World J Surg (2019) 43:1880–1889
https://doi.org/10.1007/s00268-019-04993-1

SCIENTIFIC REVIEW

Perioperative Mortality Rates as a Health Metric for Acute Abdominal Surgery in Low- and Middle-Income Countries: A Systematic Review and Future Recommendations

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Published online: 5 April 2019

Abstract

Background Approximately 5 billion people do not have access to safe, timely, and affordable surgical and anesthesia care, with this number disproportionately affecting those from low–middle-income countries (LMICs). Perioperative mortality rates (POMRs) have been identified by the World Health Organization as a potential health metric to monitor quality of surgical care provided. The purpose of this systematic review was to evaluate published reports of POMR and suggest recommendations for its appropriate use as a health metric.

Methods The protocol was registered a priori with PROSPERO. A peer-reviewed search strategy was developed adhering with the PRISMA guidelines. Relevant articles were identified through Medline, Embase, CENTRAL, CDSR, LILACS, PubMed, BIOSIS, Global Health, Africa-Wide Information, Scopus, and Web of Science databases. Two independent reviewers performed a primary screening analysis based on titles and abstracts, followed by a full-text screen. Studies describing POMRs of adult emergency abdominal surgeries in LMICs were included.

Results A total of 7787 articles were screened of which 7466 were excluded based on title and abstract. Three hundred and twenty-one articles entered full-text screen of which 70 articles met the inclusion criteria. Variables including timing of POMR reporting, intraoperative mortality, length of hospital stay, complication rates, and disease severity score were collected. Complication rates were reported in 83% of studies and postoperative stay in 46% of studies. 40% of papers did not report the specific timing of POMR collection. 7% of papers reported on intraoperative death. Additionally, 46% of papers used a POMR timing specific to the duration of their study. Vital signs were discussed in 24% of articles, with disease severity score only mentioned in 20% of studies.

Conclusion POMR is an important health metric for quantifications of quality of care of surgical systems. Further validation and standardization are necessary to effectively use this health metric.

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Introduction

Approximately 5 billion people worldwide do not have access to safe, timely, and affordable surgical and anesthesia care, with this number disproportionately affecting those within low–middle-income countries (LMICs) [1]. Surgical health metrics are crucial to assess progress toward Universal Health Coverage, including financial risk protection, that incorporates surgical and anesthesia care as an equal partner in health system strengthening. Such metrics are calculated values used to measure the performance of a healthcare system, identify deficits, determine resource allocation, and support policy implementation. Health metrics are not a new concept, and their success can be reflected in the reduction of maternal and infant mortality rate [2]. The Lancet commission on global surgery (LCoGS) recommended the collection of perioperative mortality rates (POMRs) in 100% of countries by 2030 [3] as one of the six measures for assessing the surgical system safety of a country. POMR was identified by the World Health Organization (WHO) through the Safe Surgery Saves Lives program as a safe surgery access tool and potential health metric and is now incorporated into its core 100 indicator list [4] [5]. Although variability exists, POMR is commonly calculated by dividing the total number of deaths by the total number of procedures. Despite the success of health metrics and the recommendation for POMR collection, a significant variability exists in the parameters surrounding their collection and reporting. As laparotomy has been identified as one of the three Bellwether procedures and selected by the LCoGS and incorporated into the WHO core Health Indicators as a method to monitor surgical accessibility, we decided to focus our search on POMR reporting for acute abdominal surgeries in LMICs. It is our objective to identify challenges to POMR reporting and suggest recommendations for its use as an effective health metric.

