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Levelling the learning ground for healthcare professionals across the world through SIMBA: a mixed-methods study

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ABSTRACT

Objectives To compare the acceptance, strengths and limitations of Simulation via Instant Messaging-Birmingham Advance (SIMBA) in low/middle-income countries (LMICs) and high-income countries (HICs), on healthcare professionals' professional development and learning.

Design Cross-sectional study.

Setting Online (either mobile or computer/ laptop or both).

Participants 462 participants (LMICs: 29.7%, n=137 and HICs: 71.3%, n=325) were included.

Interventions Sixteen SIMBA sessions were conducted between May 2020 and October 2021. Doctors-in-training solved anonymised real-life clinical scenarios over WhatsApp. Participants completed pre-SIMBA and post-SIMBA surveys.

Primary and secondary outcome measures Outcomes were identified using Kirkpatrick's training evaluation model. LMIC and HIC participants' reactions (level 1) and self-reported performance, perceptions and improvements in core competencies (level 2a) were compared using the χ^2 test. Content analysis of open-ended questions was performed.

Results Postsession, there were no significant differences in application to practice (p=0.266), engagement (p=0.197) and overall session quality (p=0.101) between LMIC and HIC participants (level 1). Participants from HICs showed better knowledge of patient management (LMICs: 77.4% vs HICs: 86.5%; p=0.01), whereas participants from LMICs self-reported higher improvement in professionalism (LMICs: 41.6% vs HICs: 31.1%; p=0.02). There were no significant differences in improved clinical competency scores in patient care (p=0.28), systems-based practice (p=0.05), practice-based learning (p=0.15) and communication skills (p=0.22), between LMIC and HIC participants (level 2a). In content analysis, the major strengths of SIMBA over traditional methods were providing individualised, structured and engaging sessions.

Conclusions Healthcare professionals from both LMICs and HICs self-reported improvement in their clinical competencies, illustrating that SIMBA can produce equivalent teaching experiences. Furthermore, SIMBA's virtual nature enables international accessibility and presents potential for global scalability. This model could steer future standardised global health education policy development in LMICs.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ We conducted a robust assessment to study the difference in experiences and impact of an online simulation-based learning model between participants from high-income and low-income and middle-income countries.
⇒ We have an approved standard (core competencies for postgraduate education defined by Accredited Council for Graduate Medical Education) thereby ensuring objective assessment of differences.
⇒ Although the transcript assessment was based on the adapted global rating scale for the current national and international guidelines, the experts during discussions were mostly UK based which may have resulted in the region bias.

INTRODUCTION

While the COVID-19 pandemic disrupted medical education globally, the impact on low/middle-income countries (LMICs) was disproportionate to high-income countries (HICs) due to limited resources, opportunities and infrastructure for allocation into medical technologies and education.[1–3] The pandemic forced two-thirds of nations to reduce their education budget, further widening the education gap.[4] This gap is further exacerbated in higher education including medical education, especially in LMICs.[5] Efforts to improve medical specialisation in LMICs may provide an essential framework to form an efficient universal health coverage, although it remains imperative to promote equitable access.[6 7]

Continuing medical education is an established method that focuses on maintaining or developing knowledge, skills and

relationships to ensure competent practice.[8] However, this comes with a cost for both the provider and receiver. With affordability and accessibility in the focus, there is a need for cost-effective and time-effective methods to provide evidence-based medical education globally. Simulation-based learning has been recognised as a potential turning point for both undergraduate and postgraduate medical education, with newly available technologies and tools.[9–11] However, there is a limited evidence-base of the effectiveness of simulation-based training in medical education in LMICs, particularly in comparing learning outcomes between LMICs and HICs.[12]

Simulation via Instant Messaging-Birmingham Advance (SIMBA) is a free simulation-based training model using WhatsApp and Zoom platforms to increase healthcare professionals' confidence in managing various medical conditions. The participants initially interact with moderators via WhatsApp to undergo simulation, followed by an interactive discussion led by experts on Zoom. Built on the concepts of Kolb's experiential learning theory and simulation gaming theory, SIMBA has allowed both doctors and medical students to improve their self-reported clinical competencies without compromising patient safety.[13–17] In this article, we explore the acceptance, strengths and weaknesses of the SIMBA model in HICs versus LMICs.

