Towards high-quality peri-operative care: a global perspective

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Abstract

Article 25 of the United Nations' "Universal Declaration of Human Rights" enshrines the right to health and well-being for every individual; however, universal access to high-quality healthcare remains the purview of a handful of wealthy nations. This is no more apparent than in peri-operative care, where an estimated five billion individuals lack access to safe, affordable and timely surgical care. Delivery of surgery and anaesthesia in low-resource environments presents unique challenges that, when unaddressed, result in limited access to low-quality care. Current peri-operative research and clinical guidance often fail to acknowledge these system-level deficits and therefore have limited applicability in low-resource settings. In this manuscript, the authors priority-set the need for equitable access to high-quality peri-operative care and analyse the system-level contributors to excess peri-operative mortality rates, a key marker of quality of care. To provide examples of how research and investment may close the equity gap, a modified Delphi method was adopted to curate and appraise interventions which may, with subsequent research and evaluation, begin to address the barriers to high-quality peri-operative care in low and middle-income countries.

Global health has traditionally been synonymous with the prevention and management of infectious disease. However, the past 30 years have witnessed the landscape of health priorities shift, with causes of death and disability now predominated by non-communicable disease and injuries [1]. This has repositioned peri-operative care as a recognised essential component of health systems globally. Annually, it is estimated that 30% of the worldwide burden of disease requires surgical care, and provision of equitable access to quality surgery and anaesthesia may avert up to 16.9 million deaths [2]. To put these numbers into context, every day 830 women die from pregnancy-related disorders [3] with over a third of neonatal and maternal disability adjusted life years (DALYs) avoidable through the delivery of safe peri-operative care [4]. Of the 15.2 million cancer cases diagnosed annually, more than 80% require surgical intervention [5]. Failure to deliver essential surgical services not only results in poor health outcomes but also has secondary economic implications. By 2030, low and middle-income countries (LMICs) are estimated to lose in excess of \$12.3 trillion (USD), representing almost 2% of gross domestic product (GDP) with losses predominantly from deficits in cancer and injury care [6]. Anaesthesia and surgery can contribute to restoring physical well-being, preventing premature death and avoiding disability, thereby ameliorating financial loss. Therefore, delivery of surgery, anaesthesia and obstetric services has been deemed "an indivisible, indispensable part of healthcare" [7]. Political recognition from United Nations member states was gained in 2015, with the landmark passing of resolution WHA68.15 at the World Health

Assembly, which unanimously recognised emergency and essential surgical and anaesthesia services as a component of universal health coverage [8].

Despite the recognised health, economic and political motivations for universal access to surgical care, provision remains poor with five billion people lacking access to safe and affordable surgical and anaesthesia care when needed [9]. This deficit is accentuated in paediatric populations with 1.7 billion children unable to access essential surgical care [10], despite an estimated 94% of congenital anomalies occurring in low- and middle-income countries [11]. The Lancet Commission on Global Surgery (Fig. 1) advocated for the scaling of surgical services with an estimated 143 million additional surgical procedures required to meet global demand [7,12]. Surgical system strengthening can be achieved through the creation and implementation of National Surgical, Obstetric and Anaesthesia Plans, that are designed to be integrated into national health strategic plans [13].

If surgery and anaesthesia care are to be rapidly scaled, it is equally imperative to ensure this care is safe, effective and renders the desired health benefits; adhering to the first tenant of medical ethics: “primum non nocere”. Over the last 50 years, investment in standards, workforce, training and equipment has revolutionised peri-operative care, yet these gains have not been uniform.

State of peri-operative care in low and middle-income countries

Rapid and systemic improvements in the quality of peri-operative care have been observed in high-income nations, exemplified by the reduction in all cause inpatient (elective and non-elective) 30-day peri-operative mortality rate to 1.14%–1.32% in the USA, despite an aging and increasingly co-morbid population [14,15]. However, this trend has not been reflected in outcomes observed in LMIC surgical facilities, where 6.3 billion of the world’s population resides [16]. Here, peri-operative mortality rate has been observed to stagnate, with the number of deaths following surgery estimated to be at least twice what is observed in high-income populations [17,18]. Crude mortality rates in LMICs vary greatly with estimates of death following routine appendicectomy and hernia repairs (inguinal and femoral) as high as 5.4% and 2.5% respectively [19]. Of significant concern is the incidence of anaesthesia-related mortality in LMICs, which has failed to demonstrate gross improvements between the years of 1970–2011 in published literature, bucking the trend of safe delivery of anaesthesia in high income nations [20]. This is further punctuated by the estimation that one in seven maternal deaths during or after caesarean section in LMICs is attributable to anaesthesia care [21]. The African Surgical Outcomes Study (ASOS), a prospective international cohort study observing seven-day peri-operative outcomes in Sub-Saharan Africa, identified that maternal mortality rates following caesarean section were fifty times higher than those observed in

