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# Evaluating the long-term impact of the Trauma Team Training course in Guyana: an explanatory mixed-methods approach

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## KEYWORDS:

Trauma team training;  
Interprofessional;  
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## Abstract

**BACKGROUND:** We evaluated the retention of trauma knowledge and skills after an interprofessional Trauma Team Training (TTT) course in Guyana and explored the course impact on participants.

**METHODS:** A mixed-methods design evaluated knowledge using a multiple-choice quiz test, skills and trauma moulage simulation with checklists, and course impact with qualitative interviews. Participants were evaluated at 3 time points; before, after, and 4 months after TTT.

**RESULTS:** Forty-seven course participants included 20 physicians, 17 nurses, and 10 paramedical providers. All participants had improved multiple-choice quiz test scores after the course and retained knowledge after 4 months, with nonphysicians showing the most improved scores. Trauma skill and moulage scores declined slightly after 4 months, with the greatest decline observed in complex skills. Qualitatively, course participants self-reported impact of the TTT course included improved empowerment, knowledge, teamwork, and patient care.

**CONCLUSIONS:** Interprofessional team-based training led to the retention of trauma knowledge and skills as well as the empowerment of nonphysicians. The decline in performance of some trauma skills indicates the need for a regular trauma update course.

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The significant number of trauma-related deaths in low-income countries is well documented,<sup>1,2</sup> as is the need for increased training in trauma management in these settings.<sup>3–5</sup> Structured trauma training for physicians using the Advanced

Trauma Life Support (ATLS) (1980, American College of Surgeons, Chicago, IL USA) course has been implemented in 50 countries<sup>6</sup>; however, the burden of trauma is unequally distributed globally, with the majority of trauma patients residing in low-resource settings. Furthermore, these settings often cannot support the specialized, resource-intensive, trauma programs of higher-income settings. Therefore, an effective, low-cost, sustainable trauma training program is needed in low-income countries where the burden of trauma is the highest.

In 1998, the Canadian Network for International Surgery in collaboration with the Injury Control Centre in Uganda developed a 3-day interprofessional Trauma Team

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Training (TTT) course TTT developed by Canadian Network for International Surgery (CNIS) (C) 2005 Primary Authors Dr. Ron Lett (Vancouver, BC Canada) and Dr. Olive Kobusingye (Uganda, Africa).<sup>7</sup> It was subsequently introduced to Tanzania<sup>8</sup> and Guyana in 2006.<sup>9,10</sup> By 2009 in Guyana, 19 local instructors and 126 local providers had completed the course, and the TTT was established as the national standard certification for trauma training. The course differs in several important and unique ways from the ATLS course. It uses low-cost simulation task trainers that can be produced locally and includes nurses and other paramedical personnel who work in the local emergency departments as well as physicians. The focus of the TTT is on teaching every member of the trauma team their role, including practice in team management of trauma scenarios. Critical to the successful implementation and wider impact of the course, TTT is built on a train the trainers' model so that the course can be sustained by local instructors.

Given the national recognition of the TTT in Guyana and the paucity of evidence in the literature, a formal program evaluation was needed. In this study, we conducted a mixed-methods evaluation of TTT course outcomes and knowledge retention, including follow-up interviews with course participants to document the impact of the TTT on their role as trauma care providers in Guyana.

## Methods

Informed consent was obtained from all participants, and Research Ethics Board approval was obtained from both McMaster University (REB: 09-552) in Canada and from the Institute for Health Science Education, Georgetown Public Hospital Corporation (GPHC) in Guyana.

### The TTT course

The objective of the TTT course is to develop effective and competent trauma teams in emergency departments of resource-limited centers. The 3-day course includes lectures, trauma task skill sessions, and team exercises.<sup>7</sup> Lectures outline the standard ABCDE approach to trauma, and skill stations are conducted with small groups. TTT course participants are taught specific trauma task skills using a team-based approach by local TTT instructors who have completed the TTT instructors' course. The 7 trauma skills are cardiopulmonary resuscitation, recovery position, patient log roll, venous cutdown, endotracheal intubation, cricothyrotomy, and chest tube insertion. The team exercises include team-building puzzles, the measurement of injury severity, and trauma moulage simulation scenarios ranging from a single-system uncomplicated injury to a complete complex simulated trauma patient evaluation.