METHODS

Simulated sessions

Sixteen SIMBA sessions focusing on various medical specialties, including diabetes and endocrinology,[6] acute medicine,[3] women's and reproductive health,[2] gastroenterology,[2] respiratory medicine,[1] renal medicine[1] and dermatology,[1] have been hosted between May 2020 and October 2021. A detailed description of the SIMBA model has been previously published.[14 15]

In brief, each session consisted of four to six clinical case scenarios on various medical presentations spanning the entirety of the patient's journey through secondary care. Sessions were advertised using social media platforms, junior doctor bulletins and the European Society of Endocrinology website. Information provided included the session title, date, time, virtual platform used and the session chairs. Participation was voluntary and all sessions were free. These cases were from real-life with any patient identifiable information removed and consisted of presenting symptoms, medical history, examination findings, clinical observations, investigation results (including blood tests and imaging), differential diagnoses, management and follow-up plans. These transcripts were approved by experts who chaired the corresponding SIMBA sessions and checked for appropriateness and scientific accuracy. Participants from both HIC and LMIC interact with the SIMBA transcripts using WhatsApp to solve each case at the same time. The cases are free to access and participants are asked to interact with a moderator in a style of patient encounter by taking an appropriate history, ordering relevant investigations and answering appropriate questions linked to diagnosis, follow-up and management of the patient case presented to them. After the simulation, participants interact with an expert in the case to resolve any queries they have for the simulated cases. Furthermore, peer-peer discussion observed during the case-based discussion in the Zoom chat was also picked up by experts to ensure holistic discussion and flow of ideas. A summary of the model is provided in online supplemental figure 1.

Data collection

All participants were requested to complete the pre-SIMBA and post-SIMBA survey voluntarily. Pre-SIMBA survey was shared just prior to the start of the session and included basic information on sociodemographic data and self-reported confidence in managing simulated services. Post-SIMBA survey was shared just after the end of expert case discussion session and included similar questions about self-reported confidence in managing simulated services. Post-SIMBA survey also asked for participant's experience of the session to provide us with their valuable feedback.

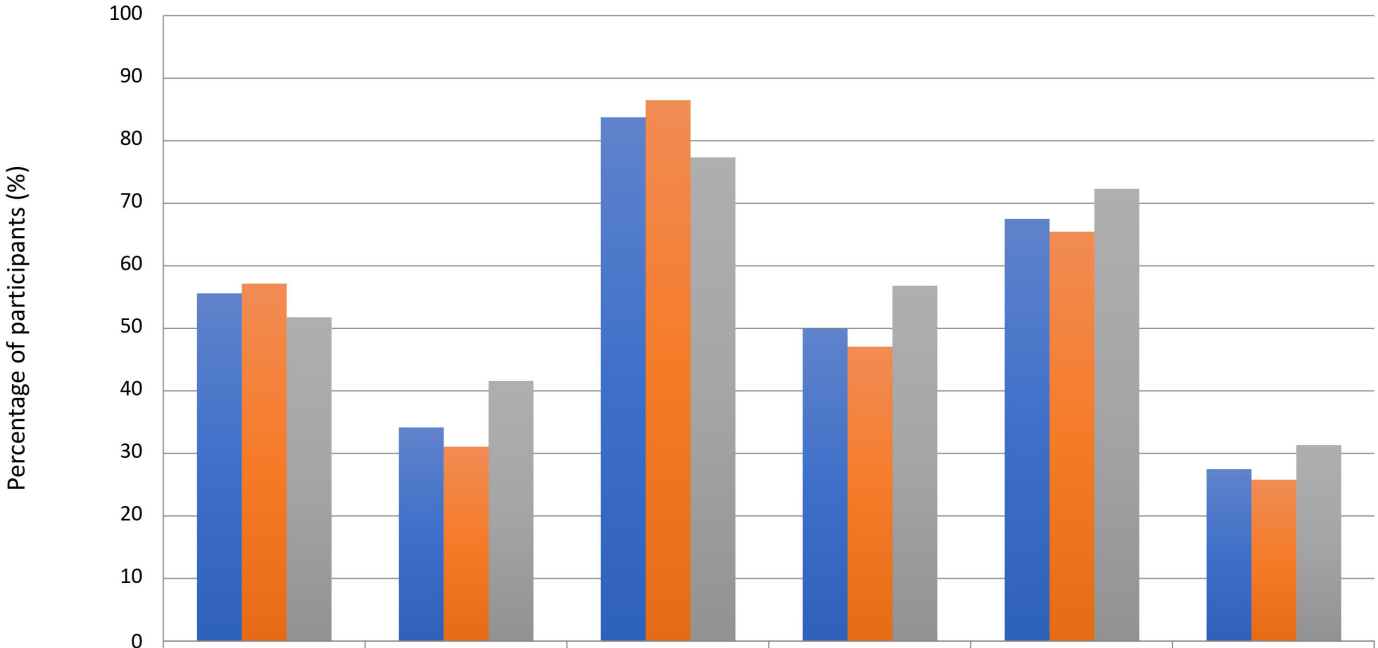
Participants self-reported their country of residence during surveys and the data was grouped into HICs and LMICs according to their country of residence based on the 2022 World Bank Report.[18] We compared participants' self-rated performance, perceptions and improvements in core competencies (practice-based learning and improvement, patient care and procedural skills, systems-based practice, medical knowledge, interpersonal and communication skills, and professionalism) as defined by the Accreditation Council of Graduate Medical Education (ACGME) across HICs and LMICs (online supplemental table 1).

