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Supporting medical education for Gaza's future physicians: a mixed-methods evaluation of a tele-mentoring program, 2025-2026

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Abstract

Introduction: The destruction of Gaza's health and educational infrastructure since October 2023 has disrupted medical education for thousands of students and severely limited access to clinical training. In response, a virtual community of practice (VCoP) delivering case-based tele-mentoring sessions was implemented to support continuity of clinical education for medical students at the Islamic University of Gaza. This study evaluated its implementation and perceived impact.

Methods: A mixed-methods formative evaluation of 16 virtual case-based sessions delivered between August 2025 and April 2026 was conducted. Quantitative data included attendance records and participant surveys. Qualitative data from focus group discussions and open-ended survey responses were analysed using inductive thematic analysis.

Results: 131 students attended at least one session. 88% of post-session respondents rated sessions as good or excellent and 91% reported they would apply the learning in practice. All end-of-series respondents (100%) reported that the case-based model enhanced their learning and 97% reported improved clinical knowledge. Qualitative analysis identified three themes with strong inter-coder agreement (Cohen's $\kappa = 0.87$): the educational value of the case-based model; the compensatory and continuity function of the VCoP amid war-driven disruption; and implementation considerations that enabled participation despite severe operational challenges.

Conclusion: The VCoP was both feasible and effective in sustaining clinical medical education during active conflict functioning as both an educational intervention and a source of professional identity and continuity support. Participatory tele-mentoring models may help mitigate long-term health-workforce losses where health and educational systems are disrupted.

Funding: The program was initiated with seed funding from Project ECHO. Giveinternet funded the shared learning spaces.

BACKGROUND/INTRODUCTION

War and conflict critically impact current and future access to medical care for affected populations by disrupting the local education systems that train future healthcare providers[1]. Delays, reduction, and even complete cessation of health professional training and education occur during war with a subsequent exodus of health professionals from the country[2]. This interruption in medical education can lead to a generational gap in the national healthcare workforce[2].

Between October 2023 and October 2025, the Israeli attacks on Gaza resulted in more than 67,000 reported deaths and 169,000 reported injuries[3]. The reported figures represent over 10% of Gaza's population of 2.2 million and are likely to underestimate the true morbidity and mortality burden[4]. Multiple reports by United Nations bodies and human rights organizations have determined the armed campaign constituted genocide[5,6]. The widespread destruction of critical civilian infrastructure has left 93% of Gaza's schools non-operational and no medical facility fully functional[7]. More than 1500 healthcare workers have been killed[8], and more than 1800 attacks on healthcare have been recorded[9]. Gaza's two main medical universities –the Islamic University of Gaza (IUG) and Al-Azhar University– have been reduced to rubble, and hundreds of their faculty and students have been killed, injured and displaced, resulting in the disruption of medical education for thousands of medical students[10]. While some medical students have been displaced abroad to continue their medical education, the majority remain inside Gaza[10]. Several hundred clinical students in their fourth, fifth, and sixth years have been pulled into hospitals to take on increased clinical responsibilities to support overwhelmed medical facilities responding to the influx of trauma, malnutrition, and noncommunicable disease exacerbations, among other cases[11]. These duties are carried out in severely damaged and undersupplied facilities and amid daily mass casualty events, which at times include their own colleagues and mentors[11]. As a result, these students have often been unable to engage in the standard clinical and patient bedside learning part of their structured training pathway and calls have been made to support the generation of future medical educators and practitioners in Gaza and beyond[12].

Against this backdrop, identifying feasible approaches to sustaining medical education has become an urgent priority for both educational continuity and for the recovery and resilience of future health systems. Tele-mentoring has emerged as a promising approach to maintaining healthcare training in conflict settings despite insecurity, travel restrictions, and damaged infrastructure[13]. Moreover, tele-mentoring models have reduced logistical and financial barriers to specialist education in conflict-affected settings[13]. Evidence in other contexts has demonstrated that virtual formats can achieve comparable effectiveness to in-person emergency care training, supporting their use in resource-constrained and insecure settings[14]. Recent literature has further emphasized the need to expand tele-mentoring and international educational support in conflict settings while highlighting the need for stronger evidence on their implementation and effectiveness[15]. Within this broader landscape, virtual communities of practice (VCoP) such as those promoted by Project ECHO connect multidisciplinary subject matter experts with local healthcare providers through virtual mentorship, case-based learning and peer-to-peer exchange[16]. This model has previously been implemented worldwide, including in humanitarian settings such as Ukraine[17] and Sudan[18], and demonstrated feasibility in sustaining learning and professional connectedness among healthcare providers during an active conflict.

Despite these promising examples, it remains unclear whether tele-mentoring can be effectively implemented and sustained in a setting such as Gaza, where the near-total destruction of educational and healthcare infrastructure, repeated attacks on healthcare, blockade and severe limitations in electricity and internet connectivity present challenges beyond those previously described. E-learning among medical students in Gaza was previously examined during the COVID-19 pandemic and showed

that virtual education could support continuity of learning. Nevertheless, it also highlighted persistent challenges to delivering clinically meaningful online medical education, including limited opportunities for practical clinical training, reduced interaction with teachers and peers, and unreliable internet connectivity[19]. Since then, the widespread destruction of Gaza's educational and healthcare systems has fundamentally altered the educational landscape[11]. More broadly, evidence remains limited on the implementation and evaluation of structured, clinically relevant virtual education programmes for medical students during active conflict, as previous initiatives have largely focused on qualified healthcare professionals. In addition, opportunities for structured case-based learning remain uncommon in Gaza and across much of the MENA region, where medical education has traditionally relied on didactic teaching approaches[11].

To address these gaps and support continuity of medical education, a virtual community of practice (VCoP) was implemented between international and local academic and technical partners. The VCoP connected fourth-, fifth-, and sixth-year medical students in Gaza with international clinical experts through case-based tele-mentoring, facilitating continuous peer-to-peer learning and clinical skills building opportunities during the patient-facing phase of training. Using a mixed-methods evaluation, this study explores the experiences of Gazan medical students in the VCoP implemented between August 2025 and April 2026 and its potential role as a model for sustaining medical education for students in settings of active conflict.

METHODS

Study design and setting

A mixed-methods evaluation of a virtual case-based medical education program, using the Project ECHO learning model[16,17,18], implemented for medical students in their clinical years at IUG was performed. The evaluation was informed by a program theory of change linking program delivery to outputs and immediate and intermediate outcomes (Figure 1). Participation, engagement, and perceived impact were assessed within this framework.