The mixed-methods sequential explanatory design consists of 2 distinct phases: quantitative followed by qualitative.<sup>11</sup> The analysis of the quantitative data provides a general understanding of the research problem, whereas

the qualitative analysis explains the statistical results by exploring participants' views in more depth.

In the first phase of the study, the following quantitative outcome measures were used: (1) a 15-question multiple-choice quiz (MCQ) to assess essential trauma knowledge,<sup>8</sup> (2) a skills checklist (SC) to assess trauma task specific skills, and (3) the Trauma Team Assessment Tool (TTAT)<sup>8</sup> to assess team management of a simulated complex trauma scenario and teamwork. Both the MCQ and the TTAT have been previously validated in Tanzania.<sup>8</sup> The TTAT's reliability was studied during the July 2009 data collection period. The intraclass correlation coefficient for the TTAT was .84 (95% confidence interval, .39–.96), which indicates a high level of reliability among TTT instructors in Guyana. The SC was developed and reviewed by senior TTT instructors and ATLS instructors. Two independent instructors trained by the research staff completed both the SC and TTAT evaluations. Data were collected from 2 separate cohorts in July 2009 and November 2009. Each cohort was re-evaluated 4 months later using the same measures.

Individuals completed the MCQ at 3 time points: before the TTT course (PRE), immediately after the TTT course (POST), and at the 4-month follow-up time point (RETENTION). The participating teams consisting of at least 1 physician, 2 nurses, and 2 paramedical professionals (orthopedic technicians or attendants) were assessed using the SC and TTAT at the PRE and RETENTION time points. Teams were arranged to closely represent their real-life setting, grouping together participants from the same hospital. At follow-up, all attempts were made to recreate the original teams.

All quantitative data were anonymized, coded, and entered into a secure pre-validated research database. Differences in MCQ scores between the PRE, POST, and RETENTION time points within each professional group and overall were compared using a paired Student *t* test. All team-based assessment scores (SC and TTAT) were averaged between 2 evaluators, and a 2-tailed paired Student *t* test was used for within-group comparisons, whereas an unpaired Student *t* test was used for between-group comparisons. The change in mean scores (RETENTION – POST) was used to evaluate the retention of TTT skills. All data analysis was completed using SPSS version 17.0 (SPSS, Chicago, IL) using a 5% significance level.

In the second phase of the study, explanatory in-depth semistructured one-on-one interviews were conducted using a 7-question interview guide developed after a review of the quantitative results. The purpose of the interviews was to further understand the impact of the TTT course on participants through contextualization and explanation of the quantitative results. All interviews were conducted 4 months after the participant completed the TTT course by a single researcher (J.P.). Interviews were recorded, transcribed verbatim, cleaned, and prepared for textual analysis. A descriptive thematic analysis<sup>12,13</sup> by 1 researcher (J.P.) was conducted using open, axial, and selective coding. The results were discussed in depth with the senior author (B.H.C.) in an iterative process until conceptual saturation

was reached and a formal codebook was created. The 2 authors finalized the major thematic results through the data-reduction process by consensus. In order to enhance data validation and rigor, an audit trail of the process was kept. A final descriptive mixed-methods analysis was completed by comparing and contrasting the qualitative themes to the quantitative results.

Results

Forty-seven course participants from 2 TTT courses in 2009 were included in this study: 20 physicians (2 surgeons and 18 general medical officers), 17 nurses, and 10 paramedical professionals (9 orthopedic technicians and 1 attendant). Twenty-three were from the tertiary trauma referral hospital (GPHC), and 24 were from regional hospitals. There were 27 women and 20 men, and they averaged 5 years of clinical experience. Forty-six participants completed the MCQ pre-test (PRE) and the post-test (POST), whereas 32 completed the 4-month follow-up MCQ test (RETENTION). Fifteen (30%) participants were lost to follow-up (5 in cohort 1 and 10 in cohort 2, Table 1).

The mean overall MCQ scores were significantly higher at both follow-up time points when compared with the pretest (POST vs PRE = +12%, *P* < .0001; RETENTION vs PRE = +7.3%, *P* < .0001). The greatest increase in MCQ scores was seen among nurses (POST vs PRE = +20.9%, *P* < .0001), who also had the highest rate of retention at follow-up (RETENTION vs PRE = +16%, *P* = .01). Physician knowledge was the highest before the TTT and remained almost constant throughout the study with no significant differences found across all time points (Table 2).