Data analysis

Participants who completed both pre-SIMBA and post-SIMBA survey were included in the analysis. Participant country of origin was obtained from pre-SIMBA survey response and grouped into HIC and LMIC using data supplied by the World Bank Report.[18]

The data from close-ended questions included in the post-SIMBA survey were analysed for overall data and further subgrouped by those from HIC and LMIC using Stata (Stata/SE V.17.0 for Mac). For graphs created from percentages, responses to 7-point Likert scale questions were divided into three groups: confident (strongly agree/agree), unsure (somewhat agree/undecided/somewhat disagree) and not confident (disagree/strongly disagree). The question surrounding quality had responses grouped in a similar way using excellent/good, fair, poor/very poor as groups for graphical data.

Using the 'filter' function to establish HIC and LMIC participant groups the 'find and replace' function in Microsoft Excel frequency participants' self-reported improvement in ACGME Core Competencies[19] was reported and displayed on a graph (figure 1). Outcomes



	Patient care	Professionalism*	Knowledge on patient management*	System based practice	Practice-based learning	Communication skills
All Countries	55.6	34.2	83.8	50	67.5	27.5
HIC	57.2	31.1	86.5	47.1	65.5	25.8
LMIC	51.8	41.6	77.4	56.9	72.3	31.4

Figure 1 Percentage of participants self-reporting an increase in Accreditation Council of Graduate Medical Education competency areas after the Simulation via Instant Messaging-Birmingham Advance session. HIC, high-income country; LMIC, low/middle-income country. *p<0.05.

were compared using the χ^2 test and reported as per Kirkpatrick's framework.[20] This was calculated by creating a two-way frequency table with measures of association with the column variable defined as country type (HIC or LMIC) and the row variable defined as the responses to the question in the survey. Statistical significance was accepted at 95% CI. For the χ^2 test, data were reported and analysed using all response variables individually, without the previously mentioned grouping. We have reported the χ^2 test results as 'χ^2 (df, N=sample size)=χ^2 statistic value, p=p value'.

Responses to open-ended questions were reviewed and a content analysis was performed. For this analysis, qualitative responses were grouped into HIC and LMIC using the 'filter' function on Microsoft Excel. The responses were then copied into a Microsoft Word document and read through, while reading through these were grouped into commonly occurring phrases or keywords for both HIC and LMIC participant responses individually. Common themes were then named, identified and presented in tables with examples. Examples remained divided by HIC and LMIC to allow for comparison between themes found.

Patient and public involvement

Though patients were not directly involved in the research process, our study simulated real-life clinical scenarios spanning the entirety of the patient journey through secondary care. This study was aimed at healthcare professionals to improve medical education delivery that may eventually lead to better patient care services. The results of this study will be shared with the study participants and global community on our social media and/or email to encourage further participation and advance medical education.

