



"Evaluation of a training program for surgical trauma teams in Botswana"

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“Evaluation of training program for surgical trauma teams in Botswana”

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Abstract

Background: Trauma represents a challenge to health care systems worldwide, particularly in low- and middle-income countries. Positive effects can be achieved by improving trauma care at the scene of the accident and throughout hospitalization and rehabilitation. Therefore, we assessed the long-term effects of national implementation of a training program for multidisciplinary trauma teams in a Southern African country.

Methods: From 2007 to 2009, an educational program for trauma, “Better and Systematic Team Training,” (BEST) was implemented at all government hospitals in Botswana. The effects were assessed through interviews, a structured questionnaire, and physical inspections using the World Health Organization’s “Guidelines for Essential Trauma Care.” Data on human and physical resources, infrastructure, trauma administrative functions, and quality-improvement activities before and at 2-y follow-up were compared for all 27 government hospitals.

Results: A majority of hospitals had formed local trauma organizations; half were performing multidisciplinary trauma simulations and some had organized multidisciplinary trauma teams with alarm criteria. A number of hospitals had developed local trauma guidelines and local trauma registries. More equipment for advanced airway management and stiff cervical collars were available after 2 y. There were also improvements in the skills necessary for airway and breathing management. The most changes were seen in the northern region of Botswana.

Conclusions: Implementation of BEST in Botswana hospitals was associated with several positive changes at 2-y follow-up, particularly for trauma administrative functions and quality-improvement activities. The effects on obtaining technical equipment and skills were moderate and related mostly to airway and breathing management.

Introduction

Physical trauma is an increasing health problem in Sub-Saharan Africa [1]. However, major effects can be achieved by strengthening trauma care services from the prehospital phase through hospital-based care to rehabilitation [2]. A systematic review of trauma system effectiveness found a 15–20% mortality reduction in Western high-income countries following introduction of a trauma system [3].

In-hospital, the initial phase has been identified as the time period in which most preventable problems in trauma care occur [4]. Introduction of multidisciplinary trauma teams has been shown to improve outcome. Studies from North America revealed that the outcome of severe trauma improved when patients were received by trauma teams [5,6]. Less information is available from resource-restricted areas, but progress in prehospital care, hospital-based care, and rehabilitation has also occurred in several low- and middle-income countries (LMIC) [7]. In Botswana, around 500 people die and more than 20,000 are injured in traffic accidents each year [8]. An unknown number die from other types of injuries. World Health Assembly Resolution 60.22 (May 2007) urged all member states to strengthen their trauma and emergency care services [9]. Therefore, the Ministry of Health (MoH) of Botswana and the Department for International Collaboration of Haukeland University Hospital (Norway) collaborated on a trauma-improvement program from 2007 to 2009. The main objective of the program was to improve trauma care in Botswana through implementation of the educational program “Better and Systematic Team Training” (BEST) for trauma teams at all government hospitals. The aim of this study was to evaluate the impact of the BEST program on the trauma care capabilities of Botswana at 2-y follow-up, in terms of its effect on structure and process at the hospital level and on the development of trauma system components at the national level.

Materials and methods

Setting

The BEST program was developed in Norway and is a nonprofit training system that focuses mainly on multidisciplinary trauma team training using simulations [10]. BEST trauma training was conducted at all 27 government hospitals in Botswana from November 2007 until the end of 2009.

Altogether, 977 healthcare workers (general surgeons, medical officers, nurses, x-ray technicians, physiotherapists, laboratory technicians, and others) involved in trauma care and 86 local instructors were trained over a 2-y period. Each training session lasted 1.5 d and included half a day of didactic lectures, with the main focus on initial assessment and teamwork, followed by half a day of practical skills training.

Half a day was dedicated to video-recorded team simulations. After each simulation, there was a structured debriefing that focused on communication, leadership, and cooperation.

Table 1 describes the topics covered.

All hospitals were encouraged to create a local trauma committee and a trauma registry. Educational materials, including a copy of the lectures, an airway trainer, a template for trauma registration, and posters, were left at every hospital. Candidates who were both interested in and had the potential to be future instructors were selected from all participating hospitals, completed a 1-d instructor course and were supposed to take responsibility for further training.

