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## Triage in low-resource emergency care settings

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### Triage systems in low-resource emergency care settings

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#### Abstract

Triage is widely regarded as a core emergency care function, as reflected in the World Health Organization (WHO) *Emergency care systems framework* and in recent World Health Assembly resolutions. In this article, we explore the evidence supporting triage in low-resource settings, with a focus on the Interagency Integrated Triage Tool. Following its release by WHO in the early stages of the coronavirus disease pandemic, the tool has been implemented across a range of low- and middle-income countries. We report evidence regarding its acceptability and performance from Papua New Guinea in the WHO Western Pacific Region. Data from four single-centre studies suggest that the tool can be reliably and efficiently applied by health workers, and its predictive validity is within the performance range of other triage instruments. The system is highly regarded by emergency care clinicians, and can be implemented with limited digital or in-person training. Although triage has intuitive and widely acknowledged value, recent research has identified a lack of high-quality evidence supporting an association between triage implementation and improved clinical outcomes. Evidence from several pre-post intervention studies suggests that the introduction of triage can reduce waiting times and mortality, but these data may have been subject to confounding and publication bias. Further research is required to establish the performance characteristics of the Interagency Integrated Triage Tool in other countries and contexts, and more rigorously examine the impact of triage implementation on quality of care.

#### Introduction

Triage aims to identify and prioritize patients with time-sensitive care needs, and fulfils a critical role whenever demands for care exceed the available resources.<sup>1,2</sup> Regarded as a core

emergency care function,<sup>3</sup> triage is an important tool for ensuring the fair and efficient use of health-care resources.<sup>1,2</sup> The global relevance of triage has been recognized in the World Health Organization (WHO) *Emergency care systems framework*<sup>4</sup> and in several resolutions from the World Health Assembly.<sup>5-7</sup>

In health-care facilities, a typical approach to triage involves a clinician assigning a category of urgency to all patients who present with emergency care needs. This categorization is then used to determine the order of patient assessment.<sup>1,8</sup> Importantly, triage is distinct from screening. In the emergency care context, this refers the assessment of communicable disease transmission risk at the point of arrival to the health-care facility.<sup>9</sup>

High-income countries have tended to adopt five-tier triage tools, such as the Emergency Severity Index.<sup>1</sup> These systems are not necessarily suited to low- and middle-income countries because of differing epidemiology, service demands and resource arrangements. Consistent with this, clinicians in low-resource settings have emphasized the need for triage instruments that are simple, efficient and reliable.<sup>10,11</sup>

Several context-specific triage scales have been developed for use in low-resource settings. An example is WHO's Emergency Triage Assessment and Triage system, a three-tier, paediatric-focused tool that links with Integrated Management of Childhood Illness.<sup>12-14</sup> The tool, which has been extensively studied across the African region,<sup>12,13</sup> uses clinical discriminators, such as signs and symptoms, rather than physiologic parameters to define urgency.

Another widely studied tool is the South African Triage Scale.<sup>15</sup> This instrument has been implemented across various countries and contexts,<sup>13,16</sup> including by *Médecins Sans Frontières*.<sup>17,18</sup> The tool categorizes patients into four urgency levels based on presenting signs and symptoms as well as physiologic criteria, calculated as a triage early warning score.<sup>15</sup>

Several systematic reviews have considered the validity and reliability of triage scales in low- and middle-income countries<sup>13,16</sup> and in high-resource settings,<sup>19-21</sup> identifying common limitations, such as suboptimal sensitivity in detecting critical time-sensitive conditions, and a lack of compelling data supporting any one instrument.<sup>13,16,19</sup> The overall quality of the evidence for paediatric triage has been assessed as poor, and heterogeneity in research methods limits the direct comparison of different systems.<sup>13</sup>

A major challenge in evaluating triage performance is the lack of a definitive measure of urgency.<sup>2</sup> For this reason, studies commonly assess predictive validity using emergency department outcomes, such as admission, as surrogate measures. This approach is problematic, however, because the requirement for inpatient care does not necessarily correlate with time-sensitivity.