RESULTS

Demographics

A total of 462 (HICs: 325 (70.4%), LMICs: 137 (29.7%)) participants who completed both pre-SIMBA and post-SIMBA surveys across 16 sessions were included in this study. Figure 2 shows the number of participants from each country. A further 21 participants were not included in the study as they did not complete the post-SIMBA survey.

Reaction of trainees (level 1 of Kirkpatrick's framework)

Both groups self-reported similarly regarding the applicability of the simulated topics to clinical practice (LMICs: 90.5% vs HICs: 94.7%, χ^2 (5, N=462)=6.4368, p=0.266). Most participants positively self-rated the teaching session as excellent or good (LMICs: 99.2% vs HICs: 93.4%, χ^2 (4, N=429)=7.7487, p=0.101). However, participants

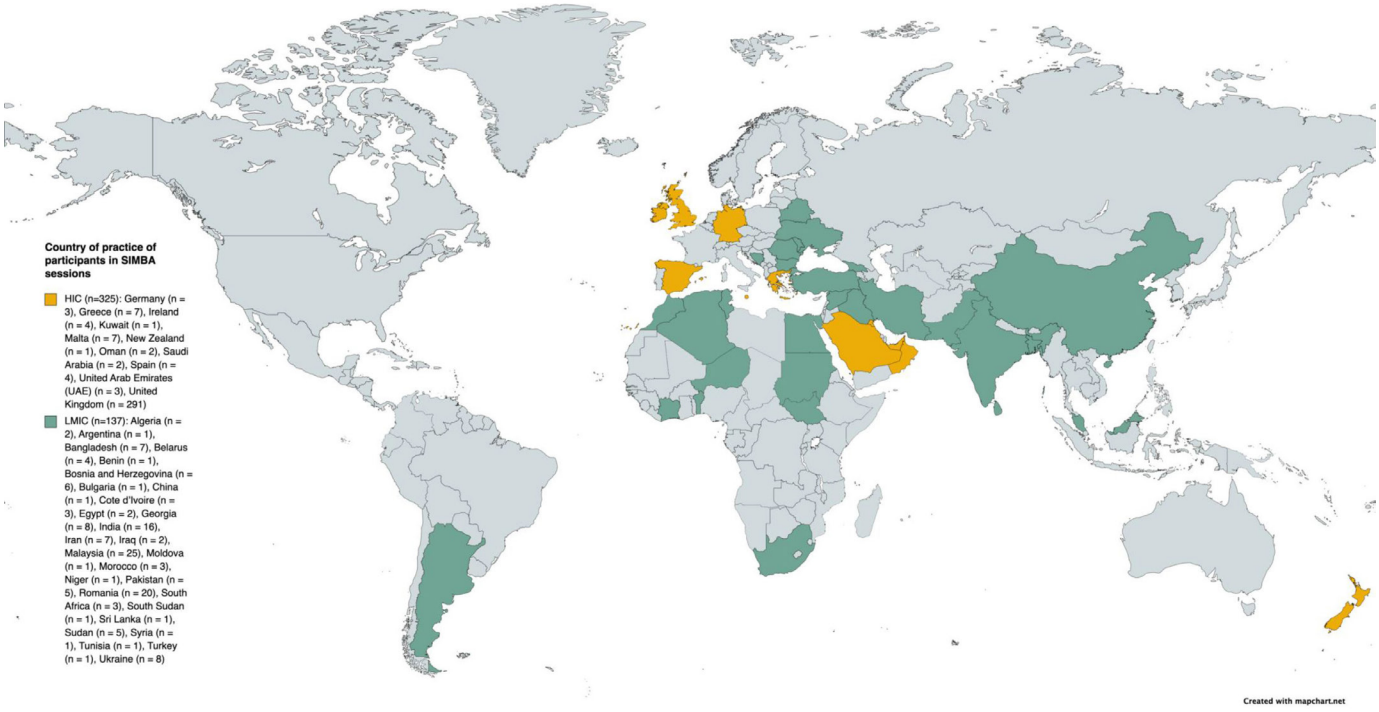


Figure 2 Country of practice of the participants of the SIMBA sessions. Map was created with https://mapchart.net/. This pictorial representation of the world map does not purport to be the political map of any country in any author's opinion and is being used only for representing the data diagrammatically. HIC, high-income country; LMIC, low/middle-income country; SIMBA, Simulation via Instant Messaging-Birmingham Advance.

