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Design and Validation of a Simulation-Based Interprofessional Trauma Team Training Module for Healthcare Interns in a Tertiary Care Hospital in India

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Research Article

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Abstract

Background

Trauma is considered one of the most common causes of preventable morbidity and mortality in low- and middle-income countries (LMICs), which include India. Trauma resuscitation requires a collaborative approach that involves professionals working together. However, training in the undergraduate and internship programs in LMICs is mostly discipline-specific without sufficient exposure to interprofessional team functioning within the context of trauma. This study aims to design and validate a context-specific, simulation-based interprofessional trauma team training module for healthcare interns in a tertiary care hospital.

Methods

This study employed a mixed-methods approach following Kern's six-step model of curriculum development. Focus group discussions with faculty and interns identified barriers to trauma care, training gaps, and educational priorities. Quantitative needs assessment surveys were administered to interns (n = 289) and faculty (n = 96). Findings were cross-checked to facilitate module development. Content validity was assessed using the Content Validity Index (CVI), and face validity was evaluated through structured faculty feedback. A pilot implementation with 16 interprofessional participants assessed feasibility and acceptability.

Results

Three major barriers were identified that hinder effective interprofessional trauma care teams: (1) training and experiential gaps in task prioritization and decision-making; (2) interprofessional collaboration deficits such as poor communication, unclear role allocation, and hierarchy barriers; and (3) organizational and operational issues such as manpower shortage, diagnostic delays, and administrative processes. Some facilitators of interprofessional teamwork included standardised, role-specific protocols, experiential learning through simulations and structured debriefing sessions. Nearly all interns agreed that interprofessional education (IPE) and simulation-based training improve trauma team effectiveness, with 99.7% and 94.5% support, respectively. The finalized module achieved strong content validity (CVI = 0.84). Pilot implementation among interns improved confidence in interprofessional teamwork from 62% to 88% and stronger agreement that teamwork improves patient outcomes from 82% to 95%.

Conclusions

A context-specific, simulation-based, trauma-focused IPE intervention module was successfully designed and tested at a teaching hospital in an LMIC setting. This module addresses several identified barriers to training and teamwork to provide a scalable model to improve trauma team preparedness and IPC. More research is needed to examine its effects on trauma team performance and patient outcome measures.

Introduction

Traumatic injury continues to be a major preventable cause of mortality and morbidity globally, with a disproportionately large burden in low- and middle-income countries (LMICs), where trauma care systems, prehospital care, and emergency response systems are often disorganized or inadequately developed. (1–3) India bears a substantial trauma burden, with persistent gaps in trauma care delivery, infrastructure, and workforce preparedness. Even though India's tertiary care capacity has improved, trauma-related mortality remains substantially higher than in high-income countries, especially among patients with severe injuries (Injury Severity Score > 16) due to gaps in trauma care delivery, infrastructure, and workforce preparedness. (1–5)

The first hour of trauma care, commonly termed the "golden hour," is critical for survival and functional results. Any delay in airway treatment, hemorrhage control, neurologic assessment, imaging, or definitive care is significantly correlated with preventable fatalities. (3, 6–8) Nevertheless, the best outcomes in trauma care are not only dependent on the individual skills of the practitioner but also on the ability of the healthcare team to work well under conditions of time pressure, uncertainty, and high cognitive load. Effective trauma resuscitation requires coordinated technical and interprofessional performance under time-sensitive conditions. (4, 6, 7)

The literature from emergency medicine and trauma care has shown that adverse events during trauma resuscitation are more likely to be related to the failure of non-technical skills, such as communication failures, unclear role delineation, poor leadership, fragmented handovers, and hierarchical barriers to speaking up, rather than a lack of theoretical knowledge alone. (5, 8–11) The fast-paced emergency room environment—with constant interruptions, frequent staff and team changes, especially during night shifts—intensifies these hazards, making it challenging even for highly skilled professionals to function effectively as a team without a shared common language and unified goals. (12)

In India and similar LMIC settings, trauma care is further challenged by workforce variability, systemic inefficiencies, and inadequate interprofessional preparation. Interns frequently serve as first responders despite limited structured exposure to collaborative trauma resuscitation, contributing to persistent theory–practice gaps. (5, 10, 13) Undergraduate and internship teaching is largely discipline-specific and instructional, and it lacks adequate opportunities for students to engage in collaborative decision-making within a simulated trauma context. This has led to a theory-practice gap, where students might remember trauma protocols and algorithms but struggle to determine what to do first, predict how things will unfold in real life, or handle competing demands when things don't go as planned. (14–16)

Simulation-based education offers a practical, safety-focused way to address these gaps by allowing deliberate practice of technical and non-technical skills in high-risk, time-critical scenarios without compromising patient safety.(10, 12, 17–20) Simulation-based education has emerged as an effective strategy for improving trauma preparedness, teamwork, leadership, closed-loop communication and learner confidence (14, 15)

Simulation can be even more effective when specifically designed for interprofessional education (IPE). (13) When incorporated into trauma simulation, IPE can enhance role understanding, decrease barriers related to hierarchy, improve shared mental models, and enhance joint responsibility for patient care (17–22) A comparative investigation demonstrates that interprofessional simulation yields greater improvements in collaboration and communication than single-profession simulation, thereby advocating the establishment of interprofessional training frameworks in trauma simulation education. (16–18)

However, most published interprofessional trauma simulation curricula have been developed in high-income countries and assume stable trauma activation pathways, adequate staffing, easy access to imaging and specialist care, and well-defined professional roles. (14, 21) Many existing trauma curricula are derived from high-resource settings and may inadequately address LMIC-specific operational realities. (13, 23) Contextual curriculum development becomes essential in this regard for its viability, applicability, and efficacy. (24)

Even though trauma is one of the leading causes of morbidity in India, no systematically planned and validated trauma simulation module exists for the tertiary level teaching hospital. The current approaches tend to be fragmented and limited to a single discipline, lacking requirements assessment or validation. (5) A validated, context-specific interprofessional trauma training framework remains lacking. (25) This study aimed to design and validate a simulation-based interprofessional trauma team training module for healthcare interns in an Indian tertiary-care teaching hospital through mixed-methods needs assessment, expert validation, and pilot feasibility testing

Methodology

Study Design and Setting

In this study, a mixed-methods study design was adopted in which both qualitative and quantitative needs-assessment data were collected and analyzed concurrently. A mixed-methods study design was chosen to enable data triangulation, integrating qualitative and quantitative findings to align the module with clinical realities, learner needs, expert consensus, and contextual barriers, thereby directly informing its content and structure. The module was evaluated and validated by subject experts using a structured, validated questionnaire. Following this, the research team conducted a pilot implementation to assess its feasibility and effectiveness. The Institutional Ethics Committee/Institutional Review Board approved

this study (IECKMCMLR-12/2024/661) and registered it with the Clinical Trials Registry of India before participant enrollment (CTRI/2025/08/092849).

The study was conducted at a tertiary-care hospital and regional trauma referral centre in India. The institution trains nearly 350 interns across multiple healthcare disciplines each year and manages a high-volume trauma care program, which has led to the development of an interprofessional trauma team training simulation-based training module.

Participants

Learner

The learner group consisted of healthcare interns from medical, nursing, respiratory therapy, and emergency medicine technology (EMT) streams who were undergoing internships in their respective clinical disciplines and had given their consent to participate.

Faculty/Subject experts

Subject experts were recruited from disciplines directly involved in trauma care and trauma resuscitation, including Emergency Medicine, Anaesthesia, Surgery, Orthopaedics, Forensic Medicine, Nursing, Respiratory Therapy, and EMT. We included subject experts who had a minimum of three years of trauma-related clinical and/or teaching experience, were actively involved in trauma care, education or supervision, and excluded those health care professionals who were not directly involved in trauma care and those unable to participate in the scheduled study activities.