Simple trauma task specific skills (log roll, venous cut-down, and endotracheal intubation) were well retained after 4 months; however, the 2 more complex task skills (ie, chest tube insertion and cricothyrotomy) showed a lower level of retention. Most team comparisons (POST/RETENTION) showed a significant difference, with the exception of log roll, venous cutdown, and endotracheal intubation; however, at the time of follow-up, all teams scored above 70% on the team-based trauma task specific skills (both simple and complex). Collective trauma team moulage performance TTAT scores declined significantly after 4 months (POST/RETENTION = -12.23%, *P* < .0001) overall (Table 3).

During the qualitative phase of the study, we interviewed 20 course participants. Ten interviews were recorded, transcribed verbatim, and included in the qualitative

analysis, including 4 physicians, 3 nurses, and 3 paramedical professionals. Seven participants were based at the tertiary centre (GPHC), and 3 participants were from regional hospitals. The additional 10 nontranscribed interview notes were used as a comparison to the in-depth thematic results after data saturation was achieved.

The qualitative analysis of the course impact on participants identified 4 main themes: empowerment/disempowerment, an increase in knowledge, improved interprofessional teamwork, and perceived improved patient care (Table 4). These 4 themes were evident across all 3 professions; however, each profession expressed these themes differently.

Empowerment/disempowerment

Empowerment was defined by the participants as an increase in clinical confidence with trauma care. This was a key theme across all professions, with the physicians reporting it most frequently. Empowerment also led to an increase in clinical responsibility for some of the nonphysician participants. Some participants felt disempowered, either because too few of their colleagues had TTT training at their site, there lacked available resources to perform their training.

Increase in knowledge

All participants, especially the nurses and paramedical professionals, reported a perceived increase in essential trauma knowledge. Physicians reported that the TTT highlighted a reiteration of important concepts from medical school.

Improved interprofessional teamwork

Improved interprofessional teamwork after the TTT course was a significant theme in the interviews. A physician reported that the TTT course cleared up confusion with the other members he was working with, whereas nurses expressed improved communication and understanding of how to assist with the more complex procedures. Some participants saw improved teamwork leading to better staff interactions.

Perceived improved patient care

Many participants identified improved patient care as an outcome of their empowerment, knowledge, and improved teamwork combined. The perceived improvement in patient care emerged as a meta-theme, which was dependent on the existence of the other 3 themes. Disempowerment had a negative effect and decreased the perceived improvement in patient care.

Mixed-methods results

The qualitative interview themes helped explain the statistical trends. The retention of knowledge at the

Table 1 Participant retention rates by cohort and profession

Profession	Cohort 1 (n = 24)		Cohort 2 (n = 23)	
	PRE	RETENTION (%)	PRE	RETENTION (%)
Physicians	11	9 (81.8)	9	5 (55.6)
Nurses	9	7 (77.8)	8	5 (62.5)
Paramedical professionals	4	3 (75.0)	6	3 (50.0)

**Table 2** Mean MCQ knowledge scores by profession\*

Profession	Pretest score	Posttest scores	Retention test scores	Pre/post <i>P</i> value	Pre/retention <i>P</i> value
Physicians (n = 20)	12.75 ± 1.71	13.25 ± 1.02	13.01 ± 1.00	.17	.35
Nurses (n = 17)	9.94 ± 2.75	13.06 ± 1.43	12.17 ± 1.64	.0001	.01
Paramedical professionals (n = 10)	7.9 ± 1.79	10.7 ± 2.16	9.33 ± 2.25	.001	.31
Overall (n = 47)	10.9 ± 2.89	12.7 ± 1.71	12.0 ± 2.02		

\*MCQ was scored out of a total of 15; higher scores are superior.

4-month follow-up documented by the MCQ quiz scores from the nurses and paramedical professionals was corroborated by the interviews. Physicians did report that the course content was an excellent review of their previous medical training but did not echo the other participants' improved knowledge, which was evident in the nonsignificant change in knowledge found in the quantitative results.

The high scores in team-based evaluations (skill stations and trauma moulage) immediately after the TTT course confirm the effectiveness of the TTT curriculum and structured approach to trauma management as well as the improved interprofessional teamwork illuminated by the interviews. Most participants reported increased empowerment, which correlated with the quantitative results in improved simple skills and trauma moulage scores. Some felt disempowered when they were the only ones at their hospital who had completed the TTT course, and this was reflected by lower team trauma moulage scores in the second cohort, which had a larger loss to follow-up (43.48% in cohort 2 vs 20.83% in cohort 1, Table 1).