Some researchers have attempted to work around these issues by reporting under- and over-triage rates, usually defined as the proportion of non-urgent patients who are admitted and urgent patients who are not, and comparing the results against pre-specified standards.<sup>17,22,23</sup> However, many studies that have adopted this approach have benchmarked against American College of Surgeons Committee on Trauma guidelines, despite the fact that (i) recommendations for trauma triage do not necessarily apply to other disease categories; and (ii) the performance targets provided by an American society are unlikely to be appropriate in the context of low- and middle-income countries.

The coronavirus disease 2019 (COVID-19) pandemic highlighted the importance of triage in both high- and low-resource settings.<sup>24–27</sup> This insight reflects the essential contribution of emergency care to the assessment and management of patients with severe acute respiratory infection, as well as broader surveillance and disease control efforts.<sup>24,25</sup> Qualitative data from the WHO Western Pacific Region has specifically identified the value of efficient triage and patient flow processes as part of a comprehensive pandemic response strategy.<sup>28</sup>

The experience of the pandemic also reinforced the value of systematized acute care capacity in low- and middle-income countries, strengthening the case for universal access to timely and quality emergency care as well as the global implementation of evidence-based triage tools.<sup>2,3,5</sup> Consistent with this, the WHO *Living guidance for clinical management of COVID-19* recommends that all health-care facilities utilize a standardized triage tool to assess patients, and lists the Interagency Integrated Triage Tool as an acceptable system.<sup>29</sup> Here, we summarize recent evidence regarding triage in low- and middle-income countries, with a focus on this particular tool.<sup>8</sup>

## Interagency Integrated Triage Tool

### Origin and implementation

The Interagency Integrated Triage Tool is a three-tier, colour-coded triage instrument developed collaboratively by WHO, *Médecins Sans Frontières* and the International

Committee of the Red Cross (Fig. 1).<sup>8</sup> Following its global release during the early stages of the COVID-19 pandemic, the tool has been promoted as part of WHO's package of resources for strengthening emergency care systems.<sup>30</sup>

The triage tool leverages the strengths of Emergency Triage Assessment and Treatment and the South African Triage Scale, synergistically combining their most advantageous features (such as the traffic-light strategy of the former). While its clinical discriminators closely resemble those used in the South African Triage Scale, the tool eliminates the need to calculate a triage early warning score,<sup>11</sup> instead relying on specific physiological parameters to identify time-critical patients (Fig. 1). This simplified approach is a key strength of the system.

The tool has recently been introduced in a variety of low- and middle-income countries, including Bangladesh, South Sudan and Vanuatu,<sup>24,31–35</sup> and several implementation programmes have been developed to support health-care facilities in its adoption. For example, bespoke in-person training packages have been delivered in Honduras and Papua New Guinea as part of broader emergency care improvement programmes,<sup>33,35</sup> and WHO and *Médecins Sans Frontières* have developed online learning tools for the system through the OpenWHO<sup>36</sup> and Tembo<sup>37</sup> platforms, respectively.

The only published assessments of Interagency Integrated Triage Tool implementation strategies come from Papua New Guinea.<sup>33,38</sup> Reports from other countries are anticipated, but not yet available. Before the COVID-19 pandemic, a team of Australian and Papua New Guinean clinicians developed and delivered a 5-hour in-person education programme, coupled with peer mentoring by external nurses. Local health workers found this approach highly acceptable.<sup>33</sup>

The COVID-19 pandemic led to increased use of digital learning to assist with health-care system changes. In Papua New Guinea, this stimulated the development of a context-specific, smartphone-based online learning platform, including modules on the Interagency Integrated Triage Tool for emergency department staff.<sup>39,40</sup> An evaluation of this approach identified improvements in knowledge and confidence among participants.<sup>38</sup> Based on this evidence, digital learning combined with peer mentoring appears to be a feasible and effective strategy for implementing the tool.<sup>38</sup> Lessons learnt through the change management process have been summarized elsewhere.<sup>33,34</sup>

## **Performance characteristics**

The predictive validity of the Interagency Integrated Triage Tool has been assessed across four emergency departments in Papua New Guinea, representing a mixture of urban and regional hospitals.<sup>41–44</sup> The primary outcome in all studies was sensitivity for the detection of time-critical illness. At three sites, this measure was defined by a list of pre-specified diagnoses requiring urgent intervention, for example, ruptured ectopic pregnancy and acute myocardial infarction.<sup>41–43</sup> Sensitivity was found to be 70.0% (95% confidence interval, CI: 50.6–85.3), 70.8% (95% CI: 58.2–81.4) and 77.8% (95% CI: 64.4–88.0) across the three emergency departments.<sup>41–43</sup>

