

Facility readiness for injury care in Low and Middle-Income Countries: a survey of 18 hospitals in Ghana, Rwanda, Pakistan and South Africa

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Abstract

Background

Addressing the high burden of injuries in Low- and Middle-Income Countries (LMICs) requires strong injury care systems that meet injury care requirements. We evaluated the facility readiness for injury care in four LMICs.

Methods

Facility readiness in eighteen hospitals (eleven tertiary and seven secondary) with ability to provide definitive care for moderate to severely injured patients in Ghana, Rwanda, Pakistan and South Africa was assessed using the International Assessment of Capacity for Trauma (INTACT) survey, and the INTACT index calculated. INTACT index 8.3–10 is deemed acceptable for both tertiary and secondary hospitals. The presence of infrastructure, supplies, and equipment items was further confirmed via a walkthrough at the time of the survey, and the 24-hour accessibility of infrastructure items assessed and described.

Results

Fifteen hospitals had INTACT index 8.3–10. Five tertiary and one secondary hospital (three in South Africa, two in Pakistan, one in Ghana) achieved the maximum INTACT score 10, with all infrastructure, equipment and supply items verified to be present and 24-hour accessibility to all infrastructure. The lowest index was 7 in two secondary hospitals in Ghana. The most frequent items on the INTACT survey unavailable in hospitals with indices less than 10 were computed tomography (CT) scanner (infrastructure), tourniquet (supplies), contracture release (procedures), endoscope (equipment) and anaesthesiologist (personnel). Some tertiary and secondary hospitals did not have 24-hour accessibility to electricity, X-ray, CT scan, ultrasound or laboratory services.

Conclusion

The majority of the hospitals achieved acceptable INTACT indices; however, subtle and marked structural, everyday functionality and continuity of care challenges that affect injury care delivery persist in some hospitals. Robust mechanisms to identify and report these to policymakers and regulatory authorities can be invaluable to monitor and benchmark hospital readiness for injury care.

Background

Low- and Middle-Income Countries (LMICs) have a significantly higher proportion of injury-related mortality compared to High Income Countries (HICs),^{1,2} yet lack strong emergency and healthcare systems, as well as the capacity to meet injury care demands.³ These settings face ongoing challenges, including shortages of trained personnel, equipment, and drugs, as well as poor adherence to injury management protocols.^{4,5} Although improvements have been made over time, with some regional and tertiary hospitals in LMICs better equipped with essential injury care services and infrastructure for initial patient stabilization, substantial gaps in infrastructure, equipment, consumable materials, and specialist availability remains.^{6,7} Assessment is therefore needed to identify areas of need and opportunities for strengthening injury care systems.

Injury care delivery is dynamic and complex, requiring system-wide and clinical interventions to work together to achieve desired patient outcomes. These systems and interventions interact in complex and mutually reinforcing ways, which poses challenges for developing effective approaches for system assessment. Health systems frameworks can support monitoring and evaluation by providing structured indicators and data sources. The World Health Organisation (WHO) building blocks framework describes health systems according to six core components: service delivery, health workforce, health information systems, access to essential medicines, financing, and governance/leadership.⁸ Within this framework, the service delivery and health workforce building blocks are relevant to the availability and readiness of care. The framework recommends the use of general and service-specific readiness scores, assessed at health facility level, as indicators for evaluating health service capacity.⁸

For injury care, some assessment score systems have been developed with the goal of setting achievable standards for services which can be made realistically available to almost every part of the world. Examples are surgical capacity assessments used as proxy for injury care such as the Tool for Situational Analysis to Assess Emergency and Essential Surgical Care (TSAEEESC)⁹ and the surgical capacity survey based on Personnel, Infrastructure, Procedures, Equipment and Supplies (PIPES).¹⁰ Trauma care specific capacity assessment tools include the WHO Guidelines for Essential Trauma Care (WHO GETC)¹¹, and the International Assessment of Capacity for Trauma (INTACT) index.¹² All the tools are administered as checklists and unless thoroughly explored, availability may not necessarily translate to physical presence at the time needed most, and all time accessibility for patient care is not the case in some settings.¹³

In this study, we evaluated the service delivery component of health system readiness for injury care across 18 hospitals in four countries using the INTACT tool. The WHO building blocks framework recommends measuring service-specific readiness using tracer items such as trained staff, equipment, supplies, and diagnostic capacity.⁸ The items of the INTACT survey includes items that reflect these domains. In addition to assessing structural readiness using the INTACT tool, this study aimed to examine functionality and the ability to provide continual care as a part of a more complete measure of readiness to deliver injury care services.