Two local surgeons and instructors took part in the majority of the training courses. A regional trauma committee had already been formally created in northern Botswana, and one was supposed to be created in southern Botswana, as well. One surgeon and one nurse from each of the two regions were appointed as medical and organizational coordinators, respectively.

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3 During the training period, a damage-control surgery course (DCSC) and also a national
4 trauma symposium were held. The project was funded in part by the Norwegian government
5 and in part by the MoH in Botswana.
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10 11 **Methods**

12 The World Health Organization's "Guidelines for Essential Trauma Care" were published in
13 2004 [11] and used in the present study as a tool to evaluate the effect of the project. The
14 status regarding human and physical resources, infrastructure and trauma administrative
15 functions, and organizational and quality-improvement activities 2 y after the initial training
16 course at the individual hospitals was compared with the status before the initial training
17 course. The methods of assessment were presented in a previously published paper [12], but
18 are summarized below:
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29 For data collection, two data collection sheets were developed: a questionnaire and a checklist
30 based on local adaptation of the "Guidelines for Essential Trauma Care." The process of
31 assessment and data collection included interviews aided by the questionnaire and physical
32 inspection according to the checklist. The checklist assessed 64 items of equipment and the
33 timely availability of 59 trauma-related skills.
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40 The questionnaire assessed the number of hospitals that had increased their local trauma
41 resources in terms of administrative and organizational structure and quality-improvement
42 activities (Data Collection Sheet 1). Each trauma-related function in a hospital was given a
43 value of one if present and zero if not present. The difference in sum represents the total
44 number of positive changes between the two assessments. The presence of basic equipment
45 for Airway, Breathing, and Circulation (ABC) management in the trauma room (Data
46 Collection Sheet 2) and the availability of basic diagnostic tools in the hospital "before" and
47 at 2-y follow-up were also assessed. In addition the timely availability of skills for ABC
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3 management at all three hospital levels, scored as “not available,” “available sometimes,” and
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5 “available 24/7/365,” was assessed and compared before the study and at 2-y follow-up (Data
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7 Collection Sheet 3). The collection of the 2-y follow-up data started November 2009 and
8
9 ended February 2012. THO was responsible for data collection at all 27 hospitals.
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14 The development of national trauma system components was evaluated through interviews
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16 with key personnel within the hospitals, MoH, University of Botswana, and the Motor
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18 Vehicle Accident Fund (MVA).
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21 Data were analyzed with IBM SPSS Statistics, version 20. Research approval was obtained
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23 from the Health Research and Development Division, MoH, Botswana (approval number
24
25 HRDC 00501).
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28 29 30 31 32 **Results**

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35 All 27 hospitals in Botswana were visited twice. Median time between the two assessments
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37 was 29.5 mo (range 23–44 mo). At least one follow-up training and supervision was
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39 performed at each hospital in the northern region by members from the northern regional
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41 trauma committee. More than 500 health workers were retrained. The extent of follow-up
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43 training locally and for the southern region is unknown.
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48 49 50 51 **Human resources**

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3 Changes in human resources for trauma care are depicted in Table 2. There was an increase in
4
5 the number of doctors at the two lower levels (primary and district hospitals) during the study
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7 period.
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10 11 12 13 14 **Local trauma administrative functions and organizational and quality-improvement** 15 16 **activities**

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19 Trauma-related structural and improvement activities, as defined in Appendix 1, are listed in
20
21 Table 3. The number of such functions or activities was 12 before study initiation and 74 at 2-
22
23 y follow-up. Fifty-two percent of the changes took place at the primary level and 45% at the
24
25 district level. Fifteen hospitals had instituted a local trauma committee during the study
26
27 period, and four had developed a local trauma registry. Nineteen percent of the hospitals had
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29 created a defined trauma team with alarm criteria for the teams, and 46% had started
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31 systematic trauma simulations.
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36 More improvement efforts took place in the northern region compared to the southern (55/74
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38 [74.3%] vs. 19/74 [25.6%]). Of the 26 hospitals assessed, 16 were in the north. Two-thirds of
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40 the facilities that had developed a local trauma committee were in the north; 83% of the
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42 hospitals that had performed additional trauma simulations were also from this region.
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46 47 48 49 **Physical resources**