The fourth study focused exclusively on patients with COVID-19, such that urgency was defined by the presence of severe or critical illness based on WHO criteria.<sup>44</sup> In this evaluation, sensitivity (defined as the proportion of severe and critical COVID-19 patients who were allocated a red or yellow triage category on arrival at the emergency department) was found to be 74.6% (95% CI: 62.1–84.7), with a negative predictive value of 92.7% (95% CI: 88.4–95.8).<sup>44</sup> Table 1 summarizes a broader set of test characteristics, related to the ability of the tool to predict admission and death at three of these study sites.

Studies have also evaluated the inter-rater reliability of the tool, comparing agreement between a recently trained triage officer and an experienced, independent, external clinician. These studies have consistently demonstrated excellent agreement, with Cohen's  $\kappa$  scores exceeding 0.8.<sup>41–43</sup> Each study included a broad range of local clinicians, including community health workers with limited formal training. This is an important finding for a triage scale designed for low-resource settings, where specialist health workers are often scarce. The tool is also efficient, with reported median triage assessment times of 94–214 seconds.<sup>41–43</sup> Speed of application is a relevant consideration for facilities facing high demand for emergency care.

### **Acceptability**

At each of the four health-care facilities in Papua New Guinea that have published their experience, the overwhelming majority of clinicians have expressed support for the tool and reported a positive impact on emergency department functioning (Table 2).<sup>33,38</sup> The slightly lower ratings for Gerehu General Hospital may be explained by the challenging infrastructure and model of care in that department, which primarily operates as an outpatient facility with limited diagnostic and admission capacity.

The results in Table 2 indicate that triage implementation can bring structure to an emergency department, and provide a foundation from which broader training and systems improvement initiatives can be developed. Based on this evidence, advantages of the system appear to be its ease of implementation and widespread acceptability.

### **Interpreting evaluation data**

Despite high levels of support among clinicians, the sensitivity of the tool to detect time-critical illness is not ideal.<sup>41–44</sup> This drawback appears, however, to be a universal limitation of triage systems. A systematic review, reporting data predominantly from high-resource settings, identified sensitivities of 36–92% for a range of urgent conditions, including severe sepsis (36–74%) and ST-elevation myocardial infarction (56–92%).<sup>19</sup> The absence of comparable data from low- and middle-income countries, for the Interagency Integrated Triage Tool or any other triage system, makes it difficult to benchmark the findings from Papua New Guinea.

The reported sensitivities also reflect that triage assesses urgency at a single point in time, for example on arrival at a health-care facility. Patients with acute illness or injury often demonstrate dynamic physiological changes, meaning those who present early might reasonably be expected to deteriorate. Consequently, criteria for a specific condition (for example severe pneumonia) may only be met later during a patient’s emergency department stay, such as at discharge when the diagnosis is recorded.

For this reason, no triage tool is likely to achieve 100% sensitivity without significantly compromising specificity. Rather, emergency care clinicians need to recognize the importance of repeat assessment (re-triage) for patients who are initially allocated a non-urgent category, and respond to clinical deterioration as appropriate. This approach to triage is essential, especially in an era of escalating demands on emergency departments.

### **Knowledge gaps**

While the Papua New Guinea experience provides important insights into the Interagency Integrated Triage Tool’s performance and acceptability, questions remain about the generalizability of these findings. The validity and reliability of triage tools, as measured through research and quality improvement initiatives, are widely understood to reflect the environments in which they are studied. Contextual factors, such as patterns of disease and resource availability, are likely to influence evaluation results.<sup>20</sup> It is therefore critical to assess the tool in other countries and contexts.

Future studies should explore the impact of the tool on a broader range of outcome measures, such as resource utilization and staff well-being. This recommendation reflects that triage has the potential to bring greater order to an emergency department, influencing functions beyond the assessment of urgency.

