95%CI [0.11; 0.79]) controls at
17 immediate post-test, with heterogeneity at 68% and 41%, for three and four studies
18 respectively.

19 For three month follow-up, a significant large effect in three studies was found for simulation
20 compared with active control (SMD=0.83; 95%CI [0.42; 1.24]), with high heterogeneity
21 ($I^2=67\%$).

22 In the four RCTs not included in meta-analyses (268 participants), two^{50,90} found significant
23 differences between simulation and control. Among the eight non-RCTs (509 participants) on
24 behaviours, four non-RCTs (366 participants) showed significant differences between
25 intervention and control groups, maintained at ten months in one study.⁶² For the 15 PPTs
26 (828 participants) assessing behaviours, ten studies (578 participants) reported significant
27 differences between pre and post-test; maintained at one month in two study,^{79,91} three months
28 in two studies,^{89,92} one year in one study,⁶³ eighteen months in one study,⁹³ and two years in
29 one study,⁶¹ with effect size at 0,32 in one study.⁹²

30 ***Patient benefits***

31 Evaluation of patient benefit was reported in 13 studies (609 participants). A significant small
32 effect size was found in a meta-analysis of two studies comparing simulation to active control
33 at three month follow-up (SMD=0.22; 95%CI [0.08; 0.36]) with no heterogeneity. In the five
34 RCTs not included in meta-analyses (279 participants), two^{94,95} found significant differences
35 between simulation and control. Two non-RCT^{96,97} reported significant differences with
36 controls. From four PPTs (111 doctors), one reported significant differences between pre and
37 post-test, maintained at six months.⁸⁴
38
39

40 **DISCUSSION**

41 This thorough systematic review sought to assess the effectiveness of simulation training in
42 psychiatry for medical students, post-graduate trainees, and doctors based on Kirkpatrick's
43 Evaluation Model. We found significant differences at immediate post-test in meta-analyses
44 for simulation compared with both active and inactive controls for attitudes, skills, knowledge
45 and behaviours. Significant differences were found at three-month follow-up with large effect
46 size for behaviours and small effect size for skills and patient benefits.

47 Most of the studies included in our systematic review focused on attitudes, skills, and
48 knowledge (ASK), showing wide effectiveness of simulation training in psychiatry on ASK.

1 PPTs showed significant differences between pre and post-test on ASK for two thirds of
2 studies, although we cannot exclude natural learning effect. Indeed, for non-RCTs and RCTs
3 not included in MA, barely half of the studies showed significant differences between
4 simulation and control groups. However, the low number of controlled studies might explain
5 such results. The number of RCTs was sufficient for meta-analyses, but not enough to provide
6 overwhelming evidence, despite some very high quality research.^{47,98-100} Of the 37 RCTs
7 identified, only 27 were included either because of incomplete data or evaluation of different
8 time points for assessment.

9
10 For behaviours and patient benefit outcomes, significant differences were found in half of the
11 included studies across RCTs (not included in MA), non-RCTs and PPTs. A smaller number
12 of studies and heterogeneous time points for assessment make interpretation difficult. Limited
13 evidence of effects at three months remains difficult to interpret because few studies were
14 included in meta-analyses. Nonetheless, this raises the question of the need for repeated,
15 consistent and continuous training. Regarding satisfaction, few studies were identified and
16 used PPT and control group, suggesting higher satisfaction for simulation versus control from
17 these initial findings. The majority of published studies used post-test design only, which
18 were not included in this study and whose results will be reported elsewhere.³⁹

19 **Comparison with other studies**

20 Findings are consistent with a recent review of medical students' learning and engagement
21 during simulation training in psychiatry regarding attitudes and skills.³¹ Our results are
22 congruent with previous reviews on undergraduate nursing students showing effects of
23 simulation on anxiety, self-confidence,^{25,30} knowledge, empathy,³⁰ communication skills,
24^{25,29,30} risk assessment, critical thinking, problem solving, and decision making.²⁹ Another
25 review on motivational interviewing training also reported significant practitioner change
26 behaviours that are indicated by our findings across a broader setting.³³ However, our results
27 are the first to include a global assessment of all types of simulation training for initial and
28 continuous training among doctors.