high-income nations [22]. Low and middle-income country paediatric surgical outcomes are markedly poorer with pooled mortality rates of up to 17% reported for congenital anomalies [23] and an observed sevenfold increase in risk-adjusted mortality following emergency abdominal surgery [24]. Given the disproportionate burden of poor-quality surgical care in LMICs, where the majority of the world resides, modelling estimates have suggested post-operative mortality to be the third leading cause of death globally [25], highlighting the need to assess the barriers to high-quality surgical care systematically.

To date, peri-operative mortality has been the most consistently proposed indicator of quality in LMIC surgical care [7,26] and is recognised as a health system safety and quality metric in the World Health Organization (WHO) global reference list of 100 core health indicators [27]. Despite this, it is important to recognise that death in the peri-operative period is a crude measure of quality, which sets the lowest bar for delivery of safe peri-operative care. However, a lack of international consensus on surgical quality metrics and availability of data limits a more cogent analysis of LMIC peri-operative care. The Lancet Commission on Global Surgery recommended all surgical facilities report in-hospital all-cause mortality rates by 2030; however, a recent analysis could only identify 28 countries that had nationally representative data [28]. Additionally, previous attempts to estimate aggregate peri-operative mortality rate from published literature have been limited due to a lack of standardised reporting [29]. As access to surgery and anaesthesia increases in low-resource settings leading to higher surgical volumes, there must be parity in ensuring the quality of all components of the surgical health system to prevent concomitant inflation of adverse peri-operative outcomes.

The global quality movement

Anaesthesia and surgical communities are not alone in their search to improve the quality of care delivery in LMICs. In 2018, a watershed moment occurred in global health with the publication of three seminal reports on quality [30–32], each highlighting the imperative to end tolerance of ineffective and unsafe care in low-resource regions of the world, stating quality is neither aspirational nor an afterthought but should be embedded into the “DNA of all health systems” [30]. The Lancet Global Health Commission on High-Quality Health Systems in the Sustainable Development Goals era (HQSS) advised a systems-based approach to quality improvement, noting that healthcare is a complex and adaptive environment. Given this, isolated individual interventions often prove ineffective and the aggregate impact of multiple uncoordinated interventions can be net negative [30]. HQSS produced a framework for conceptualising quality health systems designed with patient experience as a central component (Fig. 2), noting that high-quality systems should be

founded on the social values of equity, resilience, efficiency and be deemed 'for the people' [30]. Modelling estimates demonstrate that a total of 8.6 million deaths occur each year that are amenable to healthcare. Of these, close to 60% are thought to occur due to poor quality healthcare rather than a deficit of care accessibility and utilisation [33]. This is well illustrated by the Indian birth program, Janani Suraksha Yojana, which sought to reduce maternal and neonatal mortality with the provision of conditional cash transfers to increase the rate of institutional and skilled birth attendant deliveries. The cash incentives led to a rapid increase in institutional deliveries without a concomitant change in maternal or neonatal outcomes [34]. Further studies identified a lack of quality-assured services, namely poorly skilled birth attendants and ineffective referral networks that may account for this observation [35,36].