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Methods

The protocol was registered a priori in the PROSPERO international prospective register of systematic reviews (CRD42017060598). The study was based on a pre-designed protocol under a PICO framework in adherence with the PRISMA guidelines [6]. A peer-reviewed search strategy was developed in collaboration with a senior hospital librarian. The following databases were searched for relevant studies: Medical Literature Analysis and Retrieval System Online (via Ovid, 1946 to March 23, 2017; via PubMed, 1946 to March 23, 2017), Excerpta Medica database (via Ovid, 1974 to March 23, 2017), BIOSIS Previews (via Ovid, 1969 to 2017 Week 17); Global Health (via Ovid, 1973 to 2017 Week 11); Africa-Wide Information (via Ebsco); the Central Registry of Controlled Trials (via The Cochrane Library, to issue 2 of February 12, 2017); LILACS (via Bireme); Scopus (Via Elsevier); and Web of Science (via Thomson Reuters) were searched for relevant studies. The search strategy used text words and relevant indexing to identify articles discussing postoperative mortality for emergency abdominal surgery in low- or low–middle-income countries. The full search strategy was applied to all databases, with modifications to search terms as necessary (*see additional file 1*).

In adherence with PRISMA guidelines, a primary screen of title and abstract was performed by two independent reviewers (TP and MF) [6]. Disagreements were resolved by discussion between reviewers. Any residual disagreements were arbitrated by the senior author and principal investigator (DD). The remaining studies underwent full-text review and data extraction using a pre-determined data sheet by the same independent reviewers. Variables collected included, publication details, region of study, hospital level, patient population, time to operating room, surgical procedure, perioperative mortality, intraoperative mortality, timing of POMR reporting, and article integrity factors. EndNote 8 Software (Clarivate Analytics, Philadelphia, PA) was used to upload references, remove duplications, and perform the primary and secondary screening analysis.

Data analysis and collection was performed using Microsoft ® Excel for Mac Version 15.27 (Seattle, EA). Statistics are reported in terms of total number and percentage. We did not perform a meta-analysis as our study did not include comparative or descriptive data. The methodological index for non-randomized studies (MINORS) was used to assess risk of bias for each article [7]. Countries were identified as low-income, lower–middle income, or middle income based on their gross domestic product using the World Bank classification [8].

Results

Database analysis generated a total of 7787 papers, of which 70 met the final inclusion criteria with an interrater agreement of 82% (Fig. 1, Table 1). Article integrity and potential bias were evaluated using the MINORS criteria (Fig. 2). Database analysis yielded a diverse range of articles including retrospective chart reviews, prospective reviews, case series, cross-sectional analysis, observational studies, literature review, cohort study, randomized control trial, and systematic reviews. 54% of studies were retrospective in nature with only 24% collecting data in a prospective manner (Table 2). Regarding the timing of POMR reporting, six percent reported intraoperative mortality and seven percent presented mortality within 24 h. Four percent of articles reported mortality occurring within 30 days. Interestingly, 46% of articles reported POMRs as any death occurring prior to discharge. 41% of articles included all mortality occurring during the operative time course including preoperative, intraoperative, and postoperative mortality (Fig. 3).

The majority of studies were descriptive evaluations of a given surgical procedure, and although mentioned, did not specifically address POMR reporting. When examining country of study origin, the majority of papers were published in India, 24.6%, with the second most common region being Pakistan, 15.9% (Fig. 4). When classifying country based on gross domestic product, 59% occurred in low-income countries, 39% from low–middle-income, and 2% from middle-income countries (Fig. 5). Our study demonstrated that 45% of publications came from a teaching or university affiliated hospital. The remaining studies were undertaken in a variety of facilities including community, district, and tertiary hospitals (Table 3). In addition to hospital demographics our analysis indicated that only five papers discussed surgeon qualifications, and among those, one article mentioned non-certified surgeons performing procedures.

As many circumstances can influence operative mortality our study collected a wide range of variables in order to fully evaluate the manner in which POMR was recorded. Regarding preoperative management, 25% of articles discussed vital signs upon admission. Time from presentation to operating room was discussed in 16% of articles. Disease severity score was mentioned in 20% of cases, most commonly the American Society of Anesthesiologist Association Score (ASA), the Acute Physiology and Chronic Health Evaluation Score (APACHE), the Physiological and Operative Severity Score for the Enumeration of Morbidity and Mortality (Possum), and Boey score. Among laparoscopic surgeries 7% reported on conversion to open procedure due to difficulty. Postoperative care was reviewed through a variety of methods including complication rates which were discussed in 84% of articles. Postoperative length of stay was reported in 46% of studies.