## Comments

A trauma education course should have 3 components: a review of essential knowledge, practice of technical skills, and the development of nontechnical teamwork and leadership skills. The TTT course includes all these components and additionally is taught in an interprofessional

format. This study demonstrates that participants in the TTT course not only had an increase in trauma knowledge immediately after the course, but also that knowledge and basic trauma task skills were retained 4 months later. However, the more complex task specific skills of chest tube insertion, cricothyrotomy, and complex trauma team resuscitation were less well retained.

The knowledge component of a trauma training course is typically assessed through short written examinations or quizzes immediately before and then after a training course. The overall gain in knowledge across professions seen among the TTT participants immediately after the TTT course in this study (12%) compares favorably with the literature that reports an increase in knowledge ranging from 8% to 27% for pre-/post-test designs.<sup>3,4</sup> This perception of improved knowledge was a prevailing theme reported by all participants in the interviews regardless of their level of training or working in the district or regional hospitals. Knowledge retention is not often reported in trauma course evaluations, but the attrition of knowledge has been documented after the ATLS<sup>14</sup> and advanced trauma nursing course.<sup>15</sup> In a study of the cognitive retention of ATLS participant knowledge between 3 and 60 months after course completion, Blumenfeld et al<sup>14</sup> found a higher rate of decline in nonsurgical participants. They determined that an overall 20% decline in knowledge happened in 50% of their participants around the 180th week after course completion and recommended an update course for all ATLS providers every 3 to 4 years. Similarly,

**Table 3** The retention of trauma skills 4 months after the course\*

Station (/total number of points)	Post TTT score [B]	4-month retention score [C]	Mean change [C – B] (%)	<i>P</i> value (95% confidence interval)
<b>Skills</b>				
CPR (/12)	11.3	10.5	–6.7	.03 (.25–3.55)
Recovery position (/6)	5.5	5.1	–6.7	.02 (.14–1.46)
Log roll (/8)	7.6	7.8	+2.5	.38 (–.66 to .26)
Venous cutdown (VC) (/30)	29.1	28.1	–3.3	.06 (–.02 to 2.02)
Endotracheal intubation (ET) (/20)	18	17.1	–4.5	.34 (–.98 to 2.78)
Chest tube insertion (CT) (/24)	21.7	18.6	–12.9	.0002 (1.62–4.58)
Cricothyroidotomy (Cric) (/18)	17.6	14.6	–16.7	.0001 (2.30–3.70)
<b>Trauma simulation</b>				
Overall TTAT score (/100)	76.0	63.8	–12.23	

\*Team-based evaluations. Teams were comprised of physicians, nurses, and paramedical personnel.

**Table 4** Participants' perceived impact of TTT course

Theme	Example quotes from interviews
Empowerment/ disempowerment	<p>"I was totally scared, I would never come here [to the trauma room], but now I love it, so confidence is really good." (Nurse)</p> <p>"In the past when you used to go in the trauma room it was like you were lost, but now, it's like you can do anything. I can do anything, and it feels good...I could do more now. What was less then was now more. I could assist more." (Paramedical professional)</p> <p>"Actually that is a challenge for us in my area, seeing that we didn't have a doctor on the program in that area with us. So for me, I'm the only person that's trained so it is tough to get things flowing how it should." (Nurse)</p>
Knowledge	<p>"...not enough persons are training." (Physician)</p> <p>"Changed a lot because now I have more knowledge in that area and I would be of assistance in a better way to be able to care for my patients." (Nurse)</p> <p>"...it was bringing back everything, some of the very simple things that I have bypassed and forgotten." (Physician)</p>
Teamwork	<p>"Staff with the TTT training know what they have to do. Those who don't have the training...get a little confused in management of multi-trauma patients." (Physician)</p> <p>"So when they are doing things, you have an idea and you could even feel good saying things like find the 5th rib." (Nurse)</p> <p>"Everybody gets oxygen and the coordination of everyone working as a team. You find that you don't have that bit of confusion now with the feedback and everything." (Paramedical professional)</p>
Perceived improved patient care	<p>"...give[s] the patient a better advantage of being looked after much better." (Paramedical Professional)</p> <p>"The good thing about the [TTT] program is that whoever does this program would enable them to see any patient that comes in, they would be able to treat them." (Nurse)</p> <p>"Better management...the patients are more satisfied, we're alleviating more pain and we're transferring patients at the appropriate time which is saving lives." (Physician)</p>

nursing researchers documented a significant reduction in knowledge between the completion of the advanced trauma nursing course and a reassessment 3 months later.<sup>15</sup> Our study also found an attrition of knowledge among all participants but differed in showing better knowledge retention for nurses whose quiz scores 4 months after the course remained significantly higher than the pretest.