Quality in healthcare has been defined as 'the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge' [37]. The Institute of Medicine's model of healthcare quality, perhaps the most widely recognised, presents six core dimensions of quality: safety; timeliness; effectiveness; efficiency; equity; and patient-centeredness [38]. Building on this, the National Academies of Sciences, Engineering, and Medicine (NASEM) issued a further report in 2018 focused on delivery of quality care in LMICs [32]; cautioning the WHO's drive to deliver universal health coverage without parallel improvements to the quality of services will fail to achieve desired health outcomes [32]. The report also highlighted three global barriers to quality care that are under-appreciated: the growing role of the informal health sector (care delivered by non-credentialed workers operating outside the purview of government or professional bodies); the effect of fragile states and humanitarian crises on health systems; and the role of corruption in siphoning funds dedicated for healthcare development [32]. Owing to this, NASEM called upon governments and professional societies to develop governance structures for quality, noting that the drive for quality was distinctly lacking from political agendas and health policy, a finding echoed in the HQSS commission [39].

The last in the triad of quality reports is a joint publication from WHO, World Bank and Organisation for Economic Co-operation and Development (OECD), which provides a multilateral perspective on quality in healthcare delivery. This advisory document appraises the principles of quality in global health for policymakers and calls to action governments, health providers and national citizens to work collectively to accelerate delivery of the central goal of "access to high-quality, people-centred health services for all" [31]. Seven thematic interventions were identified as those routinely adopted for health system improvement and include: population engagement; setting standards; adapting front-line care; education for key stakeholders; the continuous use of quality improvement methods; performance-based incentives; and finally the use of legislation and

regulation [31]. These initiatives mirror the HQSS report's universal actions for systems-based quality improvement, namely: governance; service delivery; workforce transformation; and population-based strategies [30].

In short, achieving high-quality healthcare is a global priority and as peri-operative systems develop, clinicians, policymakers and civil society organisations have a clear mandate to ensure these services achieve people-centred outcomes. Furthermore, surgery and anaesthesia may be among the most sensitive health specialities to low-quality care due to their dependence on the integration of multiple services and the high risk-profile of care delivery, leaving little margin for error [40]. Therefore as the global imperative for quality care delivery grows, surgery and anaesthesia care may provide a useful barometer with which to assess progress.

The urgency to act now

In 1980, the Director General of the WHO, Dr Halfdan Mahler, called for the surgical community to engage in delivering the right to surgical care by stating “I beg of you to give serious consideration to this most serious manifestation of social inequity in health care” [41]. Decades later, the disciplines of academic Global Surgery and Anaesthesia remain in their infancy. Some may reason that as the subspecialty evolves and LMIC health systems strengthen solutions to address the challenges of quality peri-operative care may organically develop, as has occurred in high-income settings. However, a paucity of evidence does not permit us to turn a blind eye to the disparity of peri-operative outcomes between high- and low- resource areas of the world. Low-quality peri-operative care disproportionately impacts the poor along geographical borders often secondary to years of colonialism, corruption and violence. Furthermore, premature deaths due to a lack of quality-assured care only compounds the economic situation in these countries. If current low-quality practices remain the same in all sectors of healthcare (both surgical and non-surgical), estimates project that 2.6% of GDP from low income countries will be lost between 2015–2030 [42], representing a significant loss of output as health systems fail to deliver the outcomes they aspire to. Inadequate access to anaesthesia and surgical services, coupled with poor delivery when care is sought, erodes public trust in health systems and contravenes the fundamental right to ‘highest attainable standard of health’ that forms the keystone of WHO’s constitution [43]. Over the last decade, a number of surgical outcome studies and meta-analyses [17-24] have all indicated significant excess peri-operative mortality rate in LMICs and now there is an urgency to translate this knowledge into strategies designed to improve surgical and anaesthesia care delivery. Whilst evidence-based medicine is core to peri-operative practice, building evidence is of limited use if there is not a plan for how best practice can be delivered equitably. There is a pressing ethical

imperative to integrate the global quality movement with the expansion of surgical care to build resilient and adaptive peri-operative health systems which are held accountable for the outcomes they deliver.

Global initiatives for safe peri-operative care

The “Safe Surgery Saves Lives” campaign was the first international endeavour to critically review the safety of surgical and anaesthesia care in LMICs, declaring the need for safe peri-operative care a public health priority [44]. The initiative formed the WHO’s Second Global Patient Safety Challenge and convened a panel of experts, to review four key areas of peri-operative care: safe delivery of anaesthesia; surgical-site infection prevention; safe surgical teams; and metrics for surgical services. The body of work culminated in 10 key objectives for safe surgery (Table 1) and advocated for the global adoption of the WHO Surgical Checklist following a multisite pilot study which found a significant reduction in peri-operative complications and mortality rates following implementation [45].