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53 Physical resources for initial resuscitation and diagnosis of trauma victims before and at 2-y
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55 follow-up for all hospital levels combined are shown in Figures 1 and 2. Availability in the
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3 trauma room of equipment for management of airway/breathing problems increased between
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5 the two evaluations, while the situation remained unchanged for circulation equipment.
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9 Equipment for assisted ventilation and endotracheal intubation in children was deficient in the
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11 first evaluation and improved after 2 y. However, six hospitals still could not provide self-
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13 expanding bags for children, four could not provide endotracheal tubes for children, and 14
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15 did not have pediatric chest tubes anywhere in the hospital.
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19 The availability of more-expensive equipment like pulse oximeters was almost the same
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21 between study initiation and 2-y follow-up.
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24 25 26 27 **Skills**

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30 Available skills for ABC management for the two lower hospital levels are presented in
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32 Figure 3. We found some indications of improvement at 2-y follow-up, specifically an
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34 improvement in more advanced procedures like assisted ventilation and endotracheal
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36 intubation. For management of specific injuries, there were only minor changes.
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40 Neurosurgical burr holes and neck surgery were services provided at the referral level; the
41
42 same applied to chest surgery. Laparotomy could be provided “always” in two referral and
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44 one district hospital, “sometimes” in ten hospitals, and not at all in ten hospitals at 2-y, which
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46 was the same as at the initial evaluation.
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49 50 51 52 **National trauma system component**

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3 At the end of the last training course (November 2009), a national trauma organization had
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5 not yet been established, although there was a regional committee in the north, and for a
6
7 limited period of time during the training, one in the south. A national coordinator was
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9 assigned in 2007.
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12 To date, no national trauma registry has been established. There were plans for improvements
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14 in prehospital care, but by 2011 there were no central coordination of ambulance services, no
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16 national emergency number, and no standards for prehospital training. In some urban areas,
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18 equipped ambulances donated by the MVA were running. In addition, there were private
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20 ground and air ambulance services. In-hospital emergency care was provided mainly by
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22 nonspecialists, except at the referral hospital level. Postgraduate programs in emergency
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24 medicine and anesthesia were established in 2011 [13].
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30 Rehabilitation services for road traffic accident victims financially supported by the MVA
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32 were available, but not for other types of injuries. A trauma research centre at the University
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34 of Botswana was at the planning stage.
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41 **Discussion**