Program design and participant recruitment

A needs assessment was performed with the Student Branch of Palestinian Medical Forum, the student body in the faculty of medicine in IUG, to identify the target population and priority areas for intervention. The program was designed to focus on clinical year medical students (years 4-6) to reflect the stage at which students rely most heavily on hands-on clinical training based on the needs assessment. Student interest in participation was determined through a survey sent to these students (n=613), of which 50% expressed interest in participating (n=309).

The curriculum was developed to reflect core blocks across the clinical training schedules of years 4-6 (Table 1). Sessions were open to all clinical medical students (years 4-6) at IUG. Subject matter experts (SMEs) were identified for each topic based on predefined selection criteria, including a preference for being part of the Palestinian diaspora, clinical experience working in Gaza after October 2023, bilingual English-Arabic language ability, or familiarity with the local context.

Respondents to the student interest survey were recruited to participate via email, Telegram, and WhatsApp. Participation was voluntary. To address infrastructure and security constraints, participants could participate in the session in one of three ways: in shared learning spaces as a group, individually, or via recorded sessions. Giveinternet supported internet access to ensure connectivity in two shared learning spaces, one in the North and one in the South of Gaza.

Intervention

Sixteen 60-minute virtual learning sessions were planned and were delivered via Zoom. Each learning session was facilitated by SMEs who led a didactic component, followed by a clinical case presentation led by the SME or a student when available. Sessions followed the interactive case-based Project ECHO learning model.

The series launched in August 2025. Flexibility was built into the schedule in anticipation of disruption as student safety was a priority during escalations of Israeli bombing. All learning sessions were recorded and uploaded to YouTube for sharing.

Data collection

Data collection tools were adapted from prior evaluations[19,20] to assess program outputs and outcomes aligned with the theory of change (Figure 1).

Demographic data collected for each session included participants' characteristics (academic year, gender and location) and modality of attendance (individual vs shared learning space). Participants

were classified by academic year according to their training status at the end of the program period (April 2026).

Surveys included Likert-scale questions and open-ended prompts. Post-session surveys (Appendix A), distributed after each session, assessed participant satisfaction with the learning session, perceived knowledge gain, relevance and applicability to clinical practice. An end-of-series survey (appendix B) assessed self-reported knowledge gain, clinical skills, confidence, application of learning, behavior change in clinical practice and the overall impact of the series. Surveys were administered via Kobo Toolbox with informed consent, and responses were anonymous.

Virtual focus group discussions were conducted by an independent consultant with a purposely sampled subset of participants who attended five or more sessions. Three discussions were conducted, one per academic year group. Interviews were conducted via Zoom in Arabic using a structured guide (Appendix C), recorded with participant consent, transcribed, de-identified, and translated.

Data analysis

Quantitative data, derived from attendance records and surveys, were analyzed using descriptive statistics. Attendance records were summarized using unique attendance count and trends were examined by session, participant characteristics and modality of attendance. Survey responses were summarized using proportions for categorical variables and Likert-scale questions.

Three focus group discussions were conducted, one each with Year 4, Year 5 and Year 6 medical students. Six participants were purposely selected for each group and five joined in each for a total of 15 students.

Qualitative data was analyzed using inductive thematic analysis using the Braun and Clarke approach[21]. Two researchers independently reviewed the data, identified themes inductively and then coded the data against an agreed eight-code scheme. Intercoder agreement was assessed using Cohen's κ across the 121 coded excerpts and discrepancies were discussed and resolved through consensus.

Ethical considerations

The program was initiated with seed funding from Project ECHO. Giveinternet funded the shared learning spaces. This project was reviewed by the Mass General Brigham Institutional Review Board and determined to meet the criteria for non-human subjects research. Informed consent was obtained for all surveys (written) and interviews (oral).

Patient and Public involvement

Patients or members of the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Figure 1

Theory of change

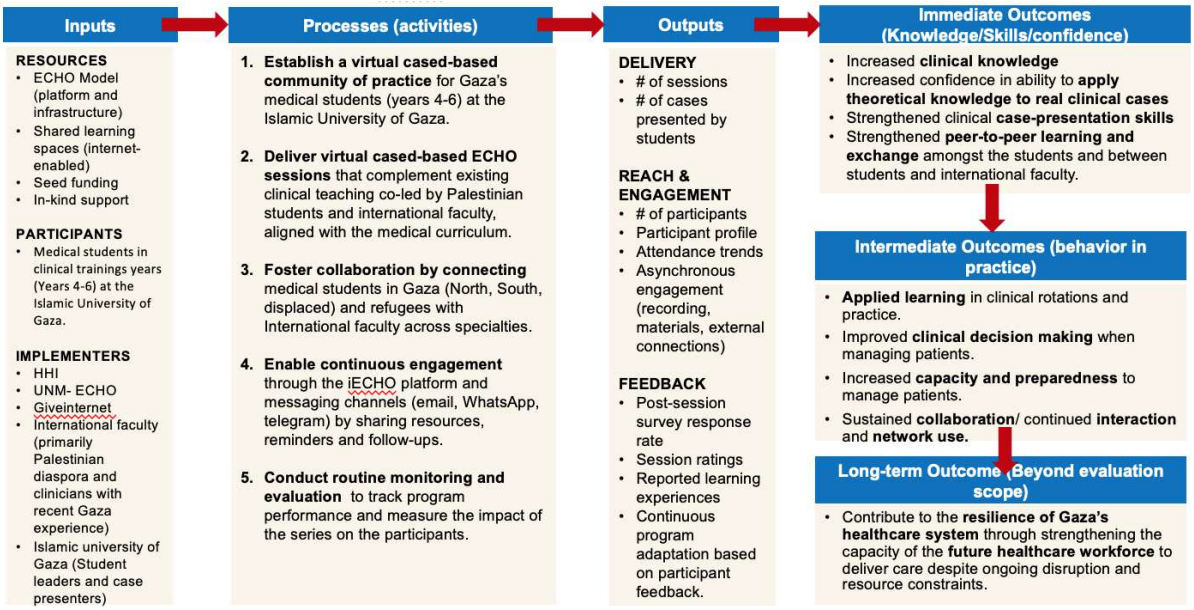


Table 1

Delivered curriculum by academic year and topic

Date	Academic Year	Topic
Mon. 11 Aug. 2025	6	Emergency Room (ER)
Wed. 20 Aug. 2025	5	OBGYN
Wed. 3 Sep. 2025	6	Surgery
	Temporary suspension of delivery	
Thu. 8 Jan. 2026	6	Pediatrics
Thu. 15 Jan. 2026	6	ER
Thu. 22 Jan. 2026	5	Ear, Nose, Throat (ENT)
Wed. 28 Jan. 2026	5	Orthopedics
Thu. 5 Feb. 2026	4	Surgery
Thu. 12 Feb. 2026	5	Obstetrics
Thu. 19 Feb. 2026	4	Internal Medicine
Thu. 5 Mar. 2026	5	ER
Thu. 12 Mar. 2026	5	Gynecology
Thu. 26 Mar. 2026	6	Internal Medicine
Thu. 2 Apr. 2026	6	Surgery
Thu. 9 Apr. 2026	4	Psychiatry
Thu. 16 Apr. 2026	4	Neurology