Discussion

To our knowledge, this is the first systematic review evaluating POMR collection specific to emergency abdominal surgery in LMICs. The literature on POMR reporting and its standardization varies considerably among countries. Our review reports on multiple acute abdominal procedures from 70 studies including a total of 17,887 patients. This study demonstrates a lack of consistency among hospitals reporting POMR. Although limited to what is published in the literature, our findings illustrate that 45% of publications originated from teaching or university affiliated hospitals. These findings are likely due to the increased number of resources and financial stability of these centers. However, if POMR is to be used as an indicator of a countries surgical system, as recommended by the LCoGS, it is crucial that all hospitals performing surgical procedures report POMR in a consistent manner. This can be supported through prioritization of POMR as part of the national health developing key performance indicators for a given country.

The LCoGS recommended POMR that be recorded at any point prior to discharge for all patients undergoing a surgical procedure within an operating theater (3). Our findings show that timing of POMR collection fluctuated between studies with the majority being a time point specific to the evaluation period of the study or any time prior to discharge. Interestingly, a literature review and expert discussion by Watters et al. recommended that POMR be measured at two time periods: on the day of the surgical procedure, as well as prior to discharge or at 30 days, whichever occurs first (11). Our review demonstrated a small percentage of articles using same day and 30-day POMR; however, in partial agreement with Watters recommendations, a large percentage of papers reported mortality prior to discharge.

In order for POMR to be a useful health metric that contributes to quality assurance and improvements of regional, national, and global health care delivery, standardized data definition that includes timing of collection is critical. POMR collection within 24 h of surgery would appear to eliminate the difficulty of patient follow-up within a low-resourced setting. It would also disregard the need to adjust for long-term postoperative complications and/or length of hospital stay. Nevertheless, limiting POMR measurement to 24 h leaves a large gap in the evaluation of postoperative surgical care management.