Sampling and sample size

A purposive convenience sampling approach was used to ensure representation across all healthcare professional disciplines involved in trauma resuscitation. Discipline diversity was prioritized to capture varied educational, operational, and collaborative insights relevant to trauma care workflows. For module design and validation, the research team recruited 16 interprofessional trauma care experts from all the aforementioned disciplines as subject matter experts.

To assess the needs of interns, we did a needs assessment survey of 289 interns, with the sample size calculated to provide a 95% confidence interval (CI) and 5% margin of error ($p = 0.25$), based on findings from a previous study. (16) A parallel survey involving 96 faculty members, with the sample size calculated to achieve a 95% CI and a 10% margin of error. (26)

Pilot feasibility and acceptability of the developed module were assessed among 16 interprofessional interns, with equal representation from the medical, respiratory therapy, EMT, and nursing disciplines.

Educational intervention: Module development approach

Educational objectives

The module development aimed to strengthen the interprofessional trauma resuscitation by targeting both the technical priorities, such as a structured initial trauma team approach, and non-technical competencies, such as closed-loop communication, role clarity, leadership responsibilities, shared situational awareness, and coordination among team members, especially during high-stress situations among the interns who are involved in the management of trauma cases.

Curriculum development framework

The curriculum development process followed a six-step process for designing the curriculum for medical education, as outlined by Kern. Reporting adhered to SRQR (Standards for Reporting Qualitative Research) and GRAMMS (Good Reporting of Mixed Methods Studies) principles to ensure methodological transparency and reporting quality. This process involves the following steps: identification of the problem, targeted needs assessment, setting goals and objectives, selection of an educational strategy, implementation of the curriculum, and evaluation of its effectiveness. The selection and reporting for the study followed the acceptable standards for transparency for the reporting of the data, as outlined by the principles for transparency for qualitative research standards.

Development of module content

Module content was developed through a staged process. (Fig. 1) Initially, we conducted focus group discussions (FGDs) with 16 experts (two sessions, each with eight experts from the disciplines listed in the participant list) and 16 interns (4 sessions with four interns who had completed their internship from each discipline- medical, respiratory therapy, EMT and nursing) to identify barriers and solutions to effective trauma care, training gaps, and workflow constraints. The FGD was conducted using a validated, structured questionnaire with appropriate prompt questions for each question. Simultaneously, the research team circulated a quantitative needs assessment survey to a diverse group of 289 interns from various backgrounds to identify their perceived training needs, barriers, and solutions to communication, as well as their preferred training modalities. Finally, we synthesized expert input from 96 faculty experts using a Google Form to identify needs into structured module components, simulation scenarios, and training strategies that were appropriate for the local clinical context. Integrated convergence analysis of intern and faculty survey findings was conducted to identify aligned educational priorities and directly inform module design (Supplementary Table S1). A visual heatmap summarizing convergence across major educational domains was also generated to enhance interpretation of stakeholder alignment (Supplementary Fig. S1).

Scenario and session design

We designed a 16-minute video-based interprofessional simulation for trauma team training, along with supporting teaching materials, to reflect both standard trauma priorities and local workflow realities. The scenario focused on initial trauma resuscitation of a head injury patient using a stepwise trauma approach aligned with airway, breathing, circulation, disability, and exposure. The 16-minute video has been divided into four shorter segments, each focusing on a distinct aspect of trauma care. These ideas were further reinforced in a didactic presentation using PowerPoint that outlined the crucial elements of trauma management as well as the key roles and responsibilities of each healthcare provider. Along with facilitating interprofessional job allocation and task ownership, the developed module includes embedded decision points to reflect real-world variability, such as personnel limitations and operational constraints, and a shared communication structure with a focus on closed-loop communication. The module also included training in various skills required for managing head-injured patients, such as airway management, intravenous cannulation, cervical collar application, and log rolling the spine. The sessions also incorporated structured prebriefing, simulation scenarios, and debriefing of the scenarios to reinforce learning and support psychological safety.

Data collection: Development and validation of FGD guides

The researchers developed separate semi-structured guides for FGD with faculty and interns to understand the existing barriers to effective interprofessional trauma care, gaps in training and confidence for trauma resuscitation, challenges in role clarity, operational and systemic-level constraints, and finally, recommended training and assessment strategies. The FGD guides were validated by four experts in trauma care, IPE, and medical education. Based on expert feedback, FDG guide was revised to enhance clarity and alignment with the study's objectives.

Focus group discussions (qualitative component)

FGDs were done separately for faculty and interns, as a round table discussion with a moderator guiding the participants with open-ended questions, starting with introductions and ground rules, then moving on to general topic discussion, key salient questions, and finally concluding each session with wrap-up insights about the discussion. After obtaining informed consent from each participant, they were assured that the information gathered was anonymous and would not affect their performance at the institution or in the workplace. Moderators were employed to conduct the FGDs, and the study also utilized field notes.

Faculty FGDs involved two 90–120-minute audio-video recorded sessions with eight subject experts from core trauma disciplines, accompanied by verbatim transcription and sociogram creation by an independent observer, with saturation achieved thereafter. Intern FGDs were conducted similarly in smaller interprofessional groups of four participants each to ensure balanced participation and minimize hierarchical influence. Thematic saturation was determined when subsequent FGDs yielded no novel themes or substantive conceptual insights.

Surveys (quantitative component)

Structured surveys were administered to interns (n = 289) and faculty members (n = 96). (Fig. 1) The questionnaires assessed the attitudes of faculty regarding feasibility, essential skills, and implementation factors, as well as attitudes toward the relative importance of IPE to trauma team functioning, perceived barriers to effective communication (lack of role clarity, hierarchical issues, and time factors), and preferences for training methods (simulation, workshop, and lecture). The survey questionnaire were circulated as Google Forms to assess the perceptions of importance of IPE for the functioning of the trauma team members, the barriers in communications, such as unclear roles, hierarchy, time pressure, preferred training modalities such as simulations, lectures, workshops, and faculty perspectives on feasibility, what the critical competencies are, and how to implement this. The survey questionnaire was developed based on a literature review and validated by subject experts for clarity and relevance. The complete survey questionnaires administered to interns and faculty experts are provided in Supplementary File S1. Pilot testing was conducted prior to administration, and internal consistency was assessed using Cronbach's alpha. The overall reliability of the assessment tools was strong (Cronbach's $\alpha = 0.87$), with excellent reliability for MCQ-based knowledge assessments ($\alpha = 0.92$), good reliability for interprofessional attitude measures ($\alpha = 0.82$), and excellent reliability for self- and peer-assessment tools ($\alpha = 0.97$)." The survey questionnaire's findings served as a guide in designing the simulation-based training module.

Validation and pilot testing

Content validity & face validity

The developed module underwent content validity and face validity (Fig. 1). Content validity was assessed using the Content Validity Index, with experts rating each module component on a four-point relevance scale, with 1 indicating "not relevant" and 4 indicating "highly relevant." Item-level and scale-level CVIs were calculated, with CVI ≥ 0.80 considered acceptable. Face validity was assessed through structured expert feedback on clarity, realism, feasibility, structure, and alignment with learner needs.

Pilot feasibility testing

After validating the module, the research team made minor refinements based on suggestions from subject experts. The finalized module was pilot tested with 16 interprofessional participants to assess the acceptability and feasibility of the module delivery format. During the pilot implementation, participants received handouts of the module two weeks prior to the actual simulation session. An interprofessional simulation on treating a patient with a head injury was carried out on the day of the simulation session. All participants were asked to complete pre test multiple-choice questions (MCQs) and an attitude questionnaire before being assigned into balanced teams of four for an initial head injury simulation scenario. Initially, they were allowed to run a simulation scenario before the lecture video-based simulation module session. This was followed by hands-on training in airway management, including endotracheal intubation, intravenous cannulation, and the log roll maneuver for the spine. After the hands-on workshop, participants were reassessed in the same team using the validated tools such as Simulation-Based Assessment Checklist and the Team Emergency Assessment Measure (TEAM).