from LMICs found the sessions more impactful for personal learning (LMICs: 98.6% vs HICs: 92.3%, χ^2 (5, N=462)=22.2823, p<0.1) and at a professional level (translating to patient care) (LMICs: 94.9% vs HICs: 91.4%, χ^2 (6, n=462)=15.1117, p=0.019). Participants' feedback indicated that the session was engaging (LMICs: 96.3% vs HICs: 89.9%, χ^2 (6, N=462)=8.6133, p=0.197), although a greater proportion of participants from LMICs felt the sessions accommodated their learning style (LMICs: 94.1% vs HICs: 85.3%, χ^2 (5, N=462)=17.4781, p=0.004). Most participants agreed that an evidenced-based approach was utilised by the session chair (LMICs: 93.5% vs HICs: 94.2%, χ^2 (3, N=462)=0.2324, p=0.972).

A greater proportion of participants from LMICs preferred SIMBA as a learning method compared with traditional lecture-based models of teaching (LMIC: 92.1% vs HIC: 73.9%, χ^2 (6, N=429)=28.4941, p<0.1). 99.3% of participants from LMICs stated they would attend future sessions, compared with 91.1% of participants from HICs (χ^2 (2, N=462)=10.6662, p=0.005). The responses of post-SIMBA survey assessing the utility of SIMBA sessions are shown in figure 3 demonstrating a positive impact.

Trainees' change in attitudes (level 2a of Kirkpatrick's framework)

Participants from LMICs self-reported greater improvements in professionalism, compared with those from HICs (LMICs: 41.6% vs HICs: 31.1%; p=0.02). In contrast, participants from HICs self-reported significant improvement in knowledge of patient management following the session (LMICs: 77.4% vs HICs: 86.5%; p=0.01). Both LMICs and HICs participants self-reported similar improvements in patient care (LMICs: 51.8% vs HICs: 57.2%; p=0.28), systems-based practice (LMICs: 56.9% vs HICs: 47.1%; p=0.052), practice-based learning (LMICs: 72.3% vs HICs: 65.5%; p=0.15) and communication skills (LMICs: 31.4% vs HICs: 25.8%; p=0.22) as shown in figure 1.

Content analysis

Several themes were identified following qualitative analysis of participants' responses to open-ended questions. 36.4% (n=168/462) responded to a question, 'Please write down any additional comments regarding the chair's contribution'. Fifteen constructive comments regarding session structure and timing were noted, of which several participants suggested that extra time was needed for discussion after the simulated session. Only one participant from LMICs suggested that the 'language barrier' may have caused delays in the session. Identified themes are presented in tables 1 and 2.

DISCUSSION

Healthcare professionals from both LMICs and HICs showed some similar self-reported gains in knowledge and core clinical competencies in SIMBA. Participants' self-perceived improvements in patient care, systems-based practice and practice-based learning were similar