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45 The main findings of this study were that an encouraging number of hospitals had started to
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47 address the issue of trauma at 2-y follow-up.
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50 The idea behind the BEST program was to provide trauma training for all personnel groups
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52 involved in trauma care, at all levels of facilities and at all government facilities and to make
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54 it sustainable through education of local instructors. After an initial training course, individual
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56 hospitals were expected to continue training according to their needs [14].
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3 At 2-y follow-up, a majority of the hospitals, as recommended, had formed trauma
4 committees, which initiated a series of initiatives. One was the introduction of
5 multidisciplinary trauma teams, the composition of which varied from place to place in
6 accordance with local needs and available resources.
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12 Trauma teams are a key component of programs to improve trauma care [15]. The purpose of
13 the trauma team is to rapidly resuscitate, stabilize, diagnose, and make a plan to further treat
14 the trauma patient. How the team is organized will vary between regions, countries, and
15 continents, and leadership is recognized as an essential component of the trauma team [16].
16 Practical simulation can positively affect knowledge and confidence among trauma team
17 members [10,17]. Trauma team organization has been shown to reduce the time to definitive
18 surgery (18) and to reduce mortality [6,15].
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29 Another initiative was the development of local trauma guidelines or manuals (definitions in
30 appendix 1). A few institutions had local enthusiasts who put serious effort into the issue of
31 trauma. However, the effect of their work was hampered by the governmental policy of
32 regular transfer of personnel between departments and hospitals.
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39 Some institutions had established basic local trauma registries. Trauma registries are valuable
40 sources of information about who is at risk, what types of injuries are sustained, how they are
41 treated, the severity of the consequences, and the outcomes [19]; it is an important tool for
42 quality improvement and research [20]. An increasing number of articles on this topic are
43 emerging from LMIC countries, and where inclusion criteria, number of data entry points, and
44 methods of injury severity scoring may vary [21,22]. The facility-based registries in Botswana
45 were simple and only contained information on patient characteristics and main injuries.
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55 However, they could be used to identify trauma cases and to establish basic trauma
56 epidemiology.
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3 Improvement activities were more prevalent in the northern trauma administrative region of
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5 the country than in the south. In the north, there was already a MoH-supported regional
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7 trauma committee that took overall responsibility for ongoing training at all facilities in the
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9 region, held refresher courses, and supported local activities. In a study from Norway on
10
11 factors promoting sustainability of team training, local enthusiasts, allocation of time, and
12
13 support from hospital administration were regarded as important elements [14]. The Primary
14
15 Trauma Care course (PTC) emphasized stronger links between PTC instructors within and
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17 outside the country; encouraging surgeon involvement, allocations of time, funding, and
18
19 support from the ministries as important factors for improving the success of their program
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21 [23]. Ersdal et al. found in a study on the effects of a 1-d neonatal resuscitation course in
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23 Tanzania that improved simulated performance did not translate into clinical practice
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25 indicating the need for long-term perspectives and outside support for training [24].
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30 Nurse anesthetists and nurses in the A&E were, in our experience, the health professionals at
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32 the hospitals most interested and also skilled in emergency care; they could hold key positions
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34 in any improvement efforts. Doctors showed more varied interest in training and emergency
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36 care in general.
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40 Although here were improvements in the availability of equipment related to
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42 airway/breathing, the level of equipment deviated substantially from the recommendations
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44 from “Guidelines for Essential Trauma Care.”
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49 It is a concern for trauma treatment that few hospitals were able to provide laparotomy 24 h a
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51 day. Transfer time to relevant facility level could take several hours and it is well known that
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53 time to the relevant intervention is related to outcome [25,26]. It is shown that in countries
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55 with poorly developed prehospital services, the majority of trauma-related deaths occur
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57 outside the hospital [27]. The situation in Botswana is likely the same. Only if the patient
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3 lives long enough to make it to the hospital can improvements in in-hospital care make a
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5 difference. Such improvements have so far taken place predominantly in urban areas.
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8 9 **Limitations**

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12 Except for the description of national trauma system components, our study was limited to
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14 hospital-based care and did not measure outcome, the ultimate goal of improvement efforts.
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18 There was, on average, 2.5 y between the two assessments. It is possible that more activities
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20 would have been recognized if the second assessment had been conducted closer to the
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22 planned 2 y. Without support, activities will diminish over time.
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26 Information on efforts to improve trauma care and skills relied on information from
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28 interviews and was therefore highly subjective. Several persons were interviewed at each
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30 facility in order to retrieve accurate information.
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33 34 35 36 37 **Conclusions**

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40 Implementation of the BEST training program in Botswana hospitals had incurred several
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42 positive changes at the 2-y follow-up in trauma administrative structures, quality-
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44 improvement activities, technical equipment, and skills for trauma care. Further research is
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46 necessary to reveal the effect of this program on patient outcome.
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50 51 52 **Acknowledgements**

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For Peer Review

Appendix 1: Definitions

Trauma guidelines: Guidelines that define the trauma patient, local trauma care structure, activation criteria for trauma teams, roles for team members, qualifications for team leader, available resources, and transfer policies.

Trauma manual written: In-hospital practice guidelines for initial triage, assessment, and treatment of injuries, aimed at standardizing care given to trauma victims.

Trauma committee: Organizational structure aimed at developing and implementing trauma care strategies at the individual hospital.

Trauma registry: Separate local registry for trauma cases, regardless of whether they are adjusted for severity.

System for trauma audit: System for identifying cases of preventable trauma deaths or suboptimal care, designing corrective plans, and monitoring the process.

Plan for trauma education: Trauma-specific systematic educational efforts.

Trauma simulations: Team organization and training activities in the emergency room using simulations.

Posters in the trauma room: Posters on the wall in the emergency room guiding systematic trauma care.