Methods

Study design: This was a cross-sectional survey. The Checklist for Reporting of Survey Studies (CROSS) guideline¹⁴ was used to ensure proper reporting of methods, results, and discussion.

Study setting: The study was conducted in four countries: Ghana (lower-middle-income), Rwanda (low-income), Pakistan (lower-middle-income), and South Africa (upper-middle-income), as part of the Equi-Injury project, which aims to understand how to improve equitable access to quality care after injury in these countries.¹⁵ The countries have diverse economic, social, cultural, geographic, and health system contexts. Health expenditure as a percentage of gross domestic product (GDP) was 3.9% in Ghana, 7.8% in Rwanda, 2.9% in Pakistan, and 8.7% in South Africa.¹⁶ Injuries account for 9%, 11%, 7%, and 13% of deaths in Ghana, Rwanda, Pakistan, and South Africa, respectively.¹⁷ All four countries also have significant health expenditure from external, private, and out-of-pocket sources.¹⁵

Study population: The facilities surveyed in this study were those from which injured patients were recruited for the Equi-Injury project.¹⁵ Facilities were purposefully selected for their ability to treat moderate to severe injuries, and be as representative of those nationally available, as possible.

Data collection tool

The International Assessment of Capacity for Trauma (INTACT)¹² tool was used. The tool collects data on 40 central elements grouped into five categories of infrastructure (7 items), supplies (5 items), procedures (16 items), equipment (10 items) and personnel (2 items). The INTACT tool was used because it is simple, assesses items deemed necessary to provide thorough injury care from initial resuscitation to definitive care, and offers a trauma-specific index which provides a standardized way of assessment. We added the following additional items to further evaluate the capacity for trauma care in the hospitals.

1. Availability of a high-dependency unit (HDU) and some basic laboratory investigations in injury care, i.e. a blood gas machine, capability to analyse full blood count, blood urea and electrolytes and time to receive blood when needed. (Infrastructure subsection)
2. Availability of mannitol and tranexamic acid; and for procedures, surgical management (internal or external fixation) of fractures.¹⁸ (Supply subsection)
3. Any other surgical and anaesthesia providers. (Personnel subsection) A surgical specialist was defined as a person who has completed specialist training in surgery, and Anaesthesiologist as physician-level anaesthesiologist.

Data collection procedure

Data collectors confirmed the presence of each item reported as available in the infrastructure, supplies and equipment categories through a hospital walkthrough and direct visualization. Verbal responses and walkthrough confirmation were recorded independently as found. Furthermore, for some items in the infrastructure category, we asked if it was available for 24-hour use. This is in line with recommendation that surgical or trauma care capacity be conducted through site visits to improve assessment completion rate; and assessing infrastructure, equipment and supplies by direct inspection to reduce subjectivity and recall bias.¹⁹

The full survey is presented as Supplementary document 1. Although the INTACT survey has been used in multiple countries, the additional questions were not pre-tested. Following modification of the tool, expert internal face validation was conducted by the principal investigators. Research team members selected to administer the tool were trained on the tool and the study objectives to ensure that the tool captured the required information.

Survey administration

At each hospital, the hospital head nominated a senior administrator with in-depth knowledge of the injury care process and hospital operations to complete the survey. The survey was administered in-person by a research team member at the hospital. In addition to recording responses, the research team member accompanied the respondent to directly observe the presence of items in the infrastructure, supplies, and equipment categories of the survey.¹⁹ All surveys were conducted between June 2023 and December 2023 in English.

Data management and Analysis

Data was collected using REDCap electronic data capture tools hosted at University of Birmingham. Data was stored on password protected computers, accessible only to the research team.

The INTACT index for each hospital was calculated using a binary scoring system.¹² One point was allotted if an item was reported as available. If not available, no point was allotted. Total scores for each section were calculated by addition of points. Thus, the maximum scores were 7 for infrastructure, 5 for supplies, 16 for procedures, 10 for equipment, and 2 for personnel; giving an overall total of 40. The overall score was normalized to 10 to get the INTACT index. No point was allocated for the additional items assessed, they were recorded and reported descriptively.