RESULTS

a. Participant reach and characteristics

131 unique participants attended at least one session out of the 309 students and recent graduates who expressed interest in the program. Eighteen unique participants served as student presenters and/ or session leads. Among the unique participants (n=131), 25 (19%) were fourth-year medical students, 59 (45%) were fifth-year medical students, 37 (28%) were sixth-year medical students and 10 (7.6%) were recent graduates. Female participants represented 52% (n=68) of attendees and geographically 53% (n=69) were located in South Gaza, 47% (n=61) in North Gaza and one participant consistently joined from Malaysia (<1%). Detailed participant characteristics are presented in Table 2.

b. Attendance and engagement

Between August 2025 and April 2026, 16 VCoP sessions were conducted with 384 cumulative attendance. Session attendance ranged from 12 to 46 participants, with a mean attendance of 24 participants per session. Among the 131 unique participants, more than half attended a single session (52%, n=68), while 22% (n=29) attended five or more sessions.

Information on joining modality was available for sessions 4-16. Across these sessions, 53% of participants joined from designated shared learning spaces while 47% joined using their personal devices and internet connection. The proportion joining from shared learning rooms varied across sessions, ranging from 18% to 77%, with greater use of shared learning spaces during earlier sessions. Learning session recordings uploaded to YouTube received 58 cumulative views.

Table 2

Participant characteristics (n=131)

Category	Subcategory	n (%)
Total Participants		131 (100)
Academic Year	Year 4	25 (19.1)
	Year 5	59 (45.0)
	Year 6	37 (28.2)
	Intern/ Graduate	10 (7.6)
Gender	Female	68 (51.9)
	Male	63 (48.1)
Location	North Gaza	61 (46.6)
	South Gaza	69 (52.7)
	Outside Gaza	1 (0.8)
Participation level	1 session	68 (51.9)

2-4 sessions	34 (26.0)
5-6 sessions	10 (7.6)
7 or more	19 (14.5%)

Note. Percentages may not total 100 due to rounding.

c. Post-session evaluation outcomes

Across the 16 learning sessions, 206/384 (54%) participants completed post-session surveys. 88% (n=182) of respondents rating the session as good or excellent, 80% (n=164) reporting good or excellent knowledge gain and 78% (n=160) rating the sessions as very or extremely relevant to their current work and studies. Ninety-one percent (n=187) of respondents reported that they would probably or definitely apply what they learned in their work.

d. End-of-series evaluation outcomes

Thirty students completed the end-of-series evaluation (n=30/131, 23%). Of these, 23% (n=7) of respondents were from Year 4, 47% (n=14) were from Year 5, and 73.3% (n=22) from Year 6. Nearly three-quarters of respondents (73%, n=22) attended at least 5 sessions.

Nearly all respondents reported improved clinical knowledge (97%, n=29). Ninety percent (n=27) reported increased confidence in managing clinical cases and feeling more prepared when approaching or managing patients. All respondents (100%, n=30) reported that it enhanced their learning. Most respondents (87%, n=26) also reported that the sessions complemented their existing clinical training and that sessions co-led by students and international faculty was beneficial to their learning. Additional end-of-series evaluation findings are presented in Table 3.

Table 3

End-of-series evaluation outcomes among respondents (n=30)

Outcome	Yes % (n)	Neutral % (n)	No % (n)
Immediate learning outcomes			
Improved my clinical knowledge	97% (29)	3% (1)	0
Increased my confidence in managing clinical cases	90% (27)	10% (3)	0
Improved my ability to apply theoretical knowledge to clinical cases	87% (26)	13% (4)	0
Improved my ability to present clinical cases	67% (20)	33% (10)	0
Strengthened peer-to-peer learning and exchange	73% (22)	27% (8)	0
Intermediate learning outcomes			
I have used what I learned in the sessions in my clinical rotations or practice.	70% (21)	20% (6)	10% (3)
The sessions improved my clinical decision-making in real cases	80% (24)	20% (n=6)	0
I feel more prepared when approaching or managing patients.	90% (27)	10% (3)	0
I have shared knowledge from the sessions with peers or colleagues.	67% (20)	27% (8)	7% (n=2)
Format and value			

The case-based format enhanced my learning	100% (30)	0	0
The sessions complemented my existing clinical training	87% (26)	13% (n=4)	0
Having sessions co-led by students and international faculty was beneficial to my learning	87% (26)	13% (n=4)	0
I feel comfortable reaching out to presenters from the program	67% (20)	30% (9)	3% (1)

Note. Percentages may not equal 100 due to rounding.

e- qualitative analysis

Qualitative analysis included three focus group discussions with 15 medical students (five from each academic year) and 18 open ended end-of-series survey responses. Three themes were identified: 1) the educational value of the VCoP and case-based learning model, 2) the program's compensatory and continuity function amid educational disruption caused by war and blockade; and 3) considerations related to program implementation and future directions; and 8 subthemes.
Intercoder agreement was high: $\kappa = 0.87$ for the primary code (89% raw agreement) and a mean per-code κ of 0.88 (range 0.74 to 1.00), indicating substantial to almost perfect agreement. Selected participant quotations are presented in Table 4 and additional quotations are provided in Appendix D.

Theme 1: Educational value of the VCoP and case-based learning model

i. Case-based and participatory learning

Participants described the case-based model as a novel learning experience that complemented their formal education. They valued learning through real clinical cases that reflected their clinical practice and opportunities to participate actively by presenting patient cases themselves.

ii. Improved knowledge, confidence and skill gains

Participants described improvements in clinical reasoning, decision-making, case presentation, and medical English communication skills. They reported applying learning to patient care and bridging theoretical learning with clinical practice.

iii. Community building, mentorship and professional connectedness

Participants described the VCoP as a source of mentorship and professional support through connections with peers and international clinicians. They reported reduced professional isolation and connection to the broader medical community.