Defined trauma team: Team organization with preassigned roles and adapted to local resources.

Alarm criteria: predefined criteria (e.g., trauma mechanism, physiologic status, and anatomic injuries) that activate a team response.

Data collection sheet 1.

Hospital characteristics and human resources for trauma care.

Hospital level	
Number of beds	
Primary/District hospitals	
• Number of doctors	
○ Any specialists?	
• Number of Anaesthetic Nurses	
• Number of nurses in OPD	
Referral hospitals:	
• Number of surgeons	
• Number of anaesthetists	
• Number of AE physicians	
• Number of AE nurses	
Aprox. number of trauma patients a year	

Do the hospital have:	No	Yes
Local trauma guidelines?		
Trauma manual/check list?		
Trauma committee?		
Local Trauma Registry?		
System for trauma audit? (If "Yes", please specify below)		
Plan for trauma education? (If "Yes", please specify below)		
Trauma simulation?		
Posters in trauma room (e.g. GCS)? (If "Yes", please specify)		
Defined trauma team?		
If "Yes" is the team activated by specified alarm criteria?		

Data collection sheet 2.

Checklist equipment

Hospital:

Date:

	Not available	Immediately available in trauma room	Available in hospital
Airways & Breathing: equipment			
Oropharyngeal airway			
Oxygen & equipment			
• Oxygen wall w/flowmeter			
• Oxygen bottle/regulator/flowmeter			
• Oxygen concentrator			
• Nasal prongs or cannula			
• O2 mask w/tubing wo reservoir			
• O2-mask w/tubing w reservoir			
Suction & equipment			
• Suction, manual			
• Suction, electric			
• Suction, pneumatic wall			
• Suction catheters			
Nebulization mask			
Self inflating bag 1500 ml w/res			
Self inflating bag 500 ml w/res			
Endotracheal intubation			
Laryngoscope			
Laryngoscope blades			
• Adult			
• Children/Infant			
Endotracheal tubes range			
• Children			
• Adult			
Introducing stylet			
Magills forceps			
Laryngeal mask airway			
Ventilator			
Needle cricothyrotomy set			
Surgical cricothyrotomy set			

	Not available	Immediately available in trauma room	Available in hospital
Circulation; equipment			
Crystalloids			
Colloids			
Blood transfusion capabilities			
Units of blood today			
Chest tubes			
• Children			
• Adult			
Underwater seal bottle			
Intravenous infusion sets			
Intravenous infusion sets luer			
Intraosseous needle			
Pressure cuffs for infusion			
Urinary catheters/collecting bags			
Blood warmer			
Infusion pump			
Fluid warmers			
Iv cannula 0.6-2.2 millimeter			

er Review

Data collection sheet 3.

Checklist skills

How often will your hospital be able to perform the following if necessary?

Airway: knowledge & skills Q2	Never	Yes		Do not know
		24/7/365	Sometimes	
Assessment of airway compromise				
Manual manoeuvres				
chin lift, jaw thrust				
recovery position				
Log roll				
Insertion of oropharyngeal airway				
Use of suction				
Assisted ventilation using bag–valve–mask				
Endotracheal intubation				
Cricothyroidotomy				

Breathing: knowledge & skills Q2	Never	Yes		Do not know
		24/7/365	Sometimes	
Assessment of respiratory distress and adequacy of ventilation				
Administration of oxygen				
Needle thoracostomy				
Chest tube insertion				
Three-way dressing (open chest injury)				

Circulation knowledge & skills Q2	Never	Yes		Do not know
		24/7/365	Sometimes	
Assessment of shock				
Compression for control of haemorrhage				
Splinting of fractures for haemorrhage control				
Deep interfascial packing for severe wounds (e.g. landmine)				
Pelvic wrap for haemorrhage control				
Knowledge of fluid resuscitation				
Peripheral percutaneous intravenous access				
Peripheral cutdown access				
Intraosseous access for children under 5 years				
Transfusion knowledge and skills				
Monitoring				
Knowledge of resuscitation parameters				
Differential diagnosis of causes of shock				
Recognition of hypothermia				
Use of warmed fluids				
Knowledge of core rewarming				

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Table 1. Topics covered in each BEST training session