The presence of items verified by direct observation, and 24-hour availability of infrastructure were reported descriptively.

Results

Eighteen hospitals – eleven tertiary and seven secondary – were surveyed; Four facilities in each of Rwanda, Pakistan and South Africa; and six facilities in Ghana were included.

Ten had a catchment area which was predominately urban, nine of which were tertiary hospitals and one secondary. Two of the eight hospitals serving predominately rural areas were tertiary facilities.

International Assessment of Capacity for Trauma (INTACT) index

Six hospitals (five tertiary and one secondary) had the maximum INTACT index of 10. These were one in Ghana, two in Pakistan, three in South Africa and none in Rwanda achieved. The lowest INTACT index among the tertiary hospitals was 8.75 (one hospital), and 7 among the secondary hospitals (two hospitals) (Fig. 1). The lowest INTACT index was 7 in Ghana, 8.75 in Rwanda and South Africa, and 9.25 in Pakistan. Details of the INTACT index calculation are presented in Table S1.

Categories of the INTACT score where hospitals with indices less than 10 did not make the maximal score were varied. Low scores were particularly in the categories of procedure, personnel and supplies in some secondary hospitals (Fig. 2).

Infrastructure – the lowest infrastructure score was 5 out of 7, observed in two secondary hospitals. The most commonly unavailable item was a CT scanner, which was lacking in four hospitals (one tertiary and three secondary).

Supplies – the lowest supplies score was 3 out of 5, observed in two tertiary hospitals. The most commonly unavailable item was a tourniquet, which was lacking in five hospitals (three tertiary and two secondary).

Procedure – the lowest procedure score was 8 out of 16 in one secondary hospital, followed by 9 out of 16 in another secondary hospital. Neither hospital provided tracheostomy, open fracture treatment, contracture release, skin grafting or amputation procedures. Across all hospitals, the most commonly unavailable procedure was contracture release, which was not offered in six hospitals (two tertiary and four secondary).

Equipment – the lowest score was 8 out of 10 in one secondary hospital. The most common item lacking was the endoscope in six (two tertiary and four secondary) hospitals.

Personnel – seven (three tertiary and four secondary) hospitals did not have an anesthesiologist. All the hospitals surveyed had a surgical specialist.

Observed accessibility of infrastructure, supplies and equipment items

During the walkthrough verification, some items reported as available were either not observed or not functioning. At one tertiary hospital, there was no electricity, the CT scan was not operational, and urinary catheter and sterilizer were not observed. At one secondary hospital, intravenous infusion sets were not observed and the blood bank was not operational (Table S2).

Regarding infrastructures, although these services were reported as available and were observed to be functioning at the time of the survey, some hospitals lacked 24-hour access to electricity and X-ray services (two tertiary hospitals), CT scan (two tertiary and one secondary hospitals), ultrasound (one tertiary and one secondary hospital), and laboratory services (one secondary hospital) (Table S3).

Additional items assessed

Eight of the eighteen hospitals (seven tertiary and one secondary) had all additional items assessed and verified to be available during the walkthrough assessment. All the hospitals had other anaesthesia and surgical providers, except for one secondary hospital that did not have another surgical provider. All hospitals could analyse full blood count, urea and electrolytes, except for one secondary hospital. Six hospitals (one tertiary and five secondary) did not have a blood gas machine, while five hospitals (two tertiary and three secondary) did not have an HDU. Three secondary hospitals did not provide internal or external fracture fixation. Two secondary hospitals did not have mannitol, while two hospitals (one tertiary and one secondary) did not have tranexamic acid. Regarding time to receive blood following a request, all hospitals received blood within 1 hour except for four hospitals (two tertiary and two secondary), where blood was received within 1–2 hours, and one secondary hospital, where blood was received after more than 3 hours (Table S4).

Overall, only four (three tertiary and one secondary) of the six hospitals with an INTACT index of 10 had all the additional items assessed available and verified as present, including receipt of blood within 1 hour of request.