Theme 2: Compensatory and continuity functions of the VCoP during educational disruption caused by war and blockade

i. Compensation for disrupted clinical education

Participants described the VCoP as compensating for disrupted medical education during the war and resource constrained conditions. They reported limited access to hospitals, reduced clinical exposure, interruptions to university teaching, overstretched faculty and limited exposure to diverse clinical cases (mainly burn cases). Participants described the sessions as providing continuity through access to specialist expertise, clinical cases and practical discussions.

ii. Reinforcement of professional identity and motivation

Participants described the VCoP as reinforcing their professional identity and commitment to becoming physicians. They reported a renewed sense of purpose and motivation to continue their education despite war, blockade and profound uncertainty.

Theme 3: Considerations related to program implementation and future direction.

i. Logistical and operational considerations

Participants identified security related and logistical factors that influenced participation. Ongoing bombardments, displacement, movement restrictions, power outages, unstable internet connection, transportation challenges, session timing and competing academic responsibilities were cited as barriers. They also identified shared learning spaces with internet access, recorded sessions – "although not a real substitute for the live interaction"– and flexible scheduling as key facilitators of participation. Participants also described how barriers and facilitators shifted over time, depending on the security situation.

ii. Educational format, content and learning experience

Participants consistently valued the program's design highlighting the interactive case-based format, the relevance of the topics, the involvement of international faculty and their facilitation style. Some participants expressed that English could limit interaction whereas others viewed it as an opportunity to strengthen medical English. Shared learning spaces were viewed as facilitating discussion and peer learning for those who could access them.

iii. Recommendations for future iterations

Participants expressed strong appreciation for the program, strong interest in continuation and taking on more active roles. Recommendations included organizing sessions by specialty, increasing involvement of Gaza-based physicians, expanding opportunities for clinical training (ATLS, BEC, etc.), and strengthening connections with clinicians and students from both conflict-affected and non-conflict settings. Some year 4 participants also requested additional theoretical teaching alongside the case-based approach. They found some cases too advanced for their stage, except the ER ones, which they used while volunteering during the genocidal escalation.

Table 4

Representative participant quotation by theme and subtheme

Theme	Subtheme	Illustrative quotes
1- Cross-cutting value of the VCoP and case-based learning model	i. Case-based and participatory learning	"First of all, honestly, the whole idea of the program was excellent. The concept of learning through a specific patient case really matches our reality as doctors. In the end, I'm not going to deal with a textbook — I'm going to deal with a real patient and a real case in the future [...] Also, the fact that we as students were allowed to participate in presenting cases was great. There was actual give-and-take, not just a lecturer teaching and that's it. You participate, you try presenting what you have."
	ii. Improved knowledge, confidence and skill gains (clinical and other)	" Regarding benefiting from the lectures, honestly there was a huge benefit. Benefit from the theoretical content and also practical benefit on the ground. Many cases were presented by doctors or by colleagues and later we saw them in real life. So through the lectures I was able to see real cases from different specialties. And I learned from the doctors and experts who presented these sessions in a very organized and practical way, and I also felt my ability for quick clinical thinking improved. And I learned how to ask questions and interact with the team."

	iii. Community building, mentorship and professional connectedness	"The VCoP helped me overcome limited clinical exposure and resource constraints by providing access to diverse cases and expert guidance. It also addressed gaps in clinical reasoning by allowing me to practice structured case discussions in a supportive environment. Additionally, it improved my confidence in presenting and discussing cases and reduced the sense of professional isolation by connecting me with peers and mentors beyond my local setting."
2- Compensatory and continuity functions of the VCoP during educational disruption caused by war and blockade	i. Compensation for disrupted clinical education	"As a medical student in Gaza with so limited resources and abilities these sessions make me aware to how properly deal with patients not in catastrophic circumstances" "It helped me overcome challenges related to limited clinical exposure, restricted access to educational resources, and interruptions in regular teaching, while also reducing feelings of academic isolation by providing structured discussions, peer support, and opportunities to practice clinical reasoning despite difficult learning conditions."
	ii. Reinforcement of professional identity and motivation	"Beyond academics, the VCoP created a sense of motivation and resilience. In a difficult environment, being connected to a learning community reminded me of my goals and reinforced my commitment to continue progressing in my medical journey." "The VCoP helped me overcome feelings of isolation and decreased motivation. Being part of an active learning community created a sense of belonging and support, which encouraged me to stay engaged and continue progressing."
3- Considerations related to program implementation and future direction.	i. Logistical and operational considerations	"For me personally, it was easier to attend from the tent or from home because transportation and timing were difficult. It wasn't easy for people to move around, so if internet was available nearby, that was definitely the better option" "the security situation didn't allow for example booking rooms here and there, you could barely go to the hospital and come back and then after that there was another displacement in Gaza and things like that."
	ii. Educational format, content and learning experience	"The discussions were close to reality. Most of the doctors who taught in the sessions came to Gaza and saw cases and knew what kinds of things are common here and what kinds of things we can deal with, and they made cases around that and we discussed them, so that made it close to us. The cases were around us, not something distant or unrealistic, not like we're learning something and not knowing if we could apply it or not. On the contrary, there were cases we saw in real life and dealt with in hospitals, and it was nice to see whether our perspective and way of handling things was correct, and how to connect the science with the clinical picture, so it really was connected to reality"

	iii. Recommendations for future iterations	"We strongly support continuing the project. It achieved major benefits for all the students. And continuing with the same doctors also gives continuity and consistency in the teaching style. And maybe adding new doctors too could be useful to broaden the experiences"

DISCUSSION

The mixed methods programme evaluation demonstrates that the VCoP successfully supported continuity of clinical medical education for IUG clinical-year medical students despite extraordinary challenges. Across 16 learning sessions, the programme engaged 131 medical students, including a highly engaged group of 29 students (22%) who attended at least five sessions, suggesting that the VCoP fostered sustained rather than one-time engagement. Participants reported high levels of satisfaction and perceived educational, clinical, and professional benefits, findings that were consistent across both quantitative and qualitative data. To our knowledge, this is the first reported VCoP designed specifically for clinical medical students and the first application of a tele-mentoring model for undergraduate medical education in an active conflict setting in the MENA region.