Part 1: Didactic lectures (4 h) Initial assessment ABCDE principles Team organization Cooperation & leadership Damage control surgery Burns Snake bite Injuries in children
Part 2: Skills training (3 h) Airway management <ul style="list-style-type: none">• Chin lift• Assisted ventilation• Endotracheal intubation Chest tube insertion Vascular access <ul style="list-style-type: none">• Intraosseous access• Venous cut Hemorrhage control <ul style="list-style-type: none">• Packing of external bleeding• Pelvic sling Spinal immobilization techniques
Part 3: Practical sessions on initial assessment and teamwork (3.5 h)

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Peer Review

Table 2. Human resources for trauma care by level of hospital.

	Primary Hospital		District Hospital		Referral Hospital	
	Before <i>N</i> = 16	After <i>N</i> = 16	Before <i>N</i> = 9	After ^a <i>N</i> = 8	Before <i>N</i> = 2	After <i>N</i> = 2
Beds	719	784	1972	1677	1065	1065
Doctors	57	77	76	109	200	200
Specialists	3	0	14	27	85	85
Surgeons	0	0	4	4	16	15
Nurse anesthetists	15	21	25	25	11	13
Physician anesthetists	0	0	2	2	13	9
Doctor in A&E ^b	0	0	0	2	10	11

^aData is missing for one district hospital, which in the first assessment had 163 beds; five doctors; 0 specialists; three nurse anaesthetists; and 0 surgeons, physician anaesthetists, and doctors in A&E.

^bNot specialists, but located in and main duty in A&E

Before, at the same time as the trauma course; After, 2 y after the training course; A&E, accident and emergency department.

Table 3. Development of trauma system components by hospital level.

	Primary Hospital		District Hospital		Referral Hospital	
	Before N = 16	After N = 16	Before N = 8	After N = 8	Before N = 2	After N = 2
Trauma guidelines	0	2	0	1	0	1
Trauma manual	0	2	0	2	0	0
Trauma committee	0	9	0	6	1	1
Trauma registry	2	4	1	3	1	1
Trauma audit	0	2	0	2	0	0
Trauma education	0	3	0	2	1	1
Trauma simulations	0	5	0	6	0	1
Posters in A&E	3	6	2	3	1	1
Defined trauma team	0	2	0	3	0	0
Trauma team alarm criteria	0	2	0	3	0	0

Before, at the same time as the trauma course; After, 2 y after the training course; A&E, accident and emergency department.