There is also a lack of data on community acceptance of the tool, particularly in settings where priority for health care is determined by factors other than urgency (such as social status). Additionally, further assessments are needed to evaluate the tool's performance among specific patient groups, such as women and children, and in vulnerable populations, such as those affected by complex emergencies.

### **Implications of WHO support**

Despite the limitations of the available evidence, endorsement of the Interagency Integrated Triage Tool by WHO and other leading global health organizations makes its widespread implementation probable. Experience to date suggests that integrating the tool into WHO's COVID-19 and emergency care toolkits has facilitated its adoption, partly due to the credibility associated with the WHO brand.<sup>26,34</sup> Additionally, aligning the tool with other joint WHO and International Committee of the Red Cross resources, such as the Basic Emergency Care course, has helped frame triage as an essential component of a broader emergency care improvement strategy.<sup>8,30</sup>

In Papua New Guinea for instance, the adoption of the Interagency Integrated Triage Tool as the national triage instrument is partly attributed to the trustworthiness of WHO and the incorporation of the tool into WHO guidance. Based on the data and experience presented above, a national training of trainers programme has been established, and local clinicians are increasingly implementing the tool across provincial hospitals.

From a global perspective, the positive early reception of the instrument presents both an opportunity and a challenge for its ongoing evaluation. Since the tool has already been disseminated by WHO, there may be barriers to further independent assessment of its performance. It is therefore critical that the global emergency care community commits to ongoing evaluation of the tool, alongside other components of the WHO emergency care systems toolkit.

### **Future directions**

#### **Measuring triage performance**

With the growing number of triage tools available to emergency care providers in low- and middle-income countries, it is increasingly important to compare the performance of individual instruments and identify opportunities to enhance their sensitivity and specificity. However, the lack of standardized research methods for assessing triage systems remains problematic, limiting comparisons between tools. Experts have repeatedly identified the potential value of a universal approach to triage tool assessment, proposing a range of strategies and measures.<sup>1,45</sup>

Developing an agreed set of metrics requires consideration of the fundamental purpose of triage. Since the primary objective is to identify patients who are likely to benefit most from timely assessment and management, measuring sensitivity to detect sentinel time-critical diagnoses and/or the need for life-saving interventions, as has occurred in Papua New Guinea, has intrinsic value. This approach aligns with a previous proposal to use triage footprints for specific conditions to compare the performance of a given tool between settings.<sup>1</sup> This strategy could also be adapted to compare the validity of different systems.

### **Data-driven quality improvement**

Many health-care facilities in low- and middle-income countries face challenges in achieving continuous quality improvement for triage and other emergency care functions.

Appropriately, triage performance has been recommended as a core indicator of safety and quality in low-resource settings.<sup>46</sup> Addressing this measure requires individual facilities to establish clear targets and systematically collect data on the timeliness and outcomes of care. The barriers to implementing these practices in low-resource settings are well documented.<sup>46–</sup>

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Registries represent a valuable tool for capturing and aggregating emergency department performance data, but have limited uptake in low- and middle-income countries.<sup>48</sup> Experience from the WHO Western Pacific Region, including through the Interagency Integrated Triage Tool studies explored above, has demonstrated the feasibility of introducing simple, low-cost, electronic registry systems to enable routine triage data collection.<sup>34</sup> The WHO Clinical Registry represents a potential vehicle for addressing this issue, subject to the provision of data entry capabilities and resources.<sup>30</sup>

For the Interagency Integrated Triage Tool, developing an implementation, monitoring and evaluation toolkit would help to ensure consistent application of the system and facilitate ongoing quality improvement. Ideally, this toolkit should be developed at a

global level and made available through an open access arrangement for facilities, organizations and authorities seeking to introduce the tool.

### **Triage for improving outcomes**

Although there is substantial evidence supporting the acceptability, validity and reliability of triage scales in low- and middle-income countries, the literature is limited regarding the impact of triage implementation on clinical outcomes and process measures.<sup>2</sup> This paucity of data reflects the challenges of conducting high-quality research in low-resource emergency care settings.<sup>47</sup>

Fundamentally, triage is aimed at expediting the care of patients with urgent care needs. Although the triage process serves additional functions, such as bringing structure to an emergency department and defining resource requirements, there is a strong imperative to establish an empirical evidence base for its impact on clinical outcomes.