The measurement of skills performance, especially as a team, is more challenging. Our procedure-specific skills checklists were developed using the Objective Structured Assessment of Technical Skills model<sup>16</sup> with an ATLS-qualified TTT surgeon instructor and were used for giving feedback for the purpose of this study rather than for measuring competence. We did not measure skills performance before the course, but we did document only a minimal decrease in performance of the more basic trauma resuscitation tasks of cardiopulmonary resuscitation, intubation, and intravenous cutdown. There was a more impressive drop-off in the performance of the more complex tasks of chest tube insertion and cricothyrotomy.

Another unique feature of the TTT skills stations is the use of low-cost training models.<sup>17</sup> Most are made from locally available materials, and the only animal part used is a rack of ribs incorporated into the chest tube insertion model. Teaching videos were available, but most instruction took place directly with the instructor, with a ratio of 1 instructor for 5 participants. The course is modeled on adult learning principles, minimizing lectures and encouraging questions, discussion, and practice.

We used the previously validated TTAT checklist tool<sup>8</sup> to evaluate performance in the team trauma moulage simulation. Although the TTAT contains several items about teamwork, there are now other better tools for assessing multidisciplinary team performance in a trauma setting. The trauma nontechnical skills (T-NOTECHS) scale is 1 example<sup>18</sup> that includes the elements of leadership, cooperation and resource management, communication and interaction, assessment and decision making, and situation awareness/coping with stress. Capella et al.<sup>19</sup> showed an improvement in clinical trauma care using a Trauma Team Performance Observation Tool to evaluate leadership, situation monitoring, mutual support, and communication.

The focus on team rather than individual performance is a key philosophy of the TTT course and differentiates TTT from the physician-focused ATLS, which does not include interdisciplinary training or address teamwork in the trauma room. The interviews of course participants clearly indicate the value of the interprofessional team training approach. The structured systematic approach reinforced through short lectures, skill stations, team-building exercises, and active trauma scenarios was well received by the participants and led to an increase in confidence and empowerment. This empowerment, when combined with an increase in knowledge and teamwork, is connected to the perceived improved patient care.

The results of this study closely parallel a similar trauma training program in India and Sri Lanka where participants valued a systematic team approach above all else<sup>20</sup> and is



consistent with international standards of best practice as outlined in the World Health Organization's Guideline to Essential Trauma Care.<sup>21</sup> Another key TTT tenet is to train the trainers to ensure local sustainability of the course. Most of the course instructors were locally trained Guyanese surgeons, with external Canadian faculty providing the initial TTT instructor course and participating alongside local faculty during some of the subsequent provider courses. Instructors are recertified every 3 years.

This study has several limitations including the lack of a randomized design, a small sample size, and a high loss to follow-up (especially in cohort 2). In addition, there are several confounding factors including the amount of practice and trauma experience course participants had during the 4-month follow-up period before reassessment. We attempted to have each participant keep a trauma log in which the numbers of procedures and confidence levels could be recorded, but compliance and supervision were challenges. We also do not have a true estimate of the effect of the loss to follow-up. We hypothesize that this impact is reflected in the team trauma exercises scores; however, this cannot be substantiated. Given these limitations, this study did use a mixed-methods design to allow for triangulation of results (investigator and data) which did improve the overall rigor of the study by strengthening some of the quantitative weaknesses. We also recognize that performance in a course does not necessarily indicate performance in real-life trauma situations or improved patient outcomes.

## Conclusions

The TTT course led to improvement and retention of trauma knowledge, skills, and teamwork necessary to manage successfully a trauma patient in a low-resource setting. This study demonstrated the feasibility of incorporating follow-up measures in internationally-partnered program evaluations as well as the strengths of using a mixed-methods design. Further research is needed to understand how the course outcomes translate into improvement in clinical care, and to develop more valid and reliable measures to assess trauma skills and teamwork in both the course and real-life settings. We have used the results of this study to develop and pilot a 1-day TTT update course in Guyana that includes a focus on the complex skills and video-supported debriefing of complex trauma scenarios using high-fidelity simulation.

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