Data are missing for one district hospital

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For Peer Review

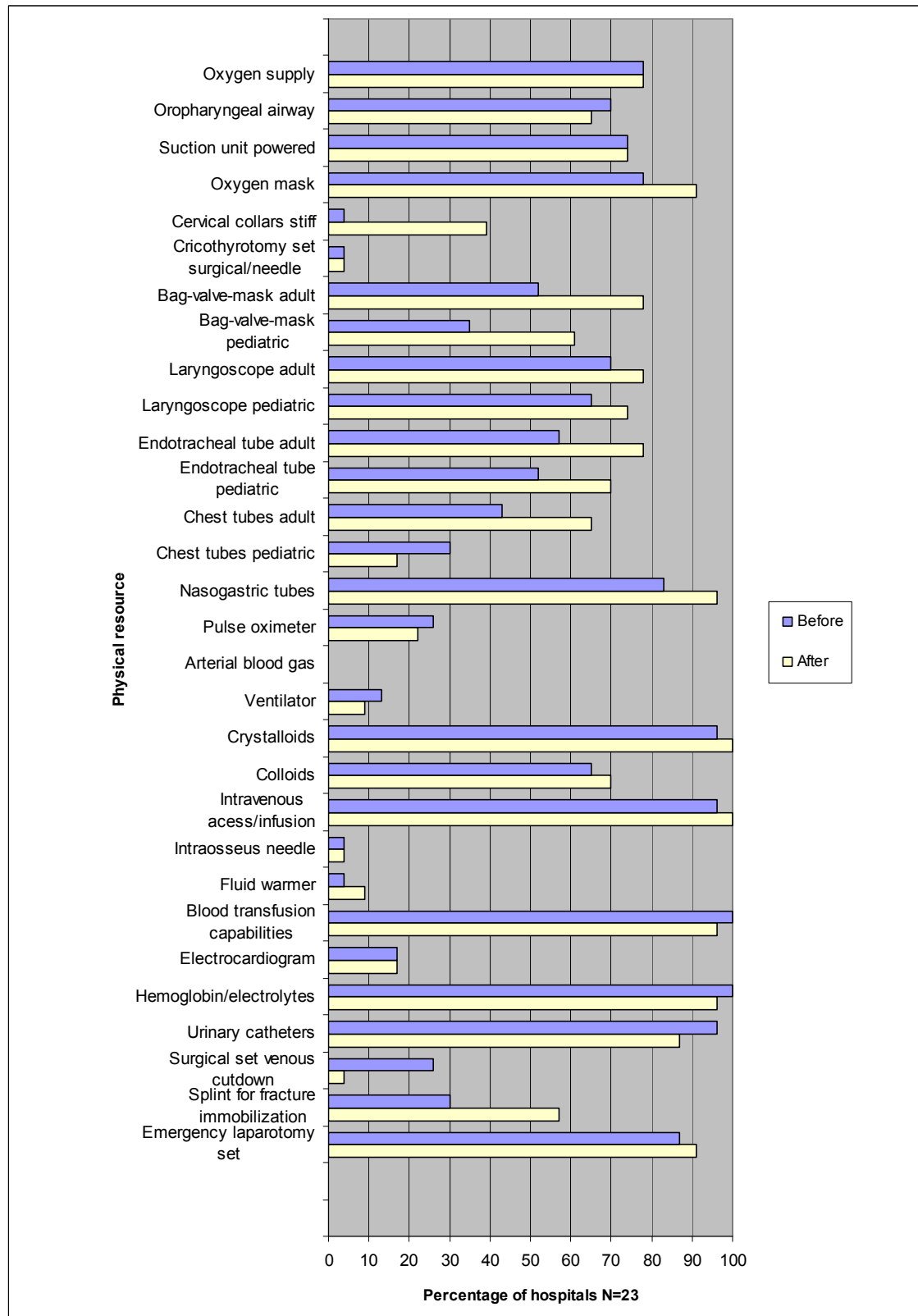


Figure 1. Physical resources for immediate resuscitation of the trauma patient.

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Data are missing for one primary, two district and one referral hospital