Finally, the participants underwent a post-test assessment using a different set of MCQs and attitude questionnaires. Additionally, they completed reflection questions and provided self and peer feedback. The pre- and post-session attitude scale framework captured participants' perceived confidence in interprofessional teamwork, their perceptions of the impact of teamwork on patient outcomes, and the acceptability of the simulation format. The pilot implementation primarily focused on learner reaction, confidence, teamwork perceptions, and feasibility rather than patient outcomes or long-term behavioral change.

Evaluation and outcome measures

The primary outcomes were expert consensus on module components (≥ 70% agreement) and content validity of the module (CVI ≥ 0.80). Secondary outcomes included face validity, feasibility, acceptability, learner confidence, perceived interprofessional teamwork, and participant feedback from pilot testing.

Data analysis

We coded the collected data, entered it into an Excel sheet, and used International Business Machines Statistical Package for the Social Sciences (IBM SPSS) Statistics, Version 29.0, to perform statistical analysis. We used medians and interquartile ranges (IQRs) for continuous variables and frequencies and percentages for categorical variables to present the descriptive data. This was done to help in module creation rather than to test hypotheses. We used bar charts to display the data when appropriate visually. It utilized descriptive statistics to analyze quantitative data, including survey responses and CVI ratings, to summarize learner needs, perceived challenges, and expert consensus. Pre- and post-intervention comparisons for pilot participants were analyzed using paired statistical methods (Wilcoxon signed-rank or paired t-test based on normality testing), while feasibility and acceptability were summarized descriptively.

Qualitative data were analyzed using Braun and Clarke’s reflexive thematic analysis. (Fig. 1) Reflective thematic analysis was conducted independently by two researchers, beginning with data familiarization and progressing through the creation of preliminary codes, topic identification and review, theme generation, theme refinement, and final reporting. Investigator triangulation, field notes, and sociograms enhanced analytical rigor. Through debate and repeated transcript examination, they carried out open coding and iteratively developed topics, resolving all disagreements through consensus. The study employed triangulation between the datasets of interns and instructors to identify differences specific to each profession and convergent themes. Data saturation was considered achieved when no new substantive themes emerged across sequential focus groups. Trustworthiness was ensured through methodological triangulation, investigator triangulation, maintenance of an audit trail, reflexive coding practices, and detailed contextual reporting, thereby enhancing credibility, dependability, confirmability, and transferability.

Figure 1. Overview of the mixed-methods study design and staged methodology used for the development, validation, and pilot testing of the simulation-based interprofessional trauma team training module.

Results

Participant Characteristics

A total of 289 interns and 96 faculty members participated in the study. Interns were predominantly early-career trainees from medical and allied health disciplines, while faculty represented trauma-relevant specialties with substantial clinical experience. Detailed demographic characteristics are presented in Table 1.

Table 1
Comparative demographic characteristics of interns and faculty participants

Variable	Interns (n = 289)	Faculty (n = 96)
Age (years), median (IQR)	24 (23–24)	34 (30–38)
Gender, n (%)		
Female	162 (56.1%)	45 (46.9%)
Male	127 (43.9%)	51 (53.1%)
Discipline / Specialty, n (%)		
Medical	241 (83.4%)	—
Nursing	20 (6.9%)	12 (12.5%)
Emergency Medicine	—	12 (12.5%)
EMT	14 (4.8%)	12 (12.5%)
Respiratory Therapy	14 (4.8%)	12 (12.5%)
Anaesthesia	—	12 (12.5%)
Clinical Forensic Medicine	—	12 (12.5%)
General Surgery	—	12 (12.5%)
Orthopaedics	—	12 (12.5%)
Years of experience, median (IQR)	—	8 (6–13)

EMT- Emergency Medicine Technology

Quantitative Findings: Needs Assessment Survey

Barriers to Interprofessional Trauma Care

Interns and faculty identified communication breakdowns, variations in training and experience levels, and a lack of role clarity as major barriers to effective interprofessional trauma care. Interns more

commonly reported uncertainty regarding roles and responsibilities, whereas faculty highlighted communication failures and variability in team competence (Table 2).

Table 2
Main barriers to effective interprofessional collaboration during trauma care

Variables	Faculty, n (%), (n = 96)	Interns, n (%) (n = 289)
Communication breakdowns between team members	63 (65.6)	146 (50.5)
Differences in training or skill levels among team members	61 (63.5)	170 (58.8)
Lack of clarity in roles and responsibilities among team members	54 (56.3)	187 (64.7)
Variability in experience levels among team members	48 (50.0)	145 (50.2)

Perceived Competency Gaps and Current IPC

Faculty identified important competency gaps among interns particularly in decision-making under pressure, leadership, communication, and role clarity (Fig. 2). Perceptions of the current effectiveness of interprofessional collaboration (IPC) during trauma resuscitation were mixed among both interns and faculty, with a substantial proportion reporting neutral or suboptimal collaboration. (Fig. 3).

Figure 2. Faculty-identified competency gaps among interns during trauma resuscitation across technical, cognitive, and non-technical domains relevant to interprofessional trauma care (n = 96).

Figure 3. Interns (n = 289) and faculty (n = 96) perceptions of the effectiveness of current IPC during trauma resuscitation. IPC = interprofessional collaboration.

Attitudes Toward IPE

Intern and faculty attitudes toward IPE were strongly positive, with both groups supporting structured simulation-based training aligned with real-life trauma workflows (Fig. 4).

Figure 4. Intern and faculty attitudes toward IPE as a strategy to improve trauma team effectiveness and collaborative practice (interns n = 289; faculty n = 96). IPE = interprofessional education.

Priority Training Needs and Educational Preferences

Interns pinpointed several key training areas, including practical technical skills, communication, collaboration, and decision-making (Fig. 5). Faculty also stressed the need to include both technical and non-technical skills in an organized trauma training curriculum (Fig. 6). Both groups greatly valued experiential learning methods. Simulation-based training, practical skill sessions, and interprofessional role-play were favored over lecture-based instruction, highlighting a collective preference for active, collaborative learning methods (Table 3). Convergent analysis demonstrated strong alignment between

intern and faculty perceptions regarding deficiencies in trauma preparedness, communication, role clarity, leadership, and the need for simulation-based interprofessional training (Supplementary Table S1). Supplementary Fig. S1 visually illustrates the high degree of quantitative convergence between interns and faculty across key trauma education domains.

Table 3
Components essential for an IP trauma resuscitation module

Components	Faculty n (%), (n = 96)	Interns, n (%), (n = 289)
Simulation-based exercise	84 (87.5%)	288 (99.7%)
Hands-on skill sessions	81 (84.4%)	195 (67.5%)
Interprofessional role-play	74 (77.1%)	215 (74.4%)
Lectures-based learning	38 (39.6%)	121 (41.9%)

Figure 5. Intern-prioritized training domains for improving trauma resuscitation effectiveness, including technical, cognitive, and non-technical competencies (n = 289).

Figure 6. Faculty perceptions of priority competencies required for a structured interprofessional trauma resuscitation training program across technical, cognitive, and non-technical domains (n = 96).

Qualitative Findings: Focus Group Discussions

Qualitative analysis yielded two overarching domains: (1) barriers to effective interprofessional trauma care and (2) proposed solutions to enhance teamwork and care delivery. The participants reported difficulties, including communication issues, hierarchical issues, role ambiguity, and workflow problems, and proposed the need for simulation-based training, role definition, and debriefing. This is illustrated in the Fig. below, which shows the themes of the barriers to curriculum development and the components to be incorporated into the module to address those barriers among faculty (Fig. 7) and interns (Fig. 8).