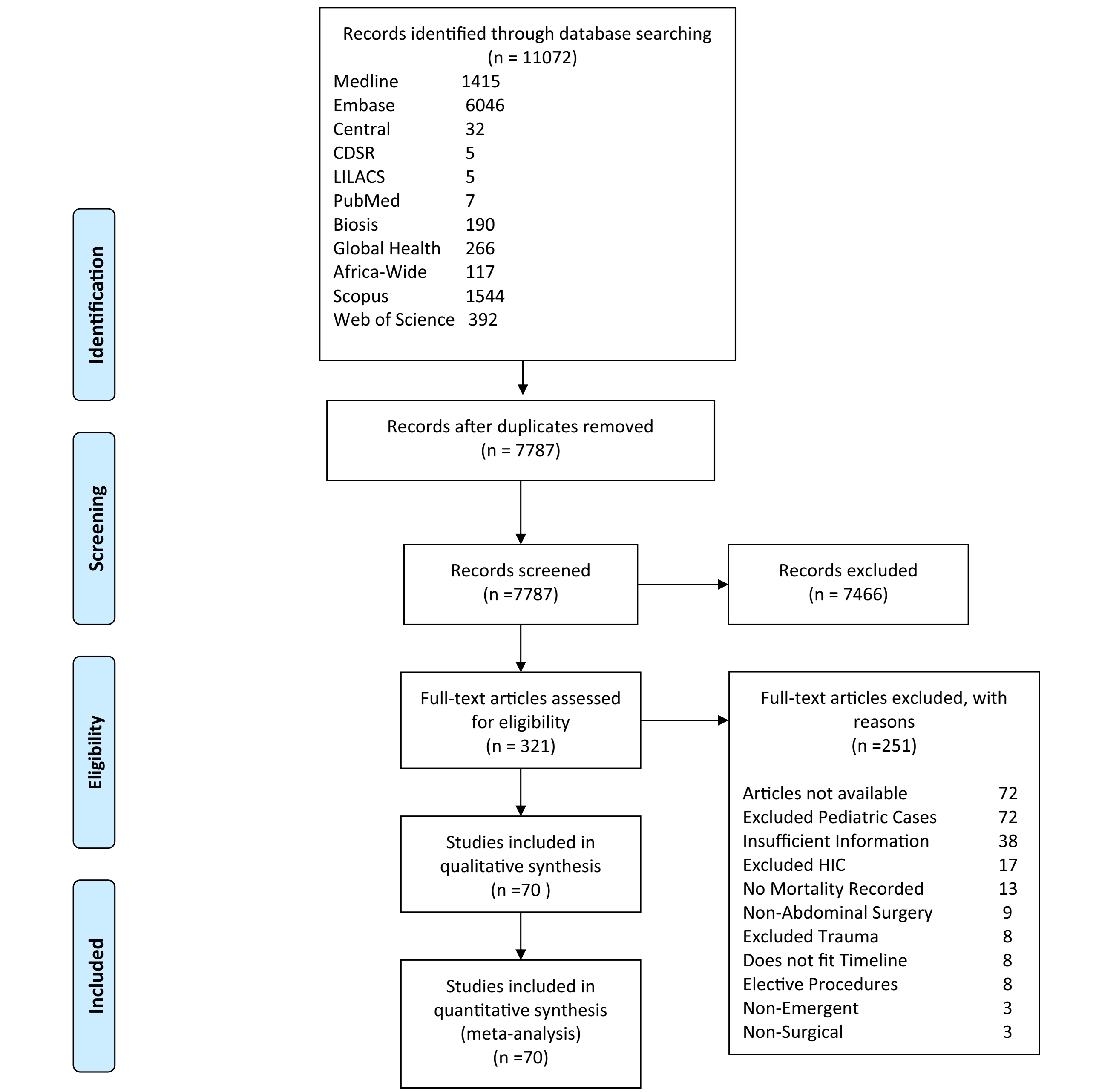


Fig. 1 PRISMA flowchart 2009 version

Table 1 Inclusion and exclusion criteria applied to primary and secondary screening

Inclusion	Exclusion
Studies describing the measurement of perioperative mortality rates in LMICs.	Studies measuring perioperative mortality rates in HICs.
Studies describing measurement of perioperative mortality rates in acute abdominal surgery.	Studies describing the measurement of perioperative mortality rates in trauma-related injuries, non-abdominal surgeries, and elective surgeries.
Studies describing necessary parameters surrounding perioperative mortality measurements in LMICs.	Studies describing perioperative mortality rates within the pediatric population.

Fig. 2 Risk of bias assessment using the methodological index for non-randomized studies