Intuitively, implementing a system designed to identify and prioritize time-critical patients should translate to better care. Supporting this is a substantial body of evidence linking timely management to improved health-care outcomes for various conditions, such as myocardial infarction, trauma and sepsis.<sup>2</sup> A key question, however, is whether the introduction of structured approaches to triage, such as the Interagency Integrated Triage Tool, conveys an advantage over informal or intuition-based systems.<sup>49</sup>

A systematic review conducted in 2023 attempted to answer this question, identifying 16 studies that used pre-post methods to assess the impact of triage implementation in low- and middle-income countries.<sup>50</sup> Effect measures in these studies included mortality, length of stay, waiting time, patient satisfaction and admission rates. Of these, early mortality and time to clinician assessment were evaluated most frequently, and most studies using these outcomes identified a reduction in the number of deaths and waiting time. The quality of the evidence was moderate for these measures, but low or very low for all other process indicators and outcomes.<sup>50</sup>

Although the available data suggest that triage implementation is likely to improve quality of care, there is a need for further research and more robust study methods to control the significant risks of publication bias and confounding. This work should be considered a priority for the global emergency care community, particularly in relation to the Interagency Integrated Triage Tool. Studies using stepped-wedge design are well suited to this purpose.

## Conclusion

Emergency care facilities in low- and middle-income countries implementing a structured triage system have a range of tools to choose from. Local stakeholders should select an instrument that is applicable to the patient population, supported by evidence and acceptable to the community.

The Interagency Integrated Triage Tool is likely to meet these criteria in many countries and contexts. Although it is not a perfect triage instrument,<sup>49</sup> the available data suggest it is valued by clinicians, feasible to implement with limited digital or in-person training and can be efficiently applied by triage officers.<sup>33,38,41–44</sup> Importantly, the tool's predictive validity (regarding admission and mortality) and inter-rater reliability (reflecting clinician agreement) appear comparable to, if not superior to, other triage tools designed for low- and middle-income countries.

Despite the intuitive and widely acknowledged value of triage, establishing high-quality evidence of its impact on quality of care is a critical next step. Further research will support WHO efforts to strengthen emergency care systems globally.

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RB, GO and PC are also affiliated with Alfred Health, Melbourne, Australia. CB is also affiliated with the College of Medicine and Dentistry, James Cook University, Townsville, Australia. GN is also affiliated with Port Moresby General Hospital, Port Moresby, Papua New Guinea.

## Competing interests:

None declared.

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**Table 1. Performance characteristics of the Interagency Integrated Triage Tool for predicting emergency department outcomes of admission and death, Papua New Guinea, 2019–2021<sup>41–43</sup>**