Figure 7. Thematic framework derived from faculty focus group discussions illustrating perceived trauma care barriers, training gaps, and educational priorities for module development in interprofessional trauma training.

Figure 8. Thematic framework derived from intern focus group discussions for identifying trauma care barriers and educational priorities for module development

1. **1. Barriers to Effective Interprofessional Trauma Care**
2. **1.1 Knowledge and Training Gaps**

Participants reported inadequate trauma-specific preparation among interns, especially in prioritization, decision-making, and management of non-routine trauma scenarios. Faculty highlighted a persistent theory–practice gap, where interns performed better in assessment settings than in dynamic clinical situations. The allied health interns appeared to be more proficient in processes due to early exposure.

“If there is a slight change in the scenario, they would not know what is life-threatening or how to assess a new priority.” — Faculty

1.2 IPC Deficits

Communication barriers among doctors, nurses, and allied health care workers including inconsistent terminology, conflicting instructions, unclear admission responsibilities, hierarchical power dynamics, and the lack of a common resuscitation language—were consistently identified across all FGDs as major obstacles to effective trauma teamwork. These factors contributed to order misinterpretation, poor collaboration, improper task performance, non-collaborative attitudes, and unclear roles.

“If everyone was speaking the same language in trauma care, the chance of miscommunication would be less.” — Faculty

1.3 Systemic and Operational Constraints

Participants identified system-level barriers to timely trauma care, including administrative delays related to consent, insurance, and operating theater readiness, limited nighttime diagnostic access, and role overload among trainees and nursing staff. Inadequate escalation pathways and delayed senior involvement during critical stages further contributed to time loss and delayed decision-making.

“After all this, we would lose about six to seven hours, which is the golden time.” — Faculty

“Each person usually has multiple roles and multiple patients.” — Faculty

2. Proposed Solutions for Strengthening Trauma Care

Across both faculty and intern FGDs, there was strong consensus that improvements in trauma care required structured, standardized, and interprofessional training approaches rather than isolated technical instruction.

2.1 Standardized Protocols and Role Clarity

Participants advocated for checklist-based trauma protocols that were adaptable to varying resource settings. Explicit role allocation for each interprofessional team member was emphasized as essential for improving efficiency, accountability, and decision-making.

“Along with the protocol, we need to add the actual responsibility of each department.” — Intern

2.2 Simulation-Based and Experiential Learning

High-fidelity simulation using mannequins, moulage, and role play was universally endorsed as the most effective training modality for trauma care. Participants emphasized the importance of emotional realism, time pressure, and interprofessional interaction to replicate real trauma environments.

Observational learning from real trauma cases and video-based instruction were also valued for contextualizing team dynamics and workflow.

“Simulation is hands-down the best way to learn trauma.” — Intern

“Simulation… is a must for undergraduate as well as postgraduate training.” — Faculty

2.3 Continuous Assessment and Reinforcement

Both groups emphasized the importance of repeated training, structured debriefing, and objective assessment. Suggested strategies included Objective Structured Clinical Examination (OSCE) -based evaluations, pre–post testing, periodic refresher courses, and longitudinal follow-up to assess skill retention and practice change.

Thematic Convergence and Module Validation

Triangulation of faculty FGDs, intern FGDs, and survey data identified three core challenges:training and experiential gaps in trauma preparedness, systemic and operational constraints affecting the timeliness of interventions and IPC deficits, including communication, role clarity, and coordination

These findings directly informed the design of the interprofessional trauma simulation module. The finalized module achieved a scale-level CVI of 0.84, indicating strong content validity. Faculty reviewers reported high satisfaction with the module’s face validity, regarding its realism, clarity, feasibility, and practical relevance to trauma training. Experts agreed that the module effectively reflected real-world trauma resuscitation and aligned well with IPE needs. Simulation-based learning, checklist-guided protocols, defined team roles, and experiential teaching strategies were especially valued for enhancing the module’s practical applicability and educational effectiveness.

A pilot implementation among 16 interprofessional participants demonstrated marked improvements in perceived interprofessional confidence and attitudes toward teamwork. Pilot assessment instruments demonstrated strong internal consistency, with an overall Cronbach’s alpha of 0.87 across evaluation domains. The proportion of participants who strongly agreed that they felt confident working with professionals from other disciplines increased from 62% before training to 88% after training, while those who strongly agreed that interprofessional teamwork improves patient outcomes increased from 82% to 95%. Pilot participants reported high satisfaction with the program, highlighting the realism, practical relevance, team-based learning, and structured debriefing as key strengths. They noted improved hands-on experience, interprofessional confidence, and reflective learning, confirming the module’s acceptability, educational value, and feasibility for broader implementation.

Discussion

In this mixed-methods research, the context-specific interprofessional trauma team training simulation module was developed and validated for use in a tertiary care hospital in India. Based on Kern's

curriculum development process model, involving six steps, and experiential learning theory, this module was purposely designed to consider the barriers to learning and implementation within Indian undergraduate trauma systems. (27) The integration of inputs from faculty and interns, findings from the needs assessment survey, and expert validation has led to the module's high degree of content validity (CVI = 0.84). Conventional trauma curricula tend to focus solely on technical and teamwork skills, which may be standardised. In contrast, the current module integrates the operational challenges often encountered in the Indian and LMIC settings, such as workforce variations, resource constraints, medico-legal challenges, and hospital system constraints. (28, 29) Typically, interns and early-career professionals are the first responders in a trauma situation. Despite their role, they seldom feel confident when addressing issues related to fast-paced decision making IPC, and operating within the hospital system. In line with other literature in the field of trauma teamwork, the barriers identified in the current study, such as (i) lack of training and experiential learning, (ii) system-level constraints, and (iii) inefficiency of IPC, were consistent with the literature. However, our results also highlight contextual barriers that are more pronounced in LMIC environments. These encompass delayed diagnosis, problems with administration and workflow, excessive documentation for legal and clinical reasons, and variations in clinical experience across different specialities. Collectively, these contribute to the complexity of providing well-coordinated, high-quality trauma care and underscore the need for structured, context-sensitive interprofessional training approaches. (5, 11, 23, 24)

Training and experiential gaps

The theory–practice gap emerged as a key finding in faculty and intern FGDs. Although interns may understand trauma algorithms, they often struggle with prioritization, adaptive decision-making, and task integration during dynamic trauma scenarios. This aligns with evidence that trauma competence requires not only technical knowledge but also sensemaking, situational awareness, and team-based decision-making under pressure. (9, 14, 15) The simulation literature repeatedly demonstrates that whereas trainees may complete discrete tasks when working alone, they struggle when asked to integrate them in a time-sensitive team setting. (14, 25) Panic, hesitation, and missed prioritisation—all well-known indicators of cognitive overload and insufficient "in-the-moment" framing abilities during high-acuity resuscitations—were observed in our data. (9, 30)

Our qualitative research and intern preferences both clearly indicated the need for repeated, hands-on exposure: 99.7% of interns preferred simulation-based scenarios as the training approach. This is consistent with systematic and comprehensive reviews showing that interprofessional or multidisciplinary simulation-based trauma training enhances confidence, role clarity, and collaborative behaviours, especially when combined with organised debriefing. (14, 15, 31) These findings also align with best-practice simulation standards emphasizing structured prebriefing, psychologically safe facilitation, and formal debriefing as essential mechanisms for translating simulation experiences into sustained behavioural and educational improvement. (32) This aligns with undergraduate IPE literature demonstrating that simulation-based experiential learning improves collaborative competence more effectively than didactic approaches alone. (33) However, unlike many global simulation curricula

developed in high-resource environments, our module explicitly incorporates context-adaptive scenarios reflecting Indian institutional and operational constraints.(34) Crucially, our environment also revealed perceived preparedness disparities among learner groups, with allied health interns occasionally characterised as more "hands-on." Teams may participate in shared simulations with varying levels of baseline procedural experience, potentially intensifying hierarchy, silence, and role ambiguity unless the curriculum deliberately establishes shared expectations and psychological safety. (18, 35) This variability further complicates interprofessional training planning. The convergence of intern and faculty perspectives further strengthens the validity of identified curriculum priorities, particularly regarding simulation-based experiential learning, role-explicit training, and structured feedback.