	1. Stated aim	2. Consecutive patients	3. Prospective data	4. Appropriate endpoints	5. Unbiased evaluation	6. Appropriate follow-up	7. Loss of follow up <15%	8. Appropriate control	9. Contemporary groups	10. Baseline equivalence	11. Sample size calculation	12. Appropriate statistics
1. Etonyeaku et al (2013)	2	2	0	0	2	2	.	.	.	.	.	.
2. Patil et al (2015)	2	2	0	0	2	0	.	.	.	.	.	.
3. Saaiq et al (2012)	2	2	1	0	1	0	.	.	.	.	.	.
4. Hagos (2015)	2	2	0	0	0	0	.	.	.	.	.	.
5. Kong et al (2012)	2	2	2	0	0	0	.	.	.	.	.	.
6. Pokharel et al (2011)	2	2	0	0	0	0	.	.	.	.	.	.
7. Adesunkanmi et al (2003)	2	2	2	2	0	0	.	.	.	.	.	.
8. Ohene-Yeboah et al (2006)	2	2	2	0	2	0	.	.	.	.	.	.
9. Nguyen Duc et al (2006)	1	2	0	0	0	0	.	.	.	.	.	.
10. Ugochukwu et al (2013)	2	2	0	0	0	2	.	.	.	.	.	.
11.Traore et al (2014)	2	2	0	2	1	0	.	.	.	.	.	.
12. Sule and Ajibade (2011)	1	2	2	0	0	2	.	.	.	.	.	.
13. Ohene-Yeboah and Togbe (2006)	2	2	2	0	0	0	.	.	.	.	.	.
14. Ngowe Ngowe et ak (2008)	2	2	0	0	0	0	.	.	.	.	.	.
15.Menakuru et al (2004)	2	2	0	0	0	0	.	.	.	.	.	.
16. Chandra and Kumar (2009)	2	1	0	0	0	0	.	.	.	.	.	.
17. Gerges and El-Atrebi (2015)	2	2	0	0	0	2	.	.	.	.	.	.
18. Fodé Baba et al (2016)	1	2	0	0	0	1	.	.	.	.	.	.
19. Adhikari et al (2010)	2	2	0	0	0	0	.	.	.	.	.	.
20. Gangappa Babu et al (2016)	2	2	2	0	0	2	.	.	.	.	.	.
21. Sule et al (2009)	2	2	2	0	0	1	.	.	.	.	.	.
22. Lebeau et al (2006)	2	2	0	0	0	2	.	.	.	.	.	.
23. Memon et al (2011)	2	2	2	0	0	0	.	.	.	.	.	.
24. Bekele and Biluts (2012)	2	2	0	0	2	0	.	.	.	.	.	.
25. Sinha and Sharma (2002)	1	2	0	0	0	1	.	.	.	.	.	.
26. Rathi et al (2011)	2	1	2	0	0	0	.	.	.	.	.	.
27. Mathew et al (2014)	2	2	0	0	0	0	.	.	.	.	.	.
28. Lebeau et al (2011)	2	2	0	0	0	1	.	.	.	.	.	.
29. Saniu et al (2011)	2	1	0	0	0	2	.	.	.	.	.	.
30. Thiam et al (2016)	2	2	0	0	0	0	.	.	.	.	.	.
31. Banna M et al (2000)	1	2	0	0	0	0	.	.	.	.	.	.
32. Sileikis et al (2013)	2	1	2	0	0	0	.	.	.	.	.	.
33. Kassi et al (2011)	2	2	0	0	0	1	.	.	.	.	.	.
34. Rahman et al (2007)	2	2	0	0	2	0	.	.	.	.	.	.
35.Traoré et al (2011)	2	2	0	0	0	1	.	.	.	.	.	.
36. Naseer et al (2010)	2	1	0	0	0	0	.	.	.	.	.	.
37. Büyükasik et al (2015)	1	2	0	0	0	0	.	.	.	.	.	.
38.Ooko et al (2015)	2	2	0	0	0	2	.	.	.	.	.	.
39. Ohene-Yeboah and Togbe (2006)	2	2	2	0	0	2	.	.	.	.	.	.
40. Watters et al (2015)	2	.	.	.	.	.	.	.	.	.	.	.
41.Rakotomavo et al (2012)	2	1	0	0	0	1	.	.	.	.	.	.
42.Gona et al (2016)	2	2	0	2	0	2	.	.	.	.	.	.
43. Rind et al (2010)	2	2	0	0	0	1	.	.	.	.	.	.
44. Ashraf et al (2012)	2	1	0	0	0	2	.	.	.	.	.	.
45. Nsar et al (2015)	2	2	2	0	0	1	.	.	.	.	.	.
46.Hama et al (2017)	2	2	2	0	0	0	.	.	.	.	.	.
47. Abdoulaye Ba and Soumah (2015)	2	2	0	0	0	1	.	.	.	.	.	.
48. Gaye et al (2016)	2	2	0	2	0	0	.	.	.	.	.	.
49. Lebeau et al (2016)	2	2	0	0	0	2	.	.	.	.	.	.
50. Chaudhary et al (2002)	2	2	0	0	0	2	.	.	.	.	.	.
51 Touré et al (2003)	2	2	0	0	0	0	.	.	.	.	.	.
52. Afridi et al (2016)	2	2	2	0	0	0	.	.	.	.	.	.
53.Jhobta et al (2006)	2	1	2	0	0	0	.	.	.	.	.	.
54. Ohene- Yeboah (2003)	2	2	2	0	0	0	.	.	.	.	.	.
55. Singh and Nayak (2016)	1	2	0	2	0	0	.	.	.	.	.	.
56. Rickard (2015)	2	.	.	.	.	.	.	.	.	.	.	.
57. Haq et al (2012)	2	2	1	0	0	2	.	.	.	.	.	.
58. Chaudhary et al (1997	2	2	0	0	0	1	.	.	.	.	.	.
59. Moses et al (2014)	2	2	2	0	0	1	.	.	.	.	.	.
60.Gupta et al (2005)	2	2	0	0	0	1	.	.	.	.	.	.
61. Lebeau et al (2011)	2	2	0	0	0	1	.	.	.	.	.	.
62. Wade et al (2016)	2	2	0	0	0	0	.	.	.	.	.	.
63. Wani et al (2005)	2	2	2	0	0	2	.	.	.	.	.	.
64. Gupta et al (2003)	2	2	0	0	0	2	.	.	.	.	.	.
65. Jain et al (2010)	2	1	0	0	0	0	.	.	.	.	.	.
66. Malik et al (2007)	2	2	2	0	2	1	.	.	.	.	.	.
67. Abid et al (2014)	2	2	0	0	0	2	.	.	.	.	.	.
68. Arveen et al (2009)	2	2	2	0	0	1	.	.	.	.	.	.
69. Raveenthiran et al (2004)	1	2	0	0	0	0	.	.	.	.	.	.
70. Aouini et al (2012)	2	2	0	0	0	2	.	.	.	.	.	.