29
30 We found high heterogeneity across studies, undermining robustness of results regarding
31 outcomes across the Kirkpatrick Model's levels. Simulation design also showed high
32 heterogeneity, both on content (for example, mental health conditions, treatment and clinical
33 processes) and modalities (for example, variation in scenarios, range of difficulties, practice
34 or observation, feedback nature, length). Additionally adjuvant pedagogy and training was
35 often included alongside simulation (for 76.1% of studies), adding complexity to comparison
36 of outcomes across studies. Heterogeneity of participants' level of experience and receiving
37 training in multi-disciplinary groups added further difficulties to comparison and
38 interpretation (for example, comparing students and doctors, or training with other healthcare
39 professionals). Outcome measures and instruments were also highly variable, complicating
40 comparisons. This complexity reflects the diversity and developments in educational
41 technology and approaches that influence doctors' and all healthcare professionals' learning.
42 However, such heterogeneity is consistent with the diverse and complex nature of psychiatry
43 and mental health conditions, as well as that of simulation training in this field. This may
44 highlight the external validity of our findings by recognising that attempting to understand
45 heterogeneity in simulation training in psychiatry reflects the practical implementation of this
46 method within specific contexts. Furthermore, this provides an opportunity to develop clearer
47 guidelines and support to develop simulation training in psychiatry that allows for tailoring
48 and individualization to specific contexts and needs of learners.

1 Certain studies (mostly PPTs) assessed outcomes at follow-up time points, finding significant
2 differences. However, the time points for data collection were highly disparate, preventing
3 reliable comparison to determine long term effectiveness. Certain studies evaluated behaviour
4 and patient benefit outcomes and had high pedagogical quality (for example)^{47,94,101,102} but do
5 not yet demonstrate compelling evidence on simulation training's effectiveness. Indeed the
6 ability of simulation training to improve behaviours, patient outcomes, and be effective
7 longitudinally based on retention and deep learning is a key argument for adopting simulation
8 training over more traditional methods, and as such merits further investigation.

11 **Implications**

12 Nonetheless, even in light of concerns raised with simulation in psychiatry,^{2,14,16,22,24} our
13 results suggest notable benefits, including for high complexity topics such as interpersonal
14 dynamics and psychological disturbances. Our findings build on SP guidelines¹⁰³ and reports
15 of SP training,^{104,105} suggesting foundations for psychiatric simulations, including strengths of
16 using professional actors compared with volunteers; introducing SPs to the psychiatric
17 context (through videos, readings, visit psychiatric hospital or ambulatory setting and/or real
18 patient encounter); careful recruitment and close monitoring of SPs for psychological effects
19 of acting. Role play has traditionally been used in psychiatry-² and remains common, often
20 used for mental disorders that are less complex to portray (such as depression or substance
21 use disorders). The promising effects of VR simulation, from preliminary research, has been
22 linked with important efforts to make encounters with virtual patient realistic enough to
23 effectively engage learners.^{92,106-108} Early research into the use of manikins to teach discrete
24 procedural skills in psychiatry, such as electroconvulsive therapy, have showed
25 effectiveness.^{64,109,110}

26
27 Few studies^{24,111-114} identified used real patients for simulations, possibly emphasizing the
28 need for prudence, which raises questions around how to address stigma, as proximity and
29 exposure are known approaches. However, simulation training can provide other methods
30 through which to address stigma using alternative pedagogies that illicit the personal
31 narratives and experiences of patients,^{111,115} such as: simulation formats (e.g. voice
32 simulation),^{35,116,117} simulations focused on patient-centered approaches,¹¹⁸ empathic skills
33 training,⁷³ virtual patients,¹¹⁹ Indeed, almost two-thirds of studies reported attitude change as
34 an outcome, demonstrating the importance of addressing beliefs and self-confidence as
35 essential learning that can be harnessed through simulation in psychiatry to address stigma.

36
37 As reported in eTable 7, three quarters of studies used feedback or debriefing and multiple
38 learning strategies, and two third used individualized learning and curriculum integration, to
39 ensure learning outcomes and benefits. Almost all studies were implemented in a controlled
40 environment. These features, recognized as essential in high-fidelity simulation,^{5,13} appear to
41 be essential for effective simulation training in psychiatry. Additionally, video-feedback was
42 common in psychiatry (see eTable 5), reflecting the uniqueness and idiosyncrasy of each
43 doctor-patient encounter, and allowing this to be mirror for each trainee-SP encounter.
44 Indeed, this demonstrates that simulation training in psychiatry can provide more authenticity
45 than medical simulation based on the nature of patient and simulated patient interactions.
46 Concurrently, as the principles of repetitive practice to develop mastery learning, deliberate
47 practice and employing a range of task difficulties are less commonly reported, possibly due
48 to the complexity of using these principles in psychiatric scenarios. Moreover, the structure of
49 debriefing is rarely reported and even more rarely assessed,^{119,120} demonstrating the pressing
50 need for more guidance, educational rigour and improved practice on this key feature.