IPC and communication

Throughout FGDs and questionnaires, communication issues were prevalent; 64.7% of interns reported unclear role assignments and protocols, and 58.8% reported inadequate communication skills training. This is supported by research findings showing that poor non-technical skills, particularly in leadership, communication, and shared situational awareness, significantly contribute to unfavourable outcomes in trauma resuscitation. (9, 36) Research investigating real and simulation-based trauma teams also shows that communication processes may become fragmented or overly centralised, and miscommunication often occurs within teams that lack a common language or a stable team structure. (37) The presence of contradictory instructions ("give the drug / don't give the drug") reported by interns in our data demonstrates problems with systems for clear task delegation and closed-loop communication. Closed-loop communication is highly recommended due to its ability to promote more accurate information transfer and reduce task drop-off. (38–40) These findings strongly parallel TeamSTEPPS principles, which emphasize structured communication tools, psychological safety, and shared mental models as foundational to effective team performance. (41–43)

Both qualitative and quantitative findings demonstrated the phenomenon known as the "hierarchy problem," in which almost half of the intern respondents identified hierarchy as one of their challenges (50.2%). High authority gradients are associated in the scientific literature with the inability to form shared mental models, delayed escalation, and reluctance to speak up among students and nurses. (9, 44) Role ambiguity and unequal training exposure among cadres may exacerbate hierarchy in the LMIC context; our participants specifically connected these factors to communication lags and accountability conflicts (e.g., admission responsibility). Instead of regarding communication as an inherent talent, these themes reinforce the argument for integrating role scripts and communication tools (such as callouts, check-backs, and closed-loop exchanges) into interprofessional simulation. (9, 39, 45) Consistent with broader trauma education literature, structured protocols and checklist-based approaches may reduce cognitive burden during high-stress resuscitations while improving team consistency, especially among novice learners.(46)

Systemic and operational constraints as curriculum targets

The findings clearly emphasize that system-level and operational barriers—such as delayed nighttime diagnostics, workforce shortages, role overload, and administrative delays related to insurance, consent, and operating theatre preparedness—are central challenges affecting timely trauma care. These factors, which include imaging delays and protocol adherence problems, have been connected to avoidable deaths and are frequently reported in trauma system research in India and other LMICs. (5, 11, 23, 47) For instance, system-level flaws (such as imaging delays and protocol noncompliance) have been highlighted in the analysis of trauma deaths in India as causes of avoidable mortality. (47) Consequently, rather than relying on the unrealistic assumption about the trauma system, hospital intervention assessments in India emphasise the importance of implementing practical, realistic methods to improve coordination and efficiency. (23)

Following the tenets of global health simulation design that emphasise the importance of incorporating "resource variability" into scenario construction, so learners can practice their decision-making skills despite the lack of an ideal way to diagnose or staff patients, our learners consistently pushed for adaptive plans. (21, 48) This approach distinguishes the module from traditional trauma curricula by treating systemic barriers not as external limitations but as core educational targets, thereby improving realism, transferability, and relevance for LMIC healthcare systems. (49) The significance of this point cannot be overemphasised, as learners may find themselves caught in a "training–reality mismatch," where skills fail to transfer due to system constraints, and simulation training is conducted solely for optimal performance. On the other hand, situations that purposefully introduce operational friction—such as delayed CT, understaffed, or unclear admissions—are more likely to foster strong decision-making and teamwork. (21, 31)

Implications for evaluation and scaling

While the current study focused on module design and validation, our data suggest a robust next-step evaluation. The combination of reported barriers and proposed facilitators suggests that future outcomes should include both technical process measures (task sequencing, timeliness of key interventions) and teamwork performance measures. Assessing non-technical skills and collaborative behaviours during trauma resuscitations and simulations has been done using validated measures such as T-NOTECHS and TEAM, which may provide more objective evidence of behavioural improvement than self-report. (36, 44, 45) In addition, structured measurement of closed-loop communication (including emerging quantification tools) can directly target the communication breakdowns identified by interns and faculty. (39)

There is a compelling institutional case for required interprofessional onboarding at internship entry, followed by planned refreshers, given the high level of buy-in shown in the needs assessment (94.5% strongly agreeing that IPE promotes trauma team efficacy; 99.7% preferring simulation based learning). Although developed within an Indian tertiary-care teaching hospital, this validated framework may offer broader applicability to other LMIC institutions facing similar challenges related to trauma systems, resource variability, and interprofessional training deficits. (21, 50, 51) Such “hardwiring” of teamwork behaviors into routine workflows is consistent with TeamSTEPPS-informed approaches to embedding

teamwork practice in emergency care settings. (25, 35) Faculty development, formal debriefing standards, and standardized facilitator training will be critical for maintaining educational fidelity, reproducibility, and long-term sustainability during wider implementation. (32)

Limitations

The study was conducted in a single tertiary-care teaching hospital with established simulation infrastructure, which may have limit generalizability to institutions with different staffing patterns or lower-resource settings lacking comparable educational resources. Purposive convenience sampling may also have introduced selection bias. The pilot cohort was small and relied primarily on self-reported outcomes rather than objective behavioural or patient-centered measures Long-term retention, transfer to clinical practice, and sustainability were not assessed. Future multicentric studies should include objective performance metrics, clinical outcomes, and longitudinal follow-up.

Conclusion

This study successfully designed and validated a context-specific simulation-based interprofessional trauma team training module for a high-burden tertiary-care hospital in India, achieving a strong expert-derived content validity (CVI = 0.84). Key barriers identified included training gaps, systemic operational constraints, and IPC deficits. Strong stakeholder support for structured simulation-based IPE underscores the demand for practical, role-based trauma training. By integrating structured protocols, role clarity, checklist-based learning, and context-relevant operational challenges, this module represents a scalable educational innovation to improve trauma teamwork in LMIC tertiary care settings. Future multicentric studies should evaluate long-term educational effectiveness, objective teamwork performance, clinical outcomes, and sustainability to support broader institutional and regional implementation.

Abbreviations

CI – Confidence Interval
CTRI – Clinical Trials Registry of India
CVI – Content Validity Index
EMT – Emergency Medicine Technology
FGD – Focus Group Discussion
GRAMMS - Good Reporting of Mixed Methods Studies
IBM SPSS – International Business Machines Statistical Package for the Social Sciences
IPC – Interprofessional Collaboration
IPE – Interprofessional Education
IQR – Interquartile Range
LMICs – Low- and Middle-Income Countries

MCQ – Multiple Choice Question
OSCE – Objective Structured Clinical Examination
SRQR – Standards for Reporting Qualitative Research
TEAM – Team Emergency Assessment Measure
T-NOTECHS – Trauma Non-Technical Skills Scale

ABCDE – Airway, Breathing, Circulation, Disability, Exposure

Declarations

Ethics approval and consent to participate

Ethics Statement

This study received approval from the Institutional Ethics Committee/Institutional Review Board of Kasturba Medical College, Mangalore, Manipal Academy of Higher Education (Approval No. IECKMCMLR-12/2024/661). The study was prospectively registered with the Clinical Trials Registry of India prior to participant enrollment (CTRI/2025/08/092849). Written informed consent was obtained from all participants, and all study procedures were conducted in accordance with institutional ethical standards and the principles of the Declaration of Helsinki.