These findings are particularly notable given the context in which the program operated. Participants continued to engage despite the extreme conditions created by the Israeli military campaign between October 2023 and October 2025. Most attended learning sessions while displaced, living in temporary shelters, and experiencing severe shortages of electricity, internet connectivity, basic necessities, and famine[22]. Although the programme launched in August 2025 during the active genocidal phase of the conflict, the majority of the learning sessions were delivered between January and April 2026 following the ceasefire (13 out of 16)[23]. Participants nevertheless continued to experience recurrent military operations, displacement, and dire living conditions, including an inability to return home[24]. Their sustained participation and engagement reflect both the remarkable commitment of the students and the context-responsive design of the programme. These implementation challenges and adaptations can be understood through implementation science frameworks such as the Consolidated Framework for Implementation Research (CFIR)[25]. The findings below illustrate how the VCoP remained feasible and highly valued despite an extraordinarily constrained environment.

Several design and implementation features appear to have contributed to the program's high levels of engagement and perceived value. The case-based model was particularly well received and aligned closely with participants' immediate clinical learning needs. Learning sessions featuring student patient case presentations consistently received higher participant ratings, and qualitative findings suggested that discussing real cases promoted clinical reasoning, confidence, and active participation and engagement. Students valued the opportunity to discuss patients encountered in their own clinical settings and to learn from international faculty who had either worked directly in Gaza or had a strong understanding of the local context.

Importantly, students–particularly student leaders–were not passive recipients of the programme, but co-designers. They helped identify learning priorities, coordinate sessions, and guide adaptations

throughout programme implementation. This participatory approach contrasts with an earlier evaluation of online medical education in Gaza during the COVID-19 pandemic in which students reported limited interaction with lecturers, low satisfaction with virtual learning, and little interest in continuing online education[19]. In this VCoP, participants consistently identified the interactive, case-based format and engagement with international faculty as among the program's biggest strengths. This suggests that educational design—not, rather than virtual delivery alone—, may be a critical determinant of learner engagement, particularly in conflict affected settings. Educational interventions that respond to locally identified priorities and meaningfully involve learners in programme design and implementation may therefore be more acceptable and likely to maintain participation, even under highly disrupted conditions.

The VCoP also broadened students' clinical exposure beyond the trauma and burn injuries that had come to dominate their wartime clinical experience. Against a backdrop of severely disrupted clinical training –including limited access to hospitals, reduced clinical exposure, diminished case diversity, interruptions to university teaching, overstretched faculty, and a shortage of educational resources– participants viewed the programme as an important source of continuity to their education and as a means of accessing resources that would otherwise have been difficult to obtain. They also considered the discussions relevant to the clinical realities they encountered in practice and a valuable complement to their formal curriculum. Some fourth-year students suggested that future iterations should incorporate more foundational theoretical teaching alongside case-based discussions. This may reflect the educational experience of a cohort whose foundational years of medical school (years1-3) were particularly disrupted with substantial portions of their curriculum shifting online, potentially affecting acquisition of foundational medical knowledge. In contrast, fifth- and sixth-year students may have been better positioned to build on previously acquired knowledge while using the VCoP to compensate for reductions in bedside teaching. Together, these findings suggest that although context-responsive VCoPs can help mitigate some of the longer-term consequences of disrupted medical education l for the future healthcare workforce, programme design should be tailored to learners' stage of training and the specific competencies most affected by conflict-related disruption.

Participants also identified important structural factors that shaped their ability to participate. Although nearly half the participants joined the learning sessions independently (47%), shared learning spaces were an important enabler of access to the VCoP for many students. Attendance data demonstrated substantial reliance on these spaces during early phases of the programme, while qualitative findings indicated that their value extended beyond providing internet connectivity. Shared spaces also facilitated peer discussion, social interaction, and collaborative learning. These findings highlight the importance of investing in enabling infrastructure in conflict-affected settings, where access to electricity, internet connectivity, transportation, and safe learning environments may fluctuate considerably over time.

The programme further demonstrated the importance of adaptive implementation in active conflict settings. An escalation in the Israeli military operations in September 2025 temporarily halted both clinical rotations and the VCoP sessions, which did not resume until January 2026[26]. Rather than terminating the programme, the implementation team maintained communication with student representatives throughout the programme pause, continuously assessed local conditions, and

resumed activities only when students considered participation safe and feasible. This sustained communication and flexibility helped preserve trust, maintain participant commitment, and facilitate rapid re-engagement when conditions permitted. These findings underscore that continuity in conflict settings depends not only on educational design, but also on implementation processes that remain highly responsive to rapidly changing security and operational conditions.

Beyond educational outcomes, the VCoP appeared to reinforce a sense of connection and resilience among the participants and contributed to their professional identity and development. Students described the programme as helping them feel that their academic journey had not stopped and as providing a source of motivation, resilience, hope, and connection to the international medical community. By providing academic and professional support, the programme appeared to reduce feelings of professional isolation, strengthen peer relationships, and foster a sense of belonging to a broader medical community. Although mental health outcomes were not formally evaluated, these findings suggest that educational initiatives may provide additional psychosocial benefits by fostering social connection, peer support, and a professional community, consistent with findings from previous VCoPs[11]. This may be particularly important given the well-documented psychological burden experienced by medical students[27] and health care workers[28] in Gaza.

More broadly, the programme demonstrates the potential role of tele-mentoring in sustaining clinically relevant medical education when conventional training pathways are severely constrained as they are during periods of active conflict. Although the VCoP was initially developed in response to the acute educational disruption associated with the 2023-2025 Israeli genocidal escalation, participants described longstanding structural barriers to medical education, including the occupation, blockade, professional isolation, and limited opportunities for international academic exchange. These barriers pre-dated October 2023, have been extensively documented in the literature and are likely to persist[29]. The relevance of this learning model therefore extends beyond responding to an acute educational emergency. It may also provide a mechanism for addressing chronic constraints on medical education that are rooted in prolonged occupation, isolation, and restricted academic exchange.

As Gaza's health and medical education systems confront the long-term consequences of widespread destruction and health workforce losses sustained educational partnerships will be essential to support recovery[30]. In such contexts, VCoPs may offer a scalable approach to strengthening local educational and clinical capacity while complementing, rather than replacing, local institutions and existing educational systems.

All participants who completed the end-of-series survey expressed a desire for the programme to continue, and their recommendations have directly informed the design of its second phase. The programme is now evolving toward multiple specialty-specific communities of practice that are being co-designed with participants and aligned with their educational priorities. This evolution illustrates how context-responsive, co-designed international partnerships can sustainably support local educational capacity and contribute to health workforce recovery and broader health system resilience during conflict, recovery and beyond.