Over a decade has now passed since this initiative and there have been few attempts to further build on this work at the international level. The Lancet Commission on Global Surgery provided 10 needs for the provision of safe surgery (Table 2), but again highlighted a paucity of data and consensus on what determines safe or quality peri-operative care [7]. A recent systematic review observed that research on the quality of LMIC surgical care is predominately observational, single-centre studies with variability in definitions of quality-based outcome and process metrics, making global recommendations difficult [46]. Tools for assessing quality in low-resource surgery have been proposed but await validation and large-scale adoption [47,48].

Barriers to high-quality peri-operative care: a new conceptual model

Prior attempts to evaluate the composite factors that contribute to avoidable mortality have notably been successful in the obstetric community with the development of the three-delay model in 1994 that seeks to explain key factors that account for avoidable maternal mortality [49], focusing on three temporal components:

- 1) Delays in seeking care: factors that influence the socio-economic and cultural reasons for seeking health services.
- 2) Delay in reaching care: factors that include geographic accessibility and availability of transportation to reach obstetric health services.
- 3) Delays in receiving care: factors that influence service delivery delays within a healthcare facility.

We sought to augment the three-delay model by incorporating other contributing factors identified in the literature that impact peri-operative outcomes and present these within a unified conceptual model. With peri-operative mortality rate as the key indicator for surgical and anaesthesia quality, three broad phases in the peri-operative pathway were identified where the health system collectively “fails to deliver quality care” (Fig. 3).

- 1) Failure to provide timely access to surgical and anaesthesia services. Factors that contribute to delayed presentation and time to definitive treatment of surgical disease, as described in the three-delay model.
- 2) Failure to deliver safe surgical and anaesthesia care. Factors that contribute to inadequate adoption of safe, best practice in peri-operative care.
- 3) Failure to rescue post-operatively. Factors that contribute to poor recognition and response to a postoperative complication and failure to deliver time-sensitive care.

It is noted that beyond the peri-operative pathway, there exists a wide range of socio-economic and demographic factors such as wealth, nutrition and education which all contribute to health outcomes. Whilst it is essential to be cognisant of these macro-level public health issues, they do not present factors that can be readily modulated within the peri-operative health system.

Failure to provide timely access to surgical and anaesthesia services

Access and quality of surgical care are often described as dichotomous issues, however they exhibit interdependence within the health system. The three-delay model highlighted that maternal mortality was intrinsically linked to the accessibility of clinical services [49]; these factors are equally pertinent for surgical outcomes. Causes for delayed health-seeking behaviours are culturally dependent and multifactorial. However, the core issue of public distrust in health services is frequently encountered and often stems from prior experiences of low-quality care [49]. Delayed presentation has consistently been demonstrated to be a risk factor for peri-operative morbidity and mortality [50,51] and is an important cause of advanced disease presentation which may, in part, account for the high burden of emergent case volume in LMICs. Of the many reasons that influence accessibility, cost has been identified to be a notable barrier, with an estimated 81 million individuals facing catastrophic expenditure due to the medical and non-medical direct expenses incurred from accessing surgical care each year [52]. Furthermore, even when appropriate healthcare facilities are accessed, patients often experience further delays in waiting for definitive

surgical care. A single-centre study demonstrated that close to 40% of patients waited over 24 hours for emergency surgery, significantly impacting peri-operative outcomes [53].

Failure to deliver safe surgical and anaesthesia care

The WHO defines patient safety as the “absence of preventable harm to a patient during the process of healthcare,” noting that approximately 83% of adverse events in LMICs could have been prevented and 30% resulted in death [54]. In high-income nations, a systematic review reported close to 40% of in-hospital adverse events occurred in surgical environments [55]. Though data on preventable adverse events in LMIC peri-operative care is sparse, there are indicators to suggest that unsafe care may also be a problem in these settings with pulse oximeters lacking in approximately 1 in 5 operating rooms [56] and up to 39% of LMIC hospitals lacking continuous supply of oxygen [57]. Sterile processing is another critical challenge with non-functional equipment and a lack of workforce training predominating [58].