Consent for publication

Written informed consent for participation and publication of anonymized research findings was obtained from all faculty members and healthcare interns prior to enrollment in the study. Participant confidentiality and anonymity were strictly maintained throughout data collection, analysis, and reporting.

Availability of data and materials

All data generated or analysed during this study are included in this published article and its supplementary information files. Additional datasets are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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CRediT Authorship Contribution Statement

Dr. Sanjan Asanaru Kunju contributed to conceptualization, methodology, investigation, formal analysis, data curation, visualization, writing of the original draft, review and editing, and project administration. Dr. Ciraj Ali Mohammed contributed to conceptualization, methodology, supervision, validation, and writing – review and editing. Dr. Harihara Prakash contributed to conceptualization, methodology, supervision, validation, and writing – review and editing. Dr. Mukhyaprana Prabhu contributed to conceptualization, methodology, supervision, validation, and writing – review and editing. Dr. Anand R contributed to conceptualization, methodology, validation, investigation, and project administration. Dr. Animesh Jain contributed to conceptualization, methodology, validation, investigation, data curation, and project administration. Dr. Vimal Krishnan S contributed to conceptualization, methodology, validation, investigation, and project administration. Dr. B. Unnikrishnan contributed to conceptualization, methodology, supervision, and project administration.

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Declaration of Interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that no generative artificial intelligence (AI) tools or AI-assisted technologies were used in the writing, analysis, or preparation of this manuscript. The manuscript was developed, written, and reviewed entirely by the authors, who take full responsibility for its accuracy and integrity.

Presentation at a meeting

A subsection of the study was presented as an oral presentation at the National University 1st International Higher Education Conference on Health Professions Education, held from February 3 to 5, 2026, at the Oman Convention and Exhibition Centre, Muscat, Sultanate of Oman.

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Figures

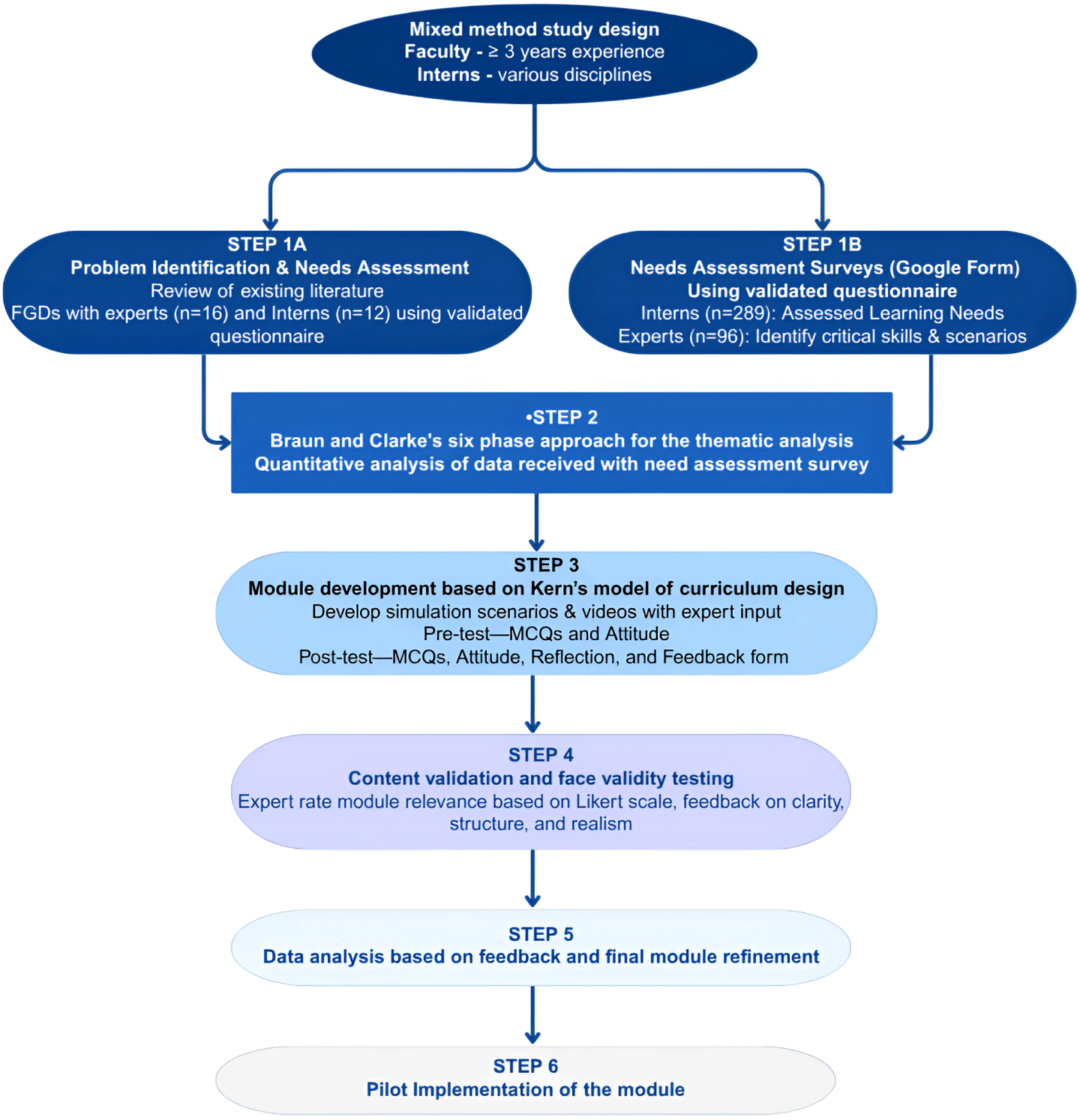


Figure 1

Overview of the mixed-methods study design and staged methodology used for the development, validation, and pilot testing of the simulation-based interprofessional trauma team training module.

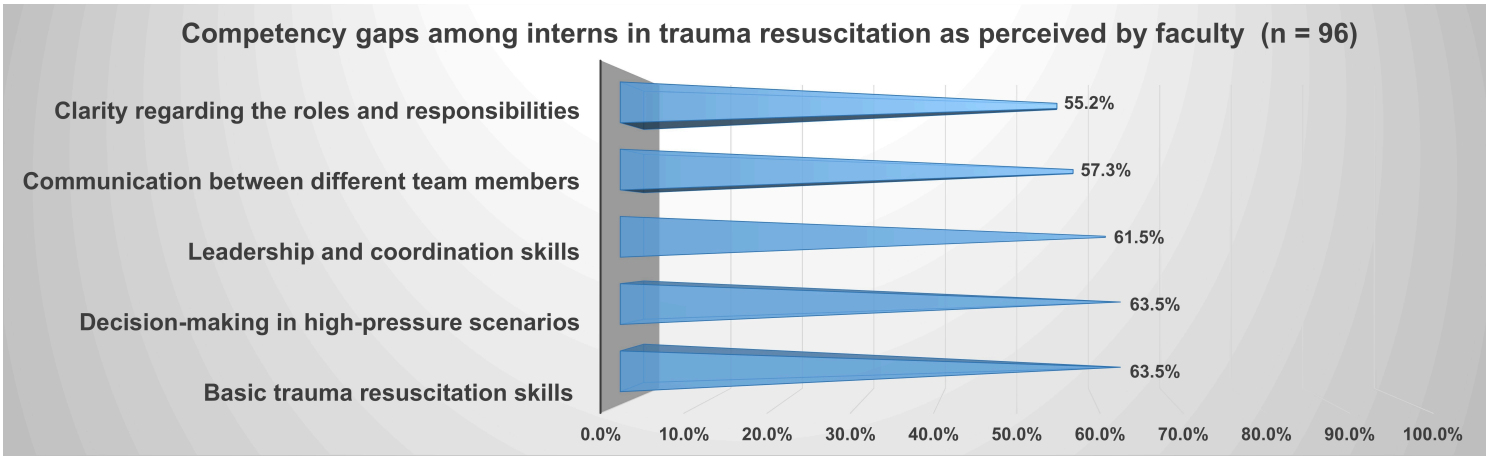


Figure 2

Faculty-identified competency gaps among interns during trauma resuscitation across technical, cognitive, and non-technical domains relevant to interprofessional trauma care (n = 96).