LIMITATIONS

This study has several limitations. First, most outcomes were based on participant self-report and did not include objective assessments of knowledge acquisition or clinical performance, making the findings subject to recall bias. Although focus group discussions may also be susceptible to social desirability bias, they were facilitated by an independent consultant rather than programme implementers, which may have reduced interviewer influence. The consistency of findings across anonymous surveys and qualitative interviews further strengthens the credibility of the results. Participation in the programme, surveys, and qualitative interviews was voluntary, however, introducing the possibility of selection bias toward students who were more engaged in the programme. In addition, ongoing conflict, displacement, internet disruptions, and competing clinical responsibilities may have affected both participation and data completeness, potentially underrepresenting students facing the greatest operational challenges. Finally, the evaluation focused on short-term educational outcomes. Future research should assess whether similar models result in sustained improvements in clinical practice, professional development, and health workforce capacity.

CONCLUSION

The virtual community of practice (VCoP) provided more than a novel educational model to medical students in Gaza. It served as a mechanism for continuity of education, active learning, professional networking, connection to the international medical community, and reinforcement of professional identity during a period of war, blockade and profound uncertainty. Its success was supported by a highly participatory design, flexibility in implementation, and strong student engagement despite extraordinary operational and security challenges. As Gaza's health and medical education system confront the long-term consequences of widespread destruction and health workforce losses, tele-mentoring may offer a scalable approach to supporting healthcare workforce development and health system recovery through global collaboration.

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APPENDICES

Appendix A: Post-session survey

Thank you you for attending the HHI/ ECHO session! We appreciate your feedback on this brief 1-minute anonymous survey. Your input will improve our understanding of the impacts of ECHO sessions and will be used in monitoring and quality improvement reports,

1- Did you attend the session on Thursday March 12, 2026?*
- Yes (Live)
- Yes (I watched the recording)
- No

2- What year or medical school are you currently in?*
- Year 4
- Year 5
- Year 6

3- On a scale of 1 to 5, how would you rate today's session overall (format, style, delivery etc.)?*1 = Very Poor, 5 = Excellent*
- 1
- 2
- 3
- 4
- 5

4- How relevant is this session to your current work or studies?*
- Not at all relevant
- Slightly relevant
- Moderately relevant
- Very relevant
- Extremely relevant

5- Rate your knowledge gain from today's session*
- No knowledge gain
- Slight knowledge gain
- Moderate knowledge gain
- Good knowledge gain
- knowledge gain

6- Will you use what you learned in this session in your work?*

- Definitely not
- Probably not
- Possibly
- Probably yes
- Definitely yes
- Not applicable

7- We would LOVE to hear ANY other thought(s) you'd like to share with us!*(what you liked or didn't like/ what was helpful/ what could be improved/ one key takeaway that you will apply in your practice or studies etc.)*

Appendix B: End-of-series survey

Thank you for being part of the HHI/ ECHO Gaza series! We appreciate your feedback on anonymous survey. Your input will help us better understand your experience, your needs, and how this initiative can best support your learning moving forward. Your feedback will directly inform next steps and will be used in monitoring and evaluation reports, as well as research to document and improve this and similar series.

SECTION I: PARTCIPATION

1- Between August 11, 2025 and April 16, 2026, how many sessions did you attend?
   - 0 (end of survey)
   - 1-2
   - 3-4
   - 5-6
   - 7 or more

2- Did you watch any session recordings on iECHO?
   - Yes
   - No

3- What year of medical school are you currently in?
   - Year 4
   - Year 5
   - Year 6
   - Already graduated

SECTION II: IMMEDIATE OUTCOMES (knowledge, skills, confidence)

4- Please rate your agreement with the following statement. The ECHO sessions:

	gree	r agree or e)	ee	sagree
Improved my clinical knowledge				
Increased my confidence in anaging clinical cases				

Improved my ability to apply eoretical knowledge to clinical ses

Improved my ability to present nical cases

Strengthened peer-to-peer arning and exchange.

SECTION III: INTERMEDIATE OUTCOMES (behavior in practice)

5- Please rate your agreement with the following statement.

	gree	r agree or e)	sagree
I have used what I learned in the ssions in my clinical rotations or actice.			
The sessions improved my nical decision-making in real ses			
I feel more prepared when proaching or managing patients.			
I have shared knowledge from e sessions with peers or lleagues.			

SECTION IV: FORMAT AND VALUE

6- Please rate your agreement with the following statement.

	gree	r agree or e)	sagree

The case-based format enhanced
/ learning

The sessions complemented my
isting clinical training

Having sessions co-led by
ıdents and international faculty
ıs beneficial to my learning

I have referred back to session
ıterials on iECHO or other
sources to support my learning or
ofessional development.

I feel comfortable reaching out to
esenters from the program in the
:ure.

7- Please share any positive impacts and/or valuable aspects of the VCoP to your learning as a medical student in Gaza:

8- Please share any challenges this VCoP helped you overcome as a medical student in Gaza:

Section V: Looking ahead

9- If this VCoP were to continue, how likely are you to continue participating in the future? Please select the best answer.

- Very likely
- Likely
- No opinion/I do not know
- Unlikely
- Very unlikely [SL1]

10- Sessions have mostly been held weekly. If this VCoP were to continue, how often would you prefer the sessions to be held?

- Once a week (as currently)
- Every other week or twice a month

- Once a month
- No preference

11- Sessions have taken place mostly on Thursdays at 3PM Gaza time. If this VCoP were to continue, is this your preferred timing for the sessions to be held?

- Yes
- Sometimes
- No[SL2]

12- Are there any additional comments or information you would like to share including suggestions for improvement, future topics or anything else you would like us to know?

Appendix C: Focus-group discussion guide (45 minutes)

1) **Introduction and consent (2-3min)**

2) **Sessions' experience and quality (10-15 minutes)**

- How would you describe your overall experience in the ECHO sessions you have attended?

- What aspects of the series did you find useful for your studies and clinical learning as a medical student in Gaza? Can you share specific examples?

- Have you been attending live from your own device or form the shared learning spaced? What format(s) have been working out well (or not) and why?

3) **Relevance and translation into practice (10-15 minutes)**

- Have you applied anything from the sessions in your studies or clinical work?
    - If yes, can you share specific examples?
    - If not, what made it difficult to apply what you learned in practice?

- Would you be interested in more opportunities to interact with fellow students, doctors, or anyone else on the team?
    - If yes, how?

4) **Areas of improvement (10-15 minutes)**

- Was there anything that made it difficult for you to join the session or follow along during the session?

- Based on your experience, what could be improved to make the sessions more useful or accessible to you?