Discussion

In this study, we assessed 18 (eleven tertiary and seven secondary) hospitals' readiness to provide injury care using the INTACT tool¹² supplemented by verifying physical presence (functionality) and 24-hour accessibility (ability to provide continual care) of items. Six hospitals (five tertiary and one secondary) obtained the maximum INTACT index of 10. The most common items not available among the hospitals that did not score the INTACT index 10 were tourniquet, CT scanner, endoscopes, contracture release and an anaesthesiologist. Some hospitals did not have 24-hour accessibility to electricity, CT scanner, X-ray and ultrasound services. Additionally, we assessed availability of an HDU, mannitol, tranexamic acid, a blood gas machine, capability to analyze full blood count, blood urea and electrolytes and time to receive blood when needed. Only four (three tertiary and one secondary) of the six hospitals with an INTACT index of 10 had all the additional items assessed available and verified as present, including receipt of blood within 1 hour of request.

The use of the INTACT tool to assess trauma care capacity in multiple hospitals across multiple LMICs demonstrates its utility as a standardized cross-sectional assessment over a wide geographical area. The INTACT index was developed through expert consensus drawing on the TSAEESC and PIPES

tools and validated in an LMIC country with documented lack of surgical capacity.¹² Although it does not assess system and operational functions such as protocols, team communication and leadership which are also important in delivering injury care for excellent outcomes, it focuses on components deemed essential to provide thorough trauma care from initial resuscitation to definitive care. As with other healthcare monitoring indices, the INTACT index could be a reporting metric for hospitals' capacity to provide injury care particularly in resource limited settings. For example, at a country level, its routine reporting at set times by hospital heads can guide managers and policymakers to monitor improvements or otherwise of essential injury care capacity in their settings.

Based on the World Health Organization (WHO) Guidelines for Essential Trauma Care (GETC) recommendations at various levels of care, secondary and tertiary hospitals should have INTACT indices between 8.3 to 10.²⁰ All eleven tertiary hospitals and four secondary hospitals made the acceptable scores. The distribution was however skewed across the countries. Three of the four hospitals in South Africa and two of the four in Pakistan obtained the maximum index 10. Though no hospital in Rwanda scored 10, the lowest was 8.75. The three secondary hospitals that did not obtain acceptable scores were in Ghana. INTACT indices for hospitals in our study are comparable to those in hospitals in other low resource settings. Indices in the eleven tertiary hospitals in our study ranged from 8.75–10 compared four tertiary hospitals each in Mongolia (8.3–9.5) and India (8.3–9.9) and one each in Sierra Leone (9), Peru (9.5).^{12,20–22} Indices for the seven secondary hospitals in our study ranged from 7–10, similar to what is reported from six secondary hospitals in Peru (6.75–10).²³ Relatively lower indices are reported for two secondary hospitals in Mongolia (7.3–8.0)²⁰ and even much lower for 5 secondary hospitals in Sierra Leone (4.3–7.0).¹² That majority of the hospitals in our study (fifteen of eighteen) obtained acceptable scores is probably a reflection of some commitments to improve injury care in the various countries. Although none of the countries have standalone injury care policies, they have it included in variable extents in policies for non-communicable disease, with other demonstrable actions to improve injury care. Particularly in Rwanda, models and recommendations to improve injury care have been developed through multi-stakeholder engagements.^{24,25}

Our study revealed that level of healthcare did not preclude lack of some items for care (Table S2). Tertiary hospitals are the apex of health care delivery and ideally, expected to have all resources but some tertiary hospitals in our study lacked a CT scan, an ultrasound machine, HDU, tourniquet, cervical collar and endoscope. Across all levels of care though, similar lack is reported in other LMIC settings in West, East, Central and Southern Africa, India, Asia and South America.^{12,20–22,26–28} Reasons for this may include concentration of items in tertiary/urban rather than secondary/rural hospitals^{21,22} as seen for example in the scores of hospitals in Ghana. Challenges to availability of medical infrastructure and supplies in LMICs have included structural and technical inefficiencies in the procurement and supply chain system, receipt of donated items that may be nonfunctional, cost, suitability for environment and maintenance issues.^{29–31} This notwithstanding, items like cervical collars and tourniquet are relatively inexpensive, and hospitals can easily implement a system of inventory and supply checks to selectively stock them for lifesaving patient care.²⁶ Only one secondary hospital could not perform laparotomies and two secondary hospitals could not provide treatment for open fractures. That the majority could perform these Bellwether procedures is very encouraging as these capabilities closely correlate with performing other general surgery procedures, many basic and emergency procedures and other orthopaedic procedures that will be life saving for injured patients.^{32,33}