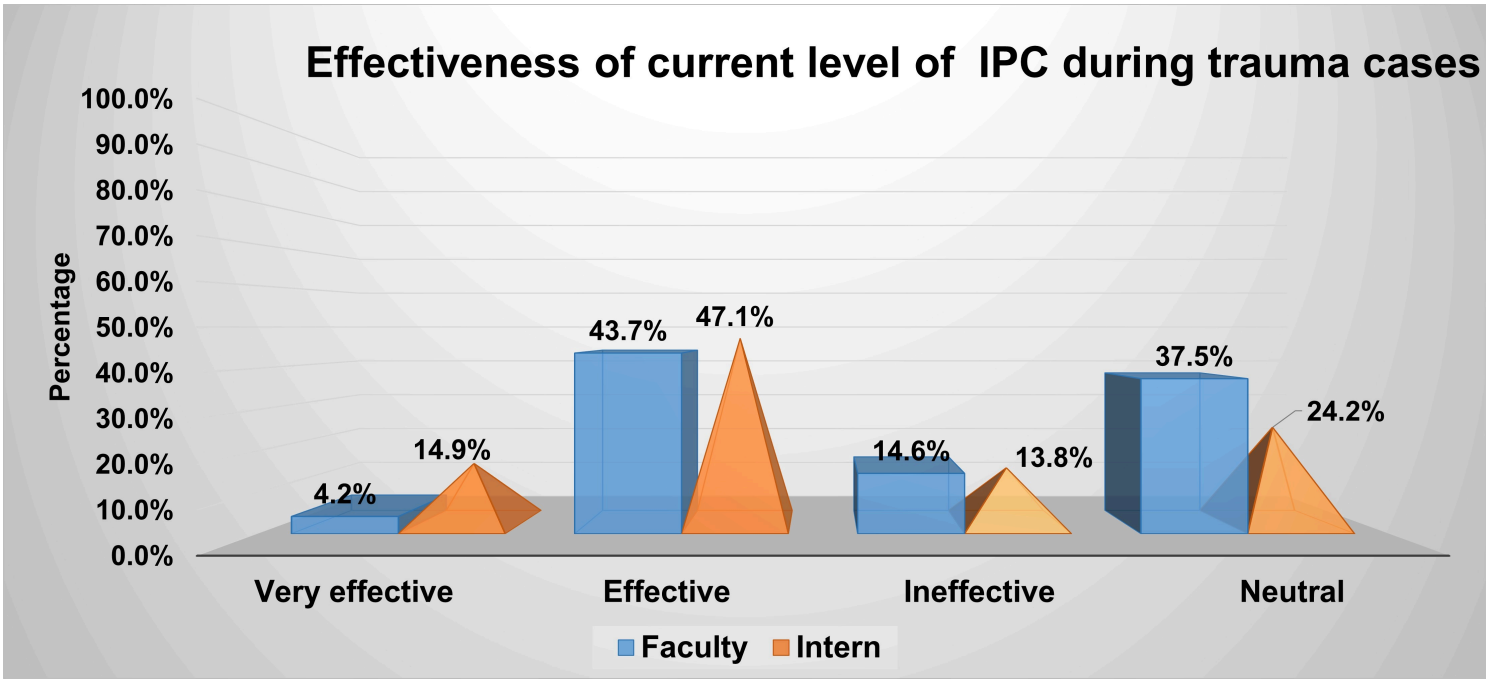


Figure 3

Interns (n = 289) and faculty (n = 96) perceptions of the effectiveness of current IPC during trauma resuscitation. IPC = interprofessional collaboration.

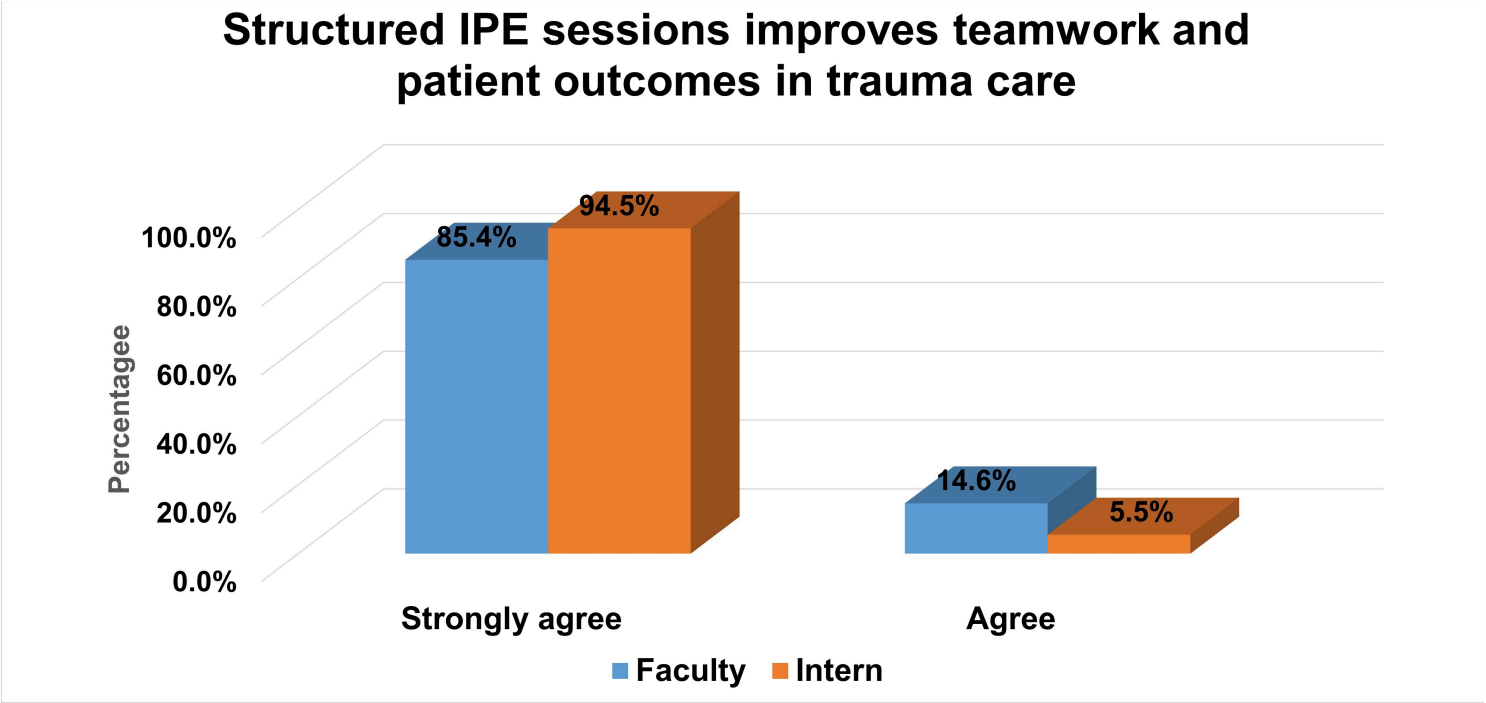


Figure 4

Intern and faculty attitudes toward IPE as a strategy to improve trauma team effectiveness and collaborative practice (interns n = 289; faculty n = 96). IPE = interprofessional education.