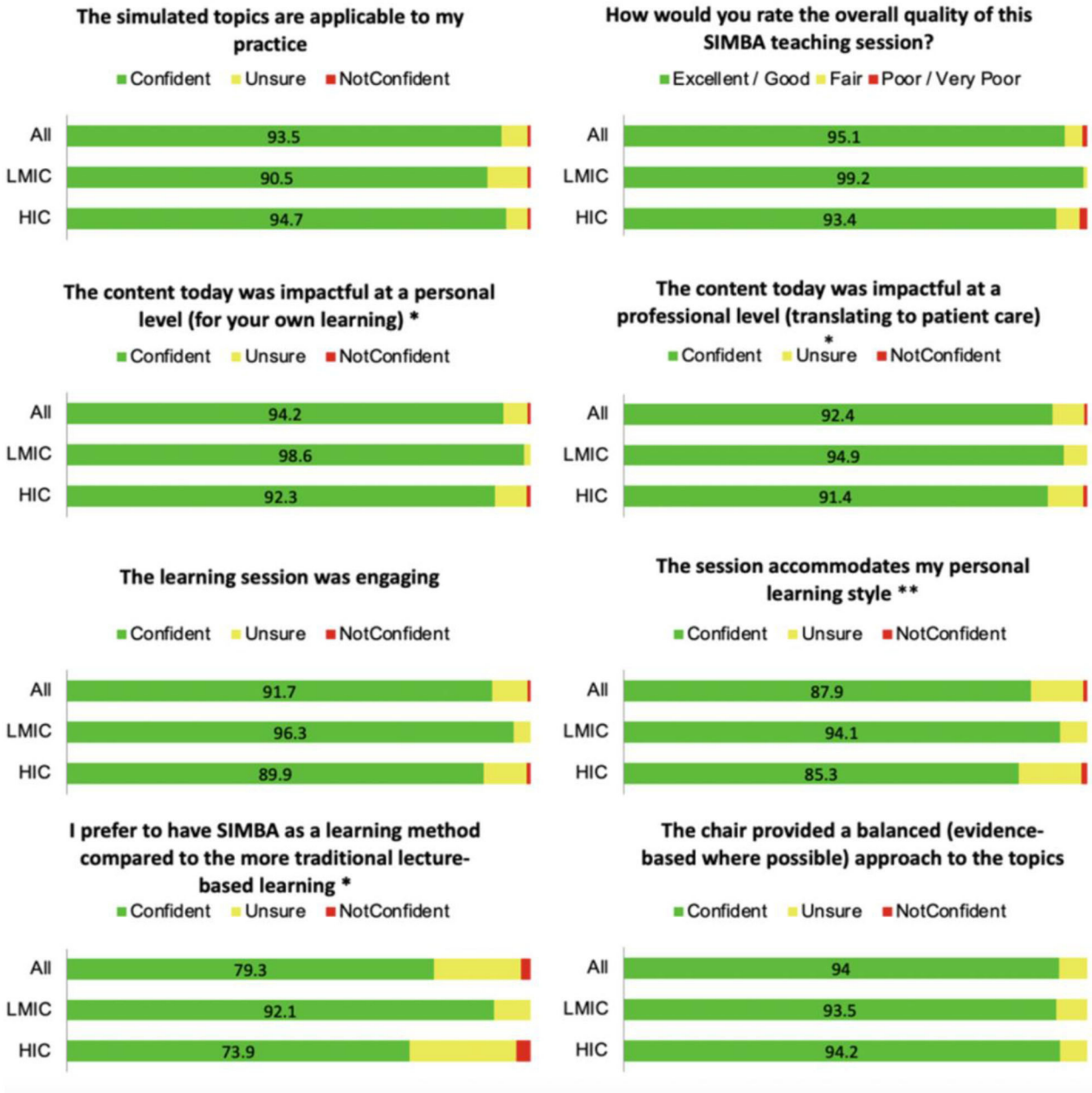


Figure 3 Variations in responses from HIC versus LMIC regarding various questions assessing the utility of SIMBA sessions. *P value between 0.05 and 0.01; **p value between 0.01 and 0.001; ***p value less than 0.0001. HIC, high-income country; LMIC, low/middle-income country; SIMBA, Simulation via Instant Messaging-Birmingham Advance.

in LMICs and HICs. Improvements in these competencies are linked to the reduction of medical errors.[20] Medical errors can lead to future negative health consequences or even fatality, thereby generating huge costs to healthcare systems.[21] The simulated nature of SIMBA enables healthcare professionals to learn from errors without compromising patient safety. Participants from LMICs and HICs also felt improvements in their communication and skills, by using the information of cases presented electronically and decision-making, which is essential for medical interdisciplinary management.[22] However, we note that this was a modest increase compared with changes with all other parameters. Further work needs to be done into why communication only had a modest increase. Interestingly, SIMBA was favoured over traditional lecture-based models of teaching more in LMICs compared with HICs, and more participants from LMICs were willing to attend future sessions. A possible explanation may be the pre-existing lack of online education tools in LMICs, mostly limited to static and audio-visual content. Many LMIC participants may be inexperienced with simulation use and therefore seeking more opportunities for future sessions.[23] More participants from LMICs found SIMBA to accommodate their learning style, despite the lack of simulation use in LMICs. This highlights the potential of expanding simulation use globally.