Table 2 Types of studies included

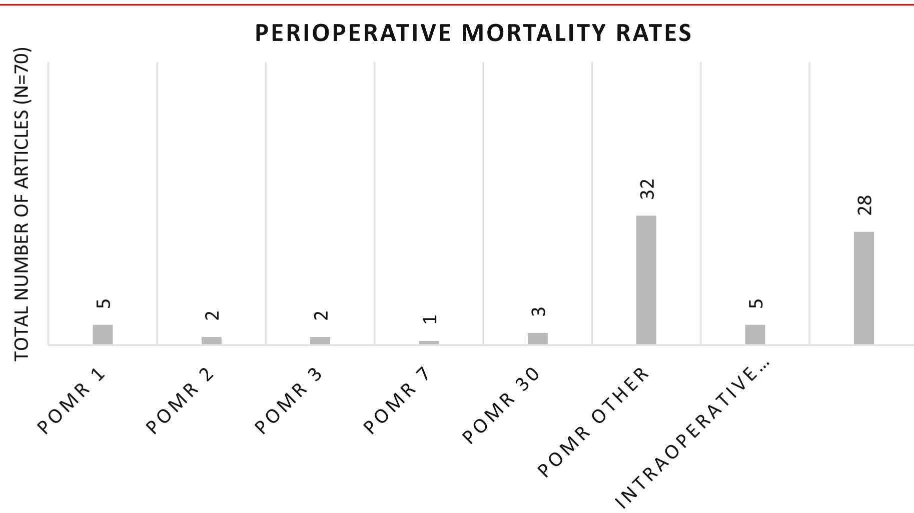
Retrospective review	38/70 (54%)
Prospective	17/70 (24%)
Descriptive case series	4/70 (6%)
Cross-sectional analysis	3/70 (4%)
Observational	3/70 (4%)
Case series	1/70 (1%)
Literature review	1/70 (1%)
Cohort study	1/70 (1%)
Randomized control trial	1/70 (1%)
Systematic review	1/70 (1%)