For Peer Review

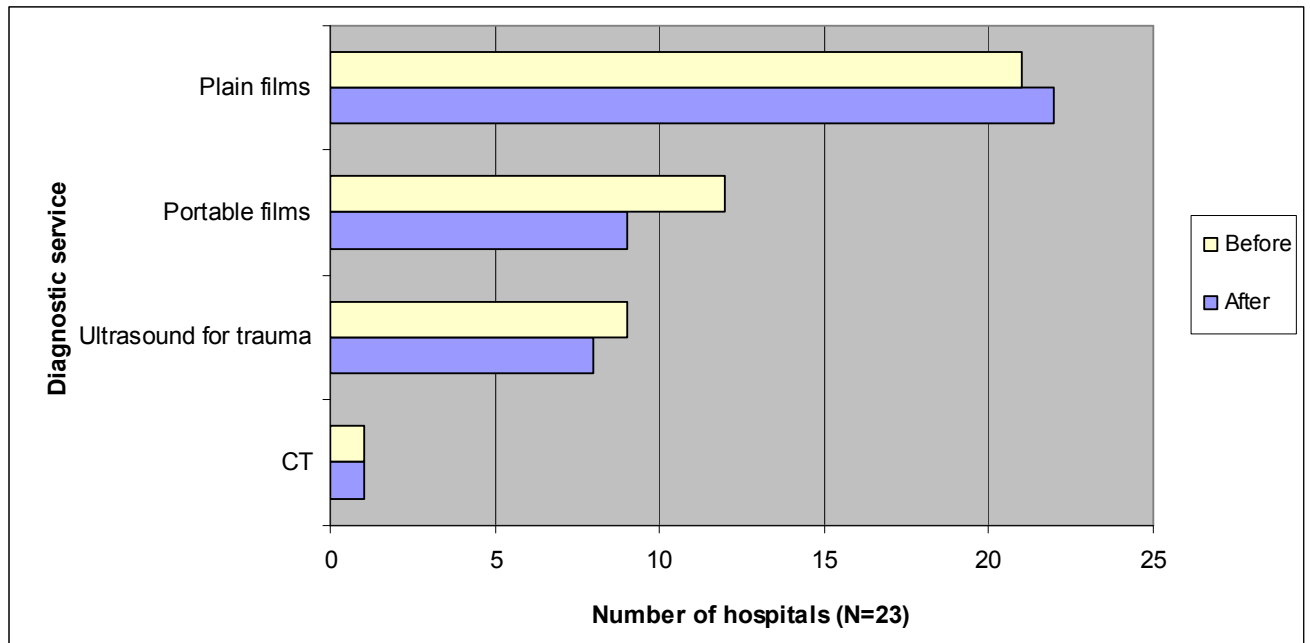


Figure 2. In-hospital availability of basic diagnostic services.

Data are missing for one primary, two district and one referral hospital

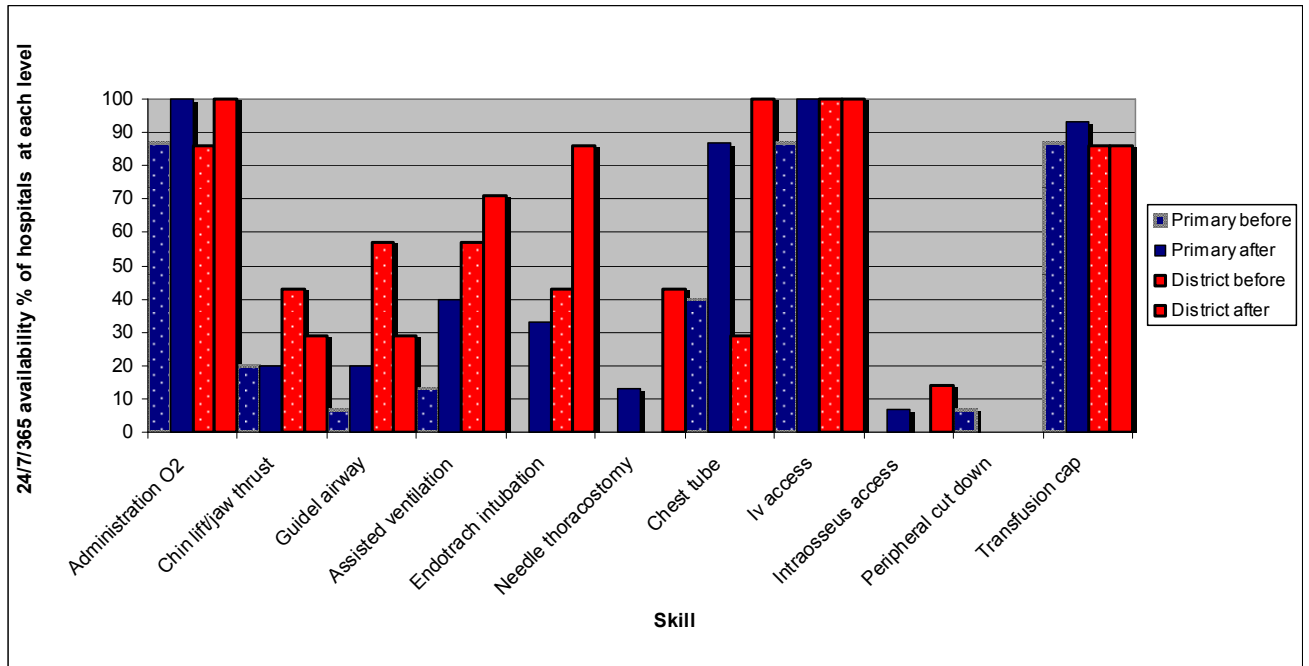


Figure 3. Skills for ABC management and 24/7/365 availability at the two lower hospital levels before and at 2-y follow-up.

Data are missing for one primary, two district and one referral hospital

Peer Review

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For Peer Review