A commonly identified issue with technology-enhanced simulation is the high cost of many simulators[11] and

Table 1 Content analysis of the open-ended question 'As a result of what I have learnt today, I intend to make the following changes to my practice that I believe will impact my patients' care in a positive way' in the post-Simulation via Instant Messaging-Birmingham Advance survey

Theme	HIC	LMIC
Specifical clinical knowledge	'Use of clomiphene for sperm induction, genetic test for hypog hypogonadism'. 'Do not necessarily use IV bisphosphonates prior to surgery in primary hyperparathyroidism'. 'I have now understood more about how to managing patients with recurring flare-ups of IBD. This will be useful in my future practice'.	'Awareness about thyroid ultrasound scans, multimodality management if thyroid disease in pregnancy, thyroid disease in critical care'. 'Use teriparatide in post menopause women with multiple fractures'.
Approach to patient care	'Integrated and evidenced based patient care'. '1. Holistic approach to patient care; 2. Early involvement of MTD if not sure or patient is critically ill'. 'Holistic approach in management of diabetes in clinic set up as mentioned in one of the case'.	'I think I have to connect the dots faster and have a wholistic approach of my patients'. 'Systematic approach in patient care'. 'I would consider a more holistic approach of the patient'.
Personal professional development	'Think more broader of my management plan. Being more specific in what need to be done …' 'Increases my confidence and helped me to think more differential diagnosis'. 'Deal with cases confidently and manage effectively'.	'Better communication' 1. Taking a good history. 2. Learning how to interpret the findings. 'Interdepartmental communication and timely/appropriate referral … mindful of social contexts'.

Overall response rate: 51.5% (n=238/462), HIC: 49.2% (n=160/325), LMIC: 56.9% (n=78/137).
HIC, high-income country; LMIC, low/middle-income country.

limited understanding of the utility and limitations of artificial intelligence.[24] Costs can include available hardware, facilities and training.[25] These costs limit simulation use in LMIC, where funding may be inadequate. Nonetheless, the just-in-time initiative has demonstrated the potential for successful medical education programmes, which are highly efficient, yet cost-effective.[26] Similarly, SIMBA differentiates itself from other high-cost simulations with free for end-user participation. The virtual nature allows participation from anywhere in the world

Table 2 Content analysis of the open-ended question 'Kindly let us know if you have any suggestions to make future sessions better' in the post-Simulation via Instant Messaging-Birmingham Advance survey

Theme	HIC	LMIC
Case discussion	'Filter out questions of participants before putting them onto consultant's discussion'. 'More time for case discussion and to be over weekend'. 'More time for discussions'.	'Need more discussion after session'. 'I would like that the discussion of the cases take place after each case'.
Future sessions	'More time for case discussion and to be over weekend'. 'Pre session questions about topics we want to include for a session'. 'Perhaps 3 cases would be enough for future'.	'I think it would be great to discuss some more cases, maybe 6 instead of 4'. 'I would like, that future sessions will be on weekends. In workdays sometimes hard to participate in your sessions'.
Transcript content	'Adding videos like today's session had a small one for laparoscopic fibroid's morcellation'. 'Please add images as previously used in SIMBA session'.	'I would like to follow-up of to patient to be more explicit and the doses and length of the treatment also'. 'If possible please include images and videos of patients'.

Overall response rate: 26.8% (n=124/462), HIC: 28.3% (n=92/325), LMIC: 23.4% (n=32/137).
HIC, high-income country; LMIC, low/middle-income country.

with internet access. This encourages widening participation globally.