POMR reporting within 7, 14, or 30 days following surgery reduces the gap and allows for a larger evaluation of the surgical timeline. Using these time points would often require follow-up after discharge, which may not always be feasible within an LMIC. Reporting mortality occurring any time prior to discharge introduces variability and thus complicates POMR comparisons between hospitals or countries. Timing of discharge is highly variable among facility levels and surgical procedures and highly influenced by postoperative complications and comorbidities. With reliable patient information databases, 30-day POMR can be easily calculated in HICs. LMICs do not have the luxury of data information systems or reliable follow-up periods; therefore, POMR within 24–48 h would be realistic for a low-resourced setting. Another option would be POMR prior to discharge as a safe surgery measure due in part to the lack of organized national death registries, hospital databases, and difficulty of postoperative follow-up in resource-limited settings. As such, specific timelines for the feasibility of POMR measurement should be further investigated and would recommend doing so with the following timeline: intraoperative, 24 h, 7 days, 14 days, and 30 days. These data can be collected using the operating room registry developed by The Center for Global Surgery at the McGill University Health Centre.

As mentioned above, a large proportion of articles describing POMR used a retrospective analysis of data collection including patient charts, operative logbooks, and in a few cases clinical registries and databases. The emphasis on retrospective analysis is likely due to the feasibility of this method within a resource-limited setting. Although successful in certain circumstances, registries and databases require additional personnel, computer systems, and reliable internet access. While prospective data collection and analysis is the favorable method, a study by Anderson et al. supported the use of OR logbooks (12). This study collected prospective data on POMRs at a rural hospital in Uganda and compared their findings to patient charts and logbook recordings. It was found that logbooks captured the most adequate information on POMRs. The use of patient charts was challenging given significant missing data in charts. In addition, this method was found to be time consuming. While the ideal method would be to prospectively collect POMR through hospital-based registries, we found this method of collection to be poorly represented in our study. For registries to be an effective data collection tool, they should include standardized pertinent variables that are easy to complete by most members of the multidisciplinary surgical team. The implementation of such registries is key to the eventual use of POMR as a health metric.

Timing of POMR collection is not the only concern when addressing standardization. In order for POMRs to be comparable globally, there needs to be risk adjustment for illness severity, which, in our study, was only reported in 20% of articles. In a study by Ariyaratnam et al., comparing POMR collection from HICs with LICs discovered the ASA to be the most effective manner of risk adjustment (13). Although ASA can be calculated using patient history

Fig. 3 Perioperative and intraoperative mortality rates. POMR1 = 24 h, POMR2 = 48 h, POMR3 = 72 h, POMR7 = 1 week, POMR30 = 30 days