Workforce capacity remains a challenge in LMICs. All eighteen hospitals surveyed had a trained surgeon, and all but two tertiary hospitals and three secondary hospitals had a physician anaesthesiologist. Lack of physician anaesthesiologists has been reported in Ghana²⁷ and trauma capacity assessments in other LMICs.^{22,26} It is commendable though that all hospitals had alternative anaesthesia providers, demonstrating task shifting in delivering essential care in resource poor settings. Task shifting remains a divisive subject in anaesthetic and surgical communities with concerns over where complex decisions need to be made and issues of task creeping.³³ A systematic review on anaesthetic task-shifting across all country settings gives conflicting results on the quality of non-physician anaesthetic care.³⁴ The studies in this review from LMICs were for caesarean sections, general surgery, including hernia repairs, and surgical male circumcisions but not injury, making inferences challenging. As a benchmark in trauma and surgical capacity assessments, efforts must be made to increase physician anaesthesiologist numbers in the workforce delivering care to injured patients. Their expertise in resuscitation at every stage in injury care, massive transfusion and airway management is invaluable.³⁵ Shortages created by entry and exit forces spanning educational, professional and socioeconomic reasons can lead to maldistribution of specialist workforce within countries.³³ While maintaining current gains, countries need national policy with strong coordination between public and private education and health sectors to scale up the anaesthetic workforce to meet demands and benchmarks.

Although deemed necessary to provide thorough care from initial resuscitation to definitive care, there is no evidence to suggest the presence of which or all items in the INTACT tool correlate with improved trauma outcomes.¹² But the items assessed by the INTACT tool are critical components of damage control resuscitation, a clinical intervention that even at 50% coverage is estimated could save over 35,000 lives in trauma care.³⁶ As such all-time accessibility of items is needed to deliver care. But the structural availability of resources does not guarantee presence and continuity of access as demonstrated in this study. Some infrastructure, equipment and supply items present and contributing to INTACT scores were not necessarily observed to be present or accessible at all times for care delivery (Tables S3 and S4).

Herein lies this study's assessment of hospital readiness – prepared for injury care at any time of day. In our study, only six hospitals (five tertiary and one secondary) obtained INTACT index 10, had all infrastructure, equipment and supply items verified to be present with 24-hour accessibility to all infrastructure. Furthermore, only four (three tertiary and one secondary) of these had all the additional items assessed available and presence verified including receiving blood in less than 1 hour upon request. It is concerning that two tertiary hospitals did not have CT scan and electricity accessible for 24-hours (Table S4). An assessment of trauma care capacity in some LMICs including Ghana found that although items may be present, they were not always available for patient use for reasons such as storage in locations that are not readily accessible in the emergency department, limited numbers such that not every patient needing it had access, periodically running out of stock for non-reuseable items, and long periods of equipment awaiting repairs and so being inoperable.¹³

Albeit the valuable results, our study has some limitations. The assessment was a one-time event, compared to an interval assessment which would have offered more insight on improvement or deterioration in indices. conducted with one individual in the hospital considered to be most able to answer the questions in the hospital. Our findings could be affected by the fact that the hospital visit for the survey administration was planned rather than on an impromptu basis which allows opportunity for them to prepare. And the assessment did not identify if it is only some or all of an item reported to be available really were. Our analysis was descriptive with no regression or correlation analysis. Furthermore, available but not accessible for 24-hours, which can affect trauma outcome was not considered in the INTACT scoring system. Then, this tool assesses the presence of components but not their appropriate and effective use or not and therefore limits inference on whether high scores truly translate to better trauma care outcomes. The findings, although giving a reflection, is not generalizable within or across the countries as the number of hospitals purposively surveyed in this study was in no way representative of the total number of hospitals that provide trauma care in each country.