The lack of evaluation on the transfer of knowledge to participants is another issue identified with online simulation use.[23] The Simnovate Global Health Domain Group found that compared with HICs, most studies focusing on LMICs concentrated on evaluating participants' baseline adherence to guidelines, rather than their improvement in medical knowledge.[27] Also, most of these were one-time studies, providing weak evidence of their effectiveness. In contrast, multiple SIMBA sessions have been conducted to evaluate the model's effectiveness and impact on improving competencies among LMICs. SIMBA, based on the Kolb's Experiential Learning theory,[27] addresses Kirkpatrick's training evaluation model,[14 28] which is described as 'the worldwide standard for evaluating the effectiveness of training'.[29] Participants from both groups found SIMBA to be engaging and applicable to their clinical practice (Kirkpatrick's model level 1). Improvements to participants' knowledge of patient management were significantly higher in HICs (Kirkpatrick's model level 2a) yet increased in both groups. Content analysis revealed participants' intentions to improve their approach to patient care and personal professional development (Kirkpatrick's model level 2a), however, further analysis is required to examine actual changes in behaviour. Further research is also required to evaluate whether participants' self-reported confidence levels translate to an improvement in clinical performance, presented by level 3 of Kirkpatrick's model.

SIMBA further assists in improving diversity in medical education. The interactive Zoom discussion allows healthcare professionals from different regions to share their perspectives on clinical diagnosis and management. This facilitates professionals' understanding of variations in clinical medicine in developed countries versus LMICs. For example, the availability of sophisticated laboratory investigation and imaging tools are important instruments in the diagnosis and management of disease[30]; however, alternative methods may be used in LMICs where these tools are inaccessible due to financial constraints. Participant interaction enables sharing of knowledge and encourages peer-to-peer learning on a global scale.

Despite having identified strengths of the SIMBA model for use in both LMICs and HICs, there are some limitations. We used the ACGME standards commonly used in the USA for our study. We could not find similar standards for the rest of the world and therefore it may limit the generalisability of our findings. The time constraint was identified as a limitation by both participants from LMICs and HICs, where participants desired more time for the postsession Zoom discussion of cases. Moderators and participants also require internet access to participate in the sessions. However, this may be difficult in some LMICs due to limited internet bandwidth and financial resources.[31] The SIMBA model is also currently only offered in English, which can further exclude moderators or participants from non-English speaking communities. This could explain why fewer participants from LMICs self-reported increased knowledge of patient management. However, the language barrier was only identified as an issue by one participant from an LMIC. We are currently working on a non-English based SIMBA model, and we will report their results in our future work. Although the transcript assessment was based on the adapted global rating scale for the current national and international guidelines, the experts during discussions were mostly UK based which may have resulted in the region bias. We are working on addressing this by having an international cohort of experts from HICs and LMICs. These limitations can be overcome by increased collaboration between institutions in HICs and LMICs,[32] which will assist in developing the model, to become suitable to the socioeconomic characteristics and context-specific needs of LMICs. This will help to address the challenges in the availability of physical and financial resources and in cultural barriers.

We had more participants from HICs compared with LMICs. This might be attributed to the awareness of the availability of the SIMBA sessions, the timing of the sessions and/or internet access issues. We are currently planning a randomised controlled trial to address these limitations.

CONCLUSION

Our study finds that SIMBA may be an effective model for improving healthcare professionals' knowledge and core clinical competencies in both LMICs and HICs. Further research and upscaling of the SIMBA model is required to assess its accessibility, replicability and potential of global scalability, particularly in LMICs where it can help to provide standardised medical training.

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Contributors KM and AA are the joint first authors having made all-round contributions to the study. VS, TO, and DZ helped write the first draft. EM contributed to the study conception and supervised executive aspects of SIMBA. MD and PK critically reviewed and revised the manuscript. PK conceptualised

and supervised the delivery of all aspects of SIMBA. SIMBA and CoMICs team contributed towards all stages of this manuscript. All authors made substantial contributions to drafting and approving the final draft of the manuscript. The final version has been reviewed and approved by all the named authors. PK is guarantor of the study.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval SIMBA sessions were approved by Health Education West Midlands Diabetes and Endocrinology Specialist Training Committee for use as an educational modality for post-graduate medical education and CARMS (Central Audit registration and management system) at the University Hospitals Birmingham NHS foundation trust (approval number-16233) approved the study. The findings reported here are part of these approvals. Participation in SIMBA sessions was voluntary and all participants completed an electronic informed consent as part of a registration form, after they reviewed the agenda of the session. All methods were carried out in accordance with relevant guidelines and regulations.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Data will be made available upon request.

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