Adopting standardised essential and best practice guidance is a well-recognised method of improving healthcare quality. Although what constitutes as safe practice may be considered a subjective vantage point, international consensus efforts led by the WHO and World Federation of Societies of Anaesthesiologists have defined what constitutes as minimum expected standards for anaesthetic care [59]. In addition to clinical guidance, the need to empower a patient-safety culture in LMIC peri-operative care has led to the development of training tools for non-technical skills [60]. Furthermore, organisational inertia to changes in clinical practice may be overcome with the adoption of implementation science strategies [61].

Failure to rescue post-operatively

The importance of addressing failure to rescue, that is for a surgical system to recognise and respond to a postoperative complication or physiological deterioration and thus avert mortality, has been well described [62]. Within the United States, surgical outcomes studies have demonstrated that when hospitals were stratified by peri-operative mortality, complication rates occurred in similar proportions among high- and low-performing hospitals. This finding suggested that the occurrence of a complication was not in itself the predictor of mortality, rather the determinate factor was the health system’s ability to detect and adequately respond to the deterioration in health [63,64]. Importantly for LMICs, ASOS was able to map where mortality occurred in the peri-operative pathway for a large cohort of patients, identifying that only 5.9% of deaths occur on the day of surgery, with the median time of death occurring on day five in the post-operative phase [18]. Despite having a twofold increase in elective peri-operative mortality rate, the ASOS complication

rate was comparable with those reported in high-income countries [65], indicating that with appropriate postoperative care and surveillance, some deaths may have been avertable.

Strategies to improve peri-operative mortality

Despite the recognised gaps in high-quality surgical and anaesthesia care, large-scale clinical studies aimed at improving peri-operative outcomes in LMICs are exceedingly rare. The most notable to date have centred on checklist implementation for safe maternal, trauma and surgical care [45,66,67]. The authors formed a consensus panel to suggest and curate strategies that may be suitable for further research. Interventions were developed with the aim of improving the outcome measure of peri-operative mortality, currently the most widely recognised measure of surgical and anaesthesia quality in LMICs. Health system domains of governance, workforce, service delivery and population were explored to develop interventions that were subsequently scored against the following two criteria [30]:

- 1) Impact: the likelihood of the strategy to decrease avoidable peri-operative mortality in LMICs
- 2) Feasibility: relative feasibility of implementing the strategy in an LMIC setting

To build consensus among the panel, a modified Delphi method was adopted with the measures ranked on three separate occasions through an online survey with interim results shared with co-authors after each cycle. A driver diagram, a recognised logic tool for communicating quality improvement strategy, was utilised to present the interventions and theory of change relating to our primary aim, reduction of avoidable peri-operative mortality (Fig. 4). In keeping with the recommendations from the global quality reports, the interventions engage a range of key stakeholders in peri-operative care, inclusive of citizens and patients, governmental and regulatory authorities, professional bodies and the health workforce. Therefore, it is hoped to demonstrate the broad nature of reform and service improvement that is needed to achieve our aim of high-quality peri-operative care for all. When these strategies are reviewed in the context of the critical failures model (Fig. 3), it is noted that the majority of interventions relate to Failure 2 (failure to deliver safe surgical and anaesthesia care) and Failure 3 (failure to rescue postoperatively). Strategies relating to Failure 1 (failure to provide timely access), which include changing health seeking behaviours, are likely more complex and thereby harder to discern improvement pathways for.

It is important to note that the presented strategies are not exhaustive. Rather, they provide examples of how investment and research in LMIC peri-operative care may begin to address the disparate surgical outcomes highlighted in this manuscript. Critically, due to limited evidence, these strategies were selected on their theoretic potential to improve outcomes and thus require

validation with in-country research and evaluation. Finally, local leadership, health priorities and population health will ultimately dictate which interventions are appropriate and feasible.

Conclusion

In high-income nations, advances in peri-operative care have centred on improved diagnostics, risk scoring mechanisms and the adoption of novel technologies. However, for the vast majority of the world, these advances do not meet the needs of local populations. There are significant research, policy and investment gaps in LMIC surgical and anaesthesia care, resulting in the provision of unsafe, low-quality care. Though the inequities are great, there are tangible opportunities for anaesthesia and surgical academia, under LMIC leadership, to contribute to human, societal and economic well-being. Therefore, it is hoped peri-operative medicine in the 21st century begins to look beyond geographical borders and develop solutions that seek to deliver high-quality peri-operative care equitably.