1 Study characteristics summarized in eTable 6 demonstrate the common use of simulation
2 training for depression, anxiety disorders, alcohol and substance use disorders, or suicide and
3 violence symptoms. Other areas such as mania, psychosis, personality disorders, or delirium
4 and hallucination are less common, suggesting more complexity in simulating these topics.
5 Moreover, some areas (subspecialties such as child and adolescent and old age psychiatry; or
6 mental health conditions such as obsessional compulsive disorders, attention-deficit
7 hyperactivity disorders, and autism) featured less in the literature, highlighting the need of
8 taking a global view of psychiatry through simulation training and expanding implementation.
9

10 Furthermore, eTable 6 reports that simulation in psychiatry is currently used mainly for
11 professionals not working in mental health. This demonstrates the opportunity for developing
12 simulation training in other medical fields when dealing with mental health, comorbidities
13 and added complexity, for example working with parents responsible for childhood
14 maltreatment in paediatrics, working with sexual disorders in urology and/or gynaecology,
15 and management of an agitated or aggressive carer for a geriatric patient.
16

17 Further research is required to clarify the full potential of simulation training in psychiatry,
18 requiring RCTs, assessment of behaviours and patient outcomes, longitudinal evaluations,
19 long term assessment of cost-effectiveness (for example through reducing errors and
20 improving clinical outcomes), and qualitative methodologies to clarify the active mechanisms
21 of learning and behaviour change in simulation training. Essential components of simulation
22 training in psychiatry require further investigation, such as the structure of debriefing, specific
23 use of video-feedback, participation of real patients and peer supporters in part of the
24 simulation training (e.g, scenario development, SP training, debriefing). Such research is
25 required to improve the quality, accessibility and implementation of simulation training in
26 psychiatry through alignment to public health and healthcare policies and funding.
27 Standardisation, while allowing tailoring to needs, and building of quality criteria including
28 pedagogy, structure, delivery and curriculum alignment must be developed. Beyond initial
29 steps, further homogenisation of approaches and learning and outcome measurement will
30 support creation of a robust evidence base in the literature, especially in specific contexts
31 (such as child and adolescent psychiatry). This would justify inclusion of simulation training
32 in psychiatry in curricula as a tool to improve professional development and clinical care.
33 Indeed more robust findings on longitudinal effectiveness would enhance the case for
34 simulation training in psychiatry to be seen as highly valuable to improving patient outcomes
35 and experience, as it is in other specialties such as Obstetrics and Gynaecology. Finally,
36 diversification of cultural implementation beyond the dominant US and UK settings would
37 develop the pedagogical approach as well as advance the field as a whole.
38

39 **Limitations**

40 While this study presents novel and useful findings in this field, it has some limitations.
41 Although we aimed to be as thorough as possible, we may have missed some studies. We
42 included only post-test results, missing baseline change (to limit data imputations), and for
43 most studies, we did not find a global summary measure of results, limiting inclusion of some
44 results in pooled estimated effects. Moreover, even for only two time point collection, we
45 could not perform meta-analyses with active and inactive controls on each level of
46 Kirkpatrick's Model. Subgroup analyses could be performed only for skills outcome. The
47 number of studies was insufficient to inspect funnel plot and to make Egger tests, raising
48 difficulties in assessing risk of publication bias. We could perform limited sensitivity
49 analyses, both because of lack of studies and high risk of bias for almost all studies included,
50 suggesting potential flaws in meta-analyses results. Consequently, quality of evidence

1 reported though the GRADE tool was on average low. Finally, we chose to limit meta-
2 analyses to RCTs to improve the strength of evidence, but consequently other studies
3 (pre/post-test and non-RCTs) were reported in less detail.
4

5 **Conclusion**

6 Despite high heterogeneity, our results provide the best currently available evidence for
7 effectiveness of simulation training in psychiatry on medical students, post-graduate trainees,
8 and doctors' behaviours, skills, knowledge, attitudes and patient benefit. A threefold increase
9 in research over the past ten years, the emergence of high quality research, the diversity of
10 countries starting to develop simulation and recent innovations (such as VS and VR) indicate
11 the growing potential in implementing simulation training in psychiatry to support and
12 improve clinical care delivery for patients with mental health conditions.
13

14 **Contributors**

15 MAP was responsible for the original study proposal. MAP, AD and GG drafted the original study protocol. BF, AT, CLB and CL revised
16 the proposal. MAP and GG independently screened papers and extracted data. AD, BF, AT and CL helped work towards consensus when
17 there was disagreement. MAP did the statistical analysis. AD provided advices on methodology and statistical analyses. MAP wrote the
18 initial draft of the manuscript. AD, BF, FJ, CA, SC, GB, AT, CLB, JJR, CL and DM provided content expertise, methodological guidance
19 and interpreted the findings in the context of the wider literature. All the authors contributed to consecutive drafts and approved the final
20 manuscript.
21

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26

27 **Conflicts of interest**

28 None declared.
29

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33

1 ***

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