- Do you have any **final reflections** or anything else you'd like to share?

5) **Closing (1 minute)**

Appendix D: Additional selected participant quotations by theme and subtheme.

Theme	Subtheme	Illustrative quotes
1- Cross-cutting value of the VCOP and case-based learning model	i. Case-based and participatory learning	
	ii. Improved knowledge, confidence and skill gains (clinical and other)	
	iii. Community building, mentorship and professional connectedness	
2- Compensatory and continuity functions of the VCOP during educational disruption caused by war and blockade	i. Compensation for disrupted clinical education	
	ii. Reinforcement of professional identity and motivation	
3- Considerations related to program implementation and future direction.	i. Logistical and operational considerations	
	ii. Educational format, content and learning experience	
	iii. Recommendations for future iterations	

Theme	Subtheme	Illustrative quotes
1- Cross-cutting value of the VCOP and case-based learning model	i. Case-based and participatory learning	"First of all, honestly, the whole idea of the program was excellent. The concept of learning through a specific patient case really matches our reality as doctors. In the end, I'm not going to deal with a textbook — I'm going to deal with a real patient and a real case in the future [...] Also, the fact that we as students were allowed

		to participate in presenting cases was great. There was actual give-and-take, not just a lecturer teaching and that's it. You participate, you try presenting what you have.." "The case-based decision way of learning is one of the most useful way to learn, as it breaks the regular boring way of receiving the info by keeping u engaged and feel valued, and it's kinda pressure u to get the info and process it out loud with others. Doing all this with someone expert -like all the trainers that were in the session- is what's making it even more and more beneficial. So hats off for all the great effort and work u have put in this project. Pretty sure it benefits each one of us" "The idea of explaining the case from beginning to end in detail was really nice. I mean we study this information or these cases may have already passed by us academically. But as an actual case, seeing how the patient presentation comes in: How I diagnosed them, how I managed them, how I treated them, what conclusions were reached and why. So when the topic is explained as a case. Yeah it really makes a difference and the information sticks much more. I think it'll also help us later as GPs for example, I'll be more capable of dealing with the patient in a better and more complete way. Not just something I saw in a textbook for example, so that part was really useful."
	ii. Improved knowledge, confidence and skill gains (clinical and other)	" Regarding benefiting from the lectures honestly there was a huge benefit. Benefit from the theoretical content and also practical benefit on the ground. Many cases were presented by doctors or by colleagues and later we saw them in real life. So through the lectures I was able to see real cases from different specialties. And I learned from the doctors and experts who presented these sessions in a very organized and practical way, and I also felt my ability for quick clinical thinking improved. And I learned how to ask questions and interact with the team." " One example of something I benefited from was a case that was presented related to obstetrics and gynecology, and later on I encountered the same case multiple times in

		the hospital. I was able to practically apply the things I learned" "The vCoP helped me better connect theoretical knowledge with real clinical cases in a practical way. It improved my confidence in discussing cases and thinking through clinical decisions. I also found the peer discussions and interaction with different perspectives very useful for understanding topics more deeply. Overall, it was a supportive environment that complemented my medical training" "The opportunity for case presentations was really great. I personally didn't present cases but I saw my classmates who did. And they benefited a lot from it, it was a new experience. I think if the project continues I'd really like to present a case based on the feedback I heard about it. So it's a really useful experience for someone to present a case. Because the presenter themselves ends up understanding the topic much more deeply than just seeing or studying the case. They'll see many more aspects, so that's really useful for a student presenting a case as a presentation, there are a lot of useful things. There was also another thing ... …I think the students who presented cases gained more experience than the rest of us. But that's just my impression of how things worked." "The vCoP in the ECHO program significantly enhanced my learning by linking theoretical knowledge to real clinical cases. The case-based discussions improved my clinical reasoning, structured thinking, and decision-making skills. " "Many cases were presented by doctors or by colleagues and later we saw them in real life. So through the lectures I was able to see real cases from different specialties."
	iii. Community building, mentorship and professional connectedness	"The vCoP helped me overcome limited clinical exposure and resource constraints by providing access to diverse cases and expert guidance. It also addressed gaps in clinical reasoning by allowing me to practice structured case discussions in a supportive environment. Additionally, it improved my

		confidence in presenting and discussing cases, and reduced the sense of professional isolation by connecting me with peers and mentors beyond my local setting." "I think the questions covered everything but there's one point my colleague mentioned about how the people who attended all the lectures became kind of a small community, and there was a group genuinely interested and consistently attending. So if you came to the lectures, the number attending was usually around 30 and it became like a small community." "The idea of meeting people with different experiences from outside and doctors more experienced than you are all really nice and excellent things. " "With limited access to hospitals and practical sessions, the vCoP provided an alternative environment where I could stay academically engaged, attend sessions, and learn from experienced doctors and peers from different backgrounds. The vCoP also fostered a strong sense of collaboration and peer support."
2- Compensatory and continuity functions of the VCOP during educational disruption caused by war and blockade	i. Compensation for disrupted clinical education	"As a medical student in Gaza with so limited resources and abilities these sessions make me aware to how properly deal with patients not in catastrophic circumstances" "It helped me overcome challenges related to limited clinical exposure, restricted access to educational resources, and interruptions in regular teaching, while also reducing feelings of academic isolation by providing structured discussions, peer support, and opportunities to practice clinical reasoning despite difficult learning conditions." "Also I remember they explained a lecture or brought one about ABCs for first aid, and during the war we were doing hospital shifts and volunteering, so this was something we were actually doing practically and it really helped us. We were applying it practically and at the same time learning, so honestly it was good. "