Conclusion and recommendation

Our findings highlight several important aspects of injury care systems. First, much as injury care items may be available, readiness of a hospital to provide injury care goes beyond structural availability to include functional presence and assurance of continuity of access. Second, tertiary hospitals that are the apex of healthcare delivery are also facing functional and continuity challenges to service delivery. Third, within countries there is subtle (Rwanda, Pakistan, South Africa) and marked (Ghana) variability in hospital readiness (structural, functional and continuity) to provide injury care. We recommend that in assessing capacity to provide injury care, structure must necessarily be evaluated with function and ability to provide continual care as structure does not unconditionally guarantee the others. Furthermore, there is a tendency to assume tertiary hospitals are adequately resourced such that resource allocation is focused on lower levels of care. Policymakers and managers must be sensitive to the susceptibility of tertiary hospitals to lack functional resources needed to deliver the care expected of them.

Establishing robust mechanisms to report gaps in service provision, including deficiencies in the availability, functionality, and accessibility of key components to policymakers and regulatory authorities can be invaluable to monitor and benchmark hospital readiness for injury care. When done repeatedly, this can ensure that identified shortcomings translate into targeted system-level action and resource allocation. Notably, an assessment of the injury care landscape in the same countries for this study identified that accountability was one of the weakest domains of injury care governance.³⁷ This highlights a critical disconnect between assessment and action, underscoring the need to strengthen health system governance structures that support transparency among all stakeholders, oversight, and responsive decision-making in injury care systems.

Abbreviations

INTACT

International Assessment of Capacity for Trauma

CT

Computed Tomography

LMICs

Low-and Middle-Income Countries

HICs

High Income Countries

TSAAEESC

Tool for Situational Analysis to Assess Emergency and Essential Surgical Care

PIPES

Personnel, Infrastructure, Procedures, Equipment and Supplies

WHO

World Health Organisation

WHO GETC

WHO Guidelines for Essential Trauma Care

CROSS

Checklist for Reporting of Survey Studies

GDP

Gross Domestic Product

HDU

High-Dependency Unit

Declarations

Ethics approval and consent to participate:

Ethical considerations: This study received approval from ethical review boards in Ghana (GHS-ERC 014/09/22), Pakistan (2022–7372–23339), Rwanda (No85/RNEC/2023), and South Africa (N22/07/079). The University of Birmingham approved the local ethics approvals in lieu of the full ethics review. Permission was sought from the hospital head, and survey respondent before it was administered. Written informed consent was obtained from respondents on the day of data collection. This study was carried out in accordance to the principles of the declaration of Helsinki.

Consent for publication:

Not applicable

Competing Interests

Some authors (AA, MB, SG, DK-Y and ST) work in the some of the hospitals surveyed in Ghana this study.

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Author Contribution

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Writing – original draft: A.E.A., J.D.

Writing – review and editing: All authors reviewed the manuscript.

Data Availability

The datasets used and/or analyzed during the current study are presented in Supplementary Tables of the submission.

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Figures

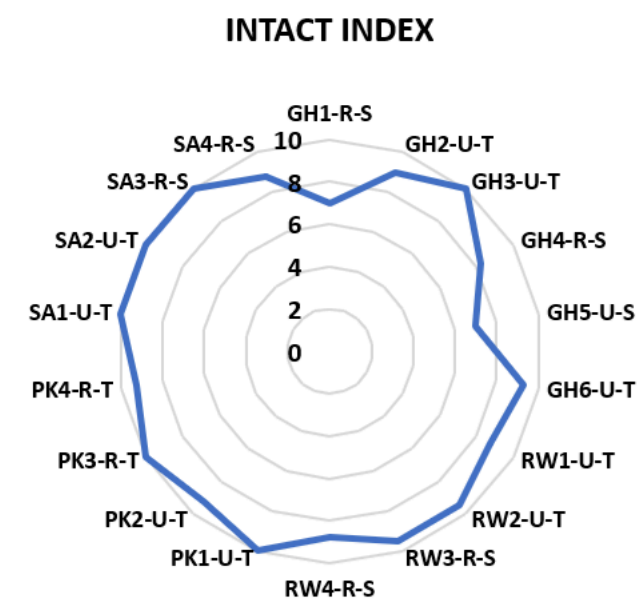


Figure 1

INTACT index of eighteen hospitals surveyed.

Legend: Ghana (GH), Rwanda (RW), Pakistan (PK) South Africa (SA), Urban (U), Rural (R), Tertiary (T), Secondary (S).