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Table 1. Ten objectives for safe surgery, from the World Health Organization Guidelines for Safe Surgery [44].

Recommendation	
Objective 1	The team will operate on the correct patient at the correct site.
Objective 2	The team will use methods known to prevent harm from anaesthetic administration, while protecting the patient from pain.
Objective 3	The team will recognize and effectively prepare for life-threatening loss of airway or respiratory function.
Objective 4	The team will recognize and effectively prepare for risk of high blood loss.
Objective 5	The team will avoid inducing an allergic or adverse drug reaction known to be a significant risk to the patient.
Objective 6	The team will consistently use methods known to minimize risk of surgical site infection.

Objective 7	The team will prevent inadvertent retention of sponges or instruments in surgical wounds.
Objective 8	The team will secure and accurately identify all surgical specimens.
Objective 9	The team will effectively communicate and exchange critical patient information for the safe conduct of the operation.
Objective 10	Hospitals and public health systems will establish routine surveillance of surgical capacity, volume and results.

Table 2. Ten needs for the provision of safe surgical and anaesthesia care, from the Lancet Commission on Global Surgery [7].

	Recommendation
Need 1	Trained surgical provider
Need 2	Trained anaesthesia provider
Need 3	Infrastructure, equipment and supplies necessary to perform safe general anaesthesia, loco-regional anaesthesia, laparotomy, caesarean delivery, and treatment of open fracture
Need 4	Decontamination and sterilisation capacity
Need 5	Blood supply that is safe and affordable (screened and cross-matched blood)
Need 6	Drugs, including antibiotics, pain medicines, and anaesthetics (from the WHO Model List of Essential Medicines)
Need 7	Nursing care, which includes a record of appropriate physiological observations
Need 8	24 h surgical cover with the ability to review and respond to a deteriorating patient
Need 9	Quality-improvement processes, including audit of perioperative mortality
Need 10	Risk assessment and operation planning for planned procedures

WHO, World Health Organization.

Figure legends

Figure 1. The Lancet Commission on Global Surgery five key messages [7]. LMIC, low- and middle-income countries.

Figure 2. The Lancet Global Health Commission on High-Quality Health Systems in the Sustainable Development Goals Quality Framework Model [30].

Figure 3. The “three critical failures” model.

Figure 4. The driver diagram resulting from the Delphi method. NSOAP, National Surgical, Obstetric and Anesthesia Plans; LMIC, low- and middle-income countries; QI, quality improvement; S, surgical ; A, anaesthetic; O, obstetric; CSO, civil society organisations.

Key message 1

Five billion people lack access to safe, affordable surgical and anesthesia care when needed.

Key message 2

143 million additional surgical procedures are needed in LMICs each year.

Key message 3

81 million individuals face catastrophic expenditure paying for surgery and anesthesia annually.

Key message 4

Investing in surgical services in LMICs is affordable, saves lives and promotes economic growth.

Key message 5

Surgery is an indivisible, indispensable part of health care.

1 <i>Failure to provide timely access to surgical and anaesthesia services</i>	2 <i>Failure to deliver safe surgical and anaesthesia care</i>	3 <i>Failure to rescue post-operatively</i>
<div data-bbox="48 252 782 453"> </div> <p data-bbox="71 550 323 588">Minimised by:</p> <ul data-bbox="71 650 691 837" style="list-style-type: none"> • Trust in health services • Financial risk protection • Transport and referral networks • Efficient delivery of surgical care 	<div data-bbox="840 267 1494 459"> </div> <p data-bbox="851 550 1104 588">Minimised by:</p> <ul data-bbox="828 650 1510 930" style="list-style-type: none"> • Establishing a patient safety culture • Skilled surgical, anaesthesia and nursing workforce • Adherence to local best practice protocols • Peri-operative risk stratification 	<div data-bbox="1547 267 2236 449"> </div> <p data-bbox="1552 550 1804 588">Minimised by:</p> <ul data-bbox="1552 650 2213 930" style="list-style-type: none"> • Post-operative monitoring and surveillance • Early recognition of deterioration and delivery of time-sensitive care • Availability of resuscitation and critical care services

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