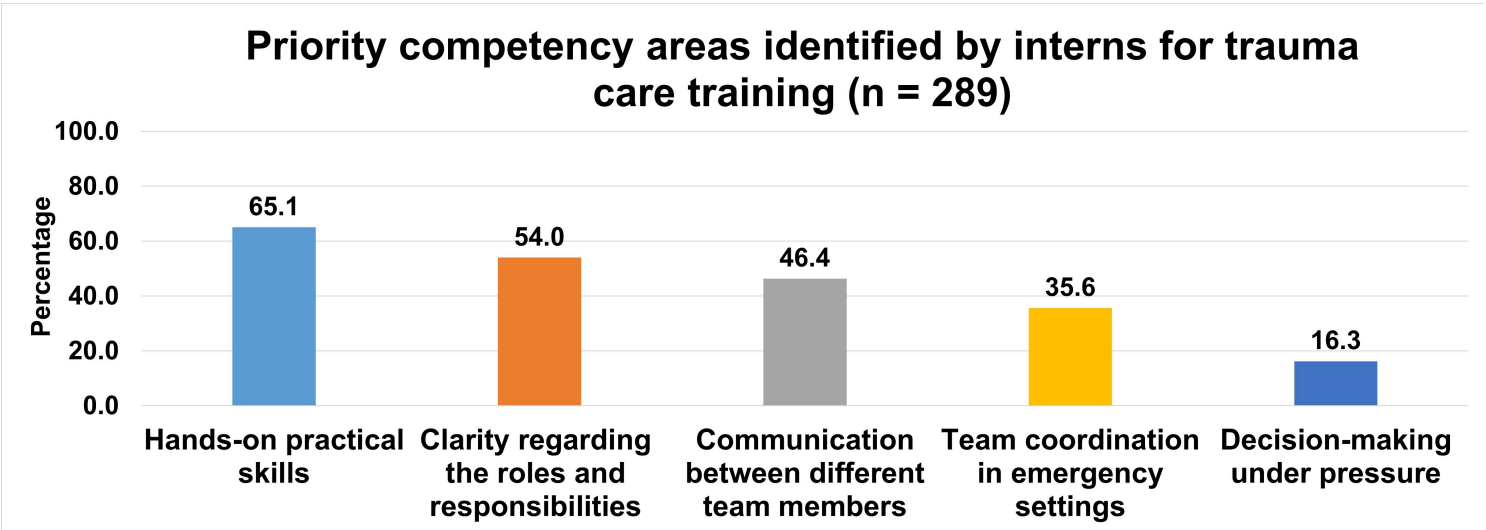


Figure 5

Intern-prioritized training domains for improving trauma resuscitation effectiveness, including technical, cognitive, and non-technical competencies (n = 289).

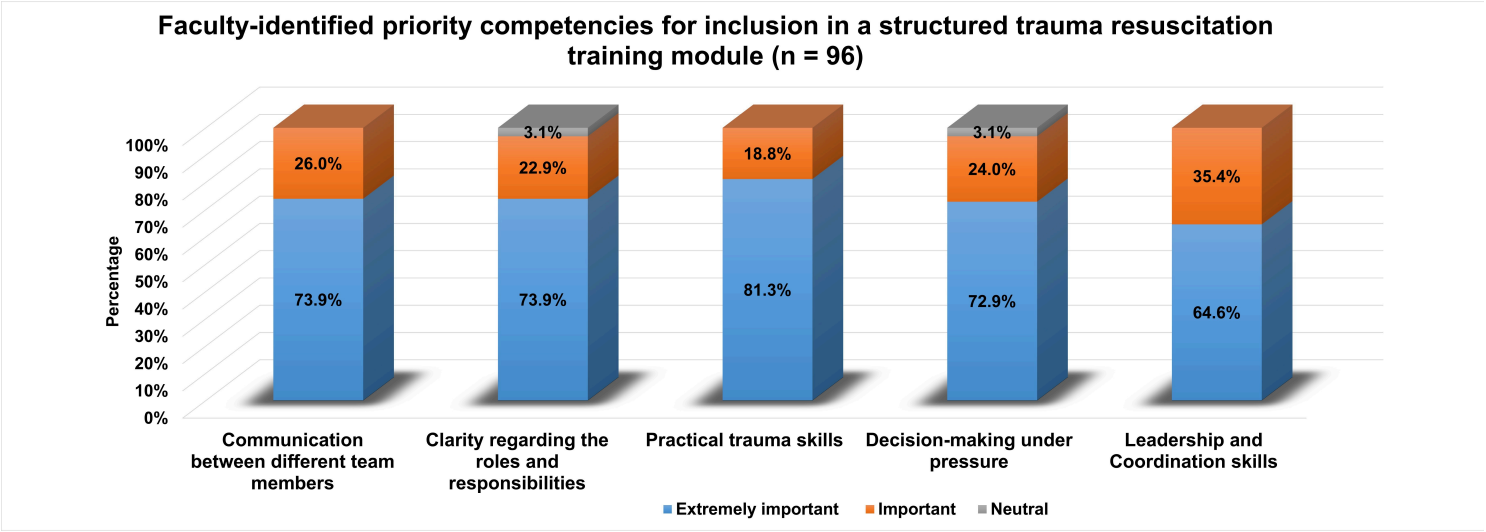


Figure 6

Faculty perceptions of priority competencies required for a structured interprofessional trauma resuscitation training program across technical, cognitive, and non-technical domains (n = 96).



Figure 7

Thematic framework derived from faculty focus group discussions illustrating perceived trauma care barriers, training gaps, and educational priorities for module development in interprofessional trauma training.

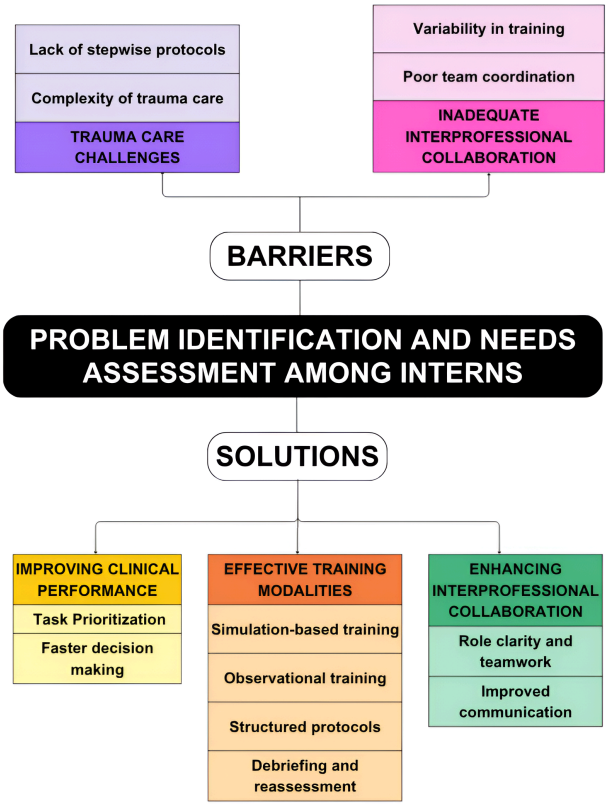


Figure 8

Thematic framework derived from intern focus group discussions for identifying trauma care barriers and educational priorities for module development

Supplementary Files

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

- SupplementaryFigure1.png
- SupplementaryFigurelegend.docx
- SupplementaryFileS1.docx
- SupplementaryTableS1.docx