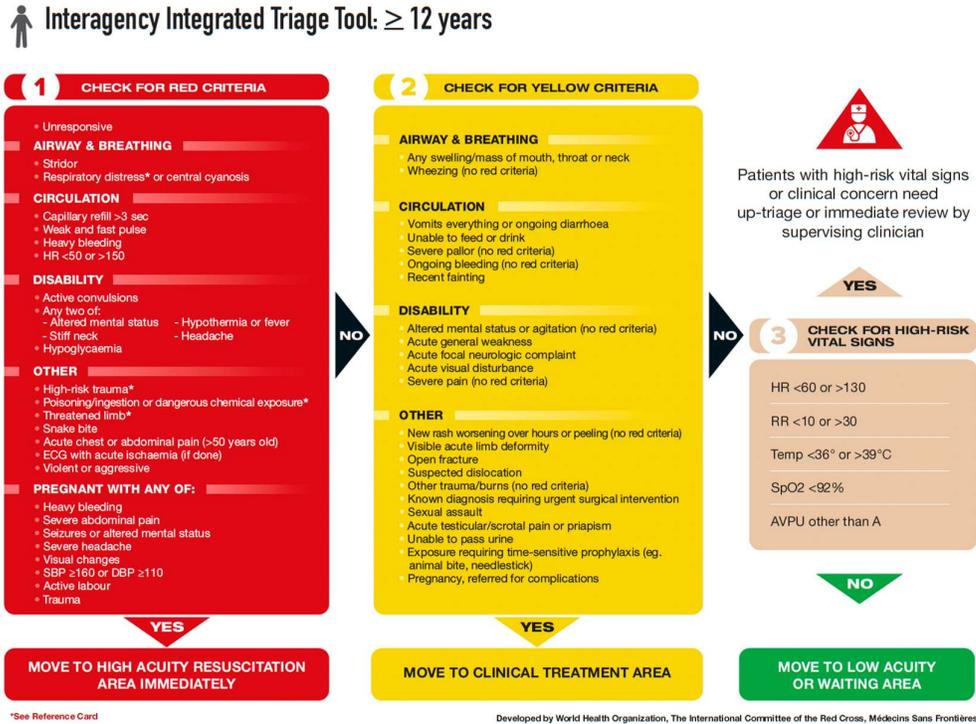
Performance measure	Value of measure (95% CI)					
	ANGAU Memorial Provincial Hospital		Gerehu General Hospital		Mount Hagen Provincial Hospital	
	Admission	Death	Admission or transfer	Death	Admission	Death
Sensitivity, %	81.0 (72.7–87.7)	87.0 (66.4–97.2)	72.6 (67.5–77.2)	88.5 (69.8–97.6)	86.5 (81.4–90.7)	92.2 (81.1–97.8)
Specificity, %	66.3 (62.5–69.9)	60.5 (56.8–64.0)	81.2 (80.0–82.3)	77.5 (76.2–78.7)	84.6 (83.8–85.3)	83.2 (82.5–84.0)
Positive predictive value, %	30.2 (25.2–35.7)	6.43 (4.0–9.8)	24.1 (21.5–26.8)	2.2 (1.4–3.3)	12.2 (10.7–14)	3.0 (2.2–4.0)
Negative predictive value, %	95.1 (92.7–96.9)	99.3 (98.1–99.9)	97.3 (96.7–97.8)	99.9 (99.7–100.0)	99.6 (99.4–99.7)	99.9 (99.9–100.0)
Positive likelihood ratio	2.4 (2.1–2.8)	2.2 (1.8–2.6)	3.9 (3.5–4.2)	3.9 (3.4–4.6)	5.6 (5.2–6.0)	5.5 (5.0–6.0)
Negative likelihood ratio	0.3 (0.2–0.4)	0.2 (0.1–0.6)	0.3 (0.3–0.4)	0.2 (0.1–0.4)	0.2 (0.1–0.2)	0.1 (0.0–0.2)

CI: confidence interval.

**Table 2. Acceptability of the Interagency Integrated Triage Tool as reported by surveyed emergency department clinicians, Papua New Guinea, 2019–2021<sup>33,38</sup>**

Statement	No. Clinicians in agreement with statements (%)			
	ANGAU Memorial Provincial Hospital ( <i>n</i> = 8)	Gerehu General Hospital ( <i>n</i> = 24)	Mount Hagen Provincial Hospital ( <i>n</i> = 15)	Port Moresby General Hospital ( <i>n</i> = 22)
The new triage and flow system helps identify and prioritize the most urgent patients	8 (100.0)	24 (100.0)	15 (100.0)	22 (100.0)
The triage and flow system has improved patient flow in the emergency department	8 (100.0)	19 (79.2)	15 (100.0)	22 (100.0)
The triage assessment process is easy to follow	8 (100.0)	23 (95.8)	15 (100.0)	22 (100.0)
Implementation of the triage and flow system has improved my job satisfaction	8 (100.0)	21 (87.5)	15 (100.0)	21 (95.5)
Implementation of the triage and flow system has improved patient and staff safety in the emergency department	8 (100.0)	21 (87.5)	14 (93.3)	21 (95.5)

Fig. 1. Interagency Integrated Triage Tool assessment criteria for patients aged 12 years and older



AVPU: alert, responding to voice, responding to pain or unresponsive; DBP: diastolic blood pressure; ECG: electrocardiogram; SBP: systolic blood pressure; SpO2: oxygen saturation; WHO: World Health Organization.

Note: asterisks are referring users to the reference card published in WHO *Clinical care of severe acute respiratory infections – tool kit*.<sup>9</sup>

Source: Adapted from WHO.<sup>8</sup>