		"The circumstances are not helping and even the patients themselves, not all cases are available or there are not enough opportunities to work with doctors next to the patient. Especially in internal medicine honestly there are many diseases but not all of them are present. Most of the internal medicine cases we see are limited to certain diseases and there isn't much diversity [...] I don't think the hospital cases are really suitable, excuse the term, they're all either burn injuries or simple cases we already know." "The vCoP helped me overcome several important challenges as a medical student in Gaza. One of the main challenges was limited access to clinical training and hospital exposure. Opportunities for hands-on learning were not always sufficient, so the vCoP helped bridge this gap through case-based discussions, interactive sessions, and exposure to real clinical reasoning. This allowed me to maintain and further develop my clinical thinking. " "Participating in the vCoP has had a meaningful positive impact on my learning as a medical student in Gaza, especially given the current challenges affecting traditional medical education. One of the most valuable aspects has been access to continuous, high-quality learning. With limited access to hospitals and practical sessions, the vCoP provided an alternative environment where I could stay academically engaged, attend sessions."
	ii. Reinforcement of professional identity and motivation	"The program helped me feel connected to the international medical community, overcoming the challenges of the blockade and limited mobility." "beyond academics, the vCoP created a sense of motivation and resilience. In a difficult environment, being connected to a learning community reminded me of my goals and reinforced my commitment to continue progressing in my medical journey." "The vCoP helped me overcome feelings of isolation and decreased motivation. Being part of an active learning community created a sense

		of belonging and support, which encouraged me to stay engaged and continue progressing." "I'm incredibly grateful for this opportunity. I was worried that our 'education during war' would be far from the actual medical science we know, but this series proved that we can still access high-quality learning. It gave me a real chance to catch up and feel connected to my studies again. Thank you for making us feel that our academic journey hasn't stopped " "Honestly, my experience was really amazing, the doctors I worked with were very cooperative and really wanted to deliver the information to us. Any question that came to my mind I would ask and they would answer, like they were really there with us. **So I felt there was a kind of support, both in terms of information and psychologically, and the environment was nice, and the discussion was suitable and encouraging for me to speak and continue and research the topic."** "Im happy about sharing medical knowledge with international doctors. It helped me be in contact with the world." "Continuity of Education. Access to Experts & Mentorship Shared Resources Resilience and Hope"
3- Considerations related to program implementation and future direction.	i. Logistical and operational considerations	For me personally, it was easier to attend from the tent or from home because transportation and timing were difficult. It wasn't easy for people to move around, so if internet was available nearby, that was definitely the better option" "the security situation didn't allow for example booking rooms here and there, you could barely go to the hospital and come back and then after that there was another displacement in Gaza and things like that." "transportation and internet were daily challenges for us. Sometimes I'd be at home and there'd be no internet, and sometimes I'd have to go to the hall, and it's far and requires time and transportation which isn't always available.

		So the whole thing was connected to our daily conditions" "The main challenges were scheduling conflicts with my university rotations and exams. Additionally, since I prefer attending from home, frequent power outages and unstable internet connection sometimes made it difficult to stay connected for the full session" "Yeah that happened a lot, especially during the period when there was a six month pause and we stopped for a long time because of the displacement and the war. Besides that, it happened many times with everyone where you'd be planning to attend and then you'd have to move somewhere or stay at home and the internet cuts off, so things would get in the way. We had to stop many times until things became more stable after we had basically finished the year." "Like if my internet at home was good I'd attend from home, and if it wasn't good there were halls with good internet. For me it depended on the internet, wherever the internet was better. At the beginning the conditions were harder especially with the war, so the internet situation was really difficult. Later when things became a bit calmer, there was the option to attend from the hall or from home depending on what was available, and there was flexibility in that depending on each person's ability" "At the beginning, internet access was much worse than it is now, so most people attended from the classroom or shared space. But later on, most people started attending from home."
	ii. Educational format, content and learning experience	"The discussions were close to reality. Most of the doctors who taught in the sessions came to Gaza and saw cases and knew what kinds of things are common here and what kinds of things we can deal with, and they made cases around that and we discussed them, so that made it close to us. The cases were around us, not something distant or unrealistic, not like we're learning something and not knowing if we could apply it or not. On the contrary, there were cases we saw in real life and dealt with in hospitals, and it was nice to see whether our

		perspective and way of handling things was correct, and how to connect the science with the clinical picture, so it really was connected to reality" "Regarding the lecturers and supervisors, honestly their style of presenting topics was really really nice. I remember during the lecture where my colleague presented. She discussed the case and they would participate and ask interactive questions, and the other presenter doctor who was supervising would for example stop during the case and ask questions as interaction" "I used to attend in the halls, and it was really nice. There were students and we would share answers when there was a question, and discuss the cases and review and reach answers that way. So there was discussion, and that helped us learn more. Even though I had internet at home, I preferred attending in the hall because I benefited more from the interaction and discussion with the students." "The opportunity for case presentations was really great. I personally didn't present cases but I saw my classmates who did. And they benefited a lot from it, it was a new experience. And they benefited a lot from it, it was a new experience. I think if the project continues I'd really like to present a case based on the feedback I heard about it. So it's a really useful experience for someone to present a case. Because the presenter themselves ends up understanding the topic much more deeply than just seeing or studying the case. They'll see many more aspects, so that's really useful for a student presenting a case as a presentation, there are a lot of useful things." "Also, the ones presenting the cases were students, so we got to learn from what they personally saw in the hospital. Honestly, my participation with them was really great and I benefited a lot from it."
	iii. Recommendations for future iterations	"We strongly support continuing the project. It achieved major benefit for all the students. And continuing with the same doctors also gives

		continuity and consistency in the teaching style. And maybe adding new doctors too could be useful to broaden the experiences" "Honestly yes, it would be nice if it was repeated, and maybe if for example we connected with medical students from outside, where we discuss cases and they discuss cases, so there would be a bridge between different schools. Maybe students from similar conditions, with the same difficult hospital situations, large numbers of injuries, and limited resources, so there could be more discussion between us about how to deal with cases in difficult and harsh conditions" "Yeah I also just said earlier that I think if it continues again, and hopefully it does continue, I'll try to present a case. I hope it continues, and if there's any change it would be for the better." "maybe focusing more on internal medicine, surgery, and emergency medicine more than other specialties might be better. They're the things we see the most." "there is this idea that instead of random lectures every week with a different topic each time, maybe it would be better to focus on one theme. For example internal medicine alone, if you wanted to do one lecture every week on internal medicine it would take two years to finish, so the idea was to make it under one big title like internal medicine with 6 or 7 lectures, surgery with 6 or 7 lectures, and so on." " I think in certain specialties, a presenter from inside Gaza could actually be more valuable than someone from outside. For example, if we're talking about emergency medicine, then I'd definitely prefer someone from inside Gaza, because doctors here have obviously seen a huge number of emergency cases and may have broader practical experience and insight. But for other specialties, I don't think the difference between someone inside or outside Gaza would be as significant."

		“I hope it's possible to prepare us with BLS and ATLS , all theoretical information can reached online and Practical is face to face with experts” “Regarding repeating the program, of course we’d want to repeat it as long as there’s an opportunity and as long as it’s something beneficial of course. And the idea of meeting people with different experiences from outside and doctors more experienced than you are all really nice and excellent things. As for things we’d want to change, honestly nothing specific comes to mind and the presentation format was really good.”