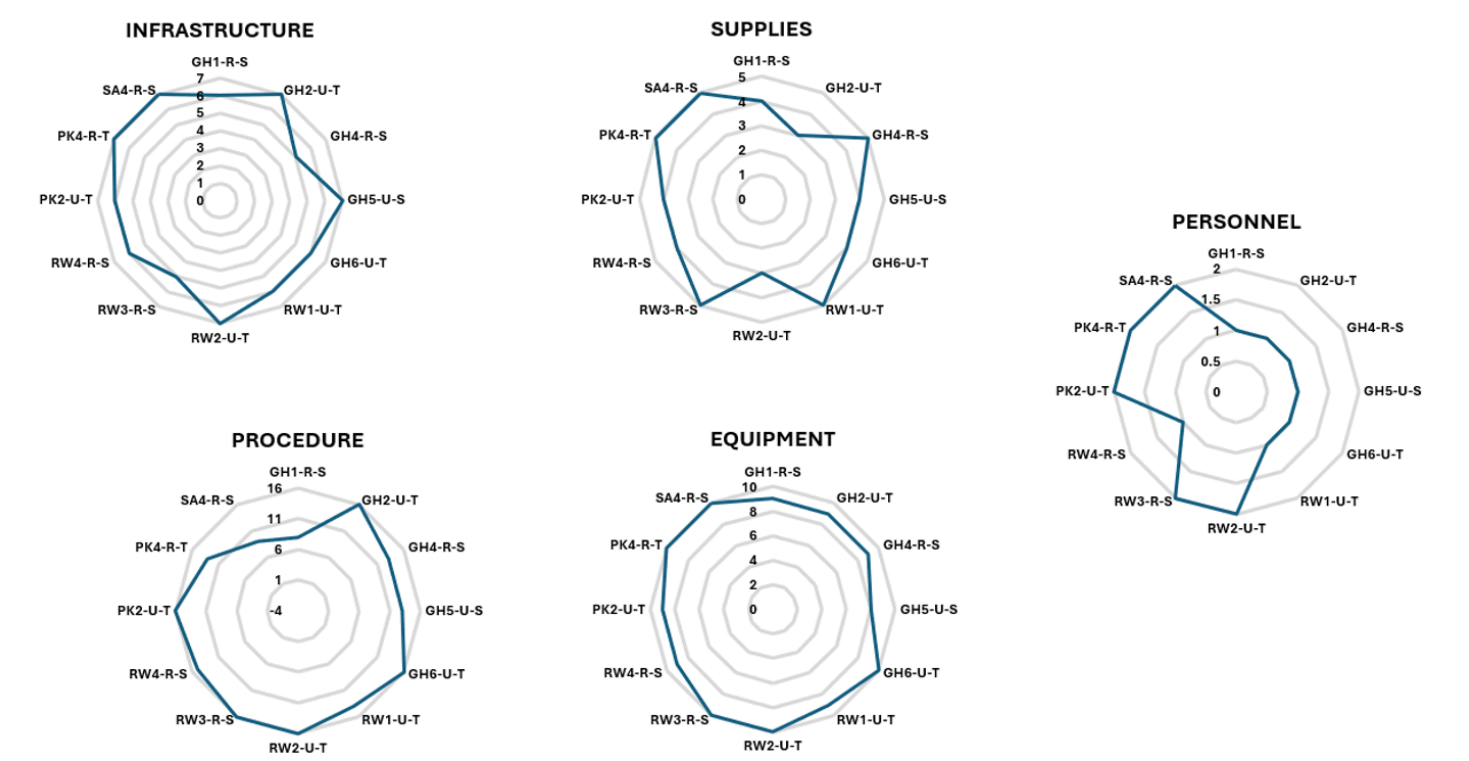


Figure 2

INTACT domain scores of facilities with INTACT index < 10

Legend: Ghana (GH), Rwanda (RW), Pakistan (PK) South Africa (SA), Urban (U), Rural (R), Tertiary (T), Secondary (S).

Supplementary Files

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- [SupplementaryDocument1SurveyFACILITYREADINESSFORINJURYCAREINLOWANDMIDDLEINCOMECOUNTRIESASURVEYOF18HOSPITALSINGHANARW/](#)
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