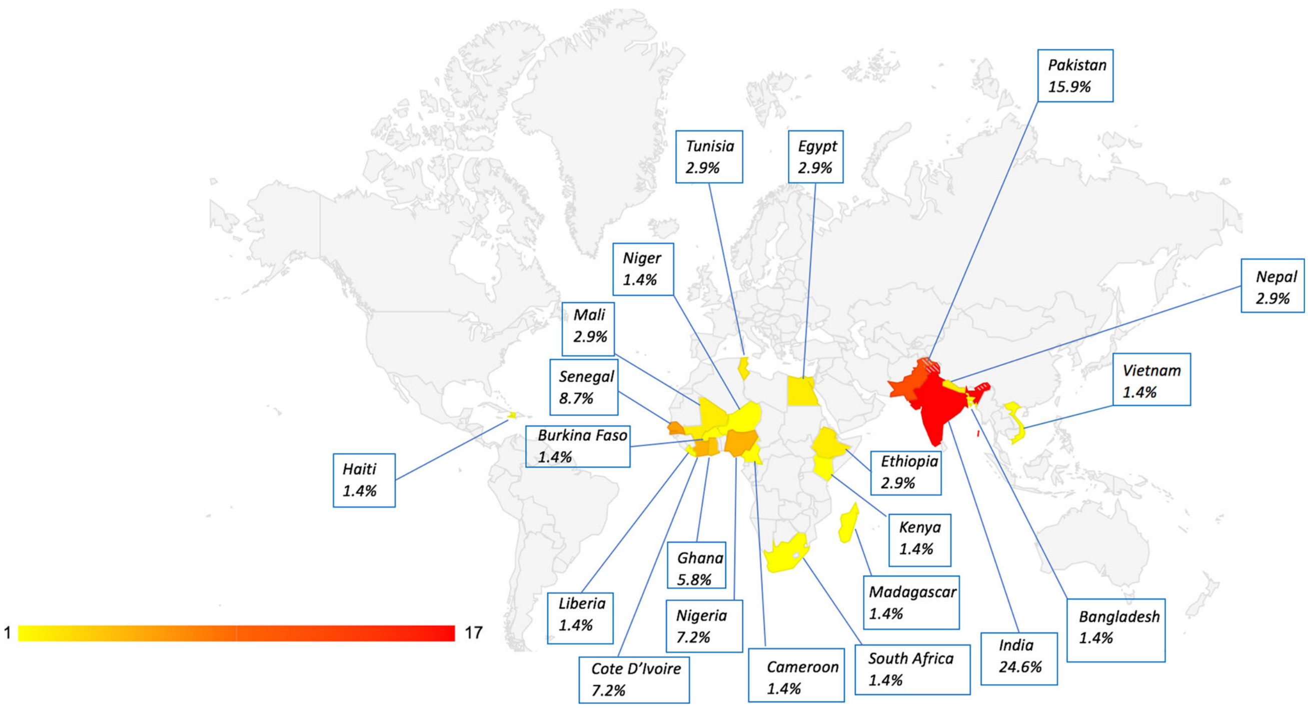


Fig. 4 Publication distribution by country. Red (higher distribution), yellow (lower distribution)

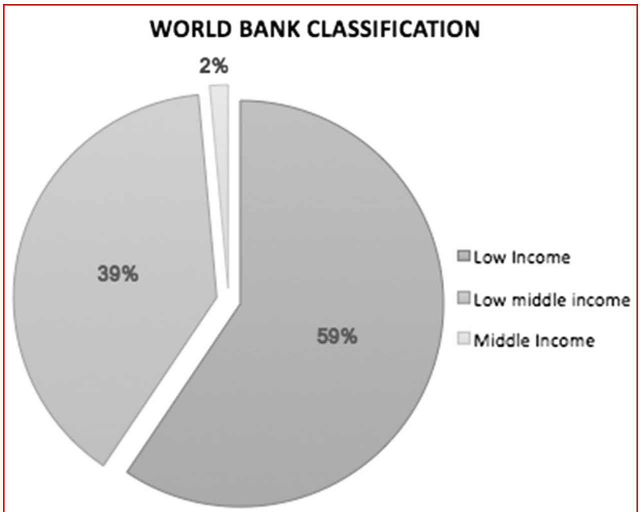


Fig. 5 Classification of countries based on gross domestic product

and vital signs, which were discussed in 25% of articles, there was little mention of the ASA score. In addition to this, not all centers use ASA as a means to calculate disease severity and may use another method such as the APACHE score. In a recent meta-analysis, examining POMR reporting within LMICs found that only 7.5% of articles reported the ASA status (14). While other health metrics such as maternal mortality rate and under five mortality

Table 3 Facility-level distribution

Hospital level	
Teaching hospital	38/70 (54%)
District/secondary hospital	3/70 (4%)
Regional	1/70 (1%)
National	6/70 (9%)
Not mentioned/not applicable	11/70 (16%)
Tertiary	9/70 (13%)
Multiple facility levels	2/70 (3%)

Table 4 Recommendations for POMR collection

The use of standardized registries including age/gender, standardized markers of illness severity (ASA, APACHE), severity upon presentation and intraoperative, time to surgery, diagnosis, and time of POMR collection.
POMR collection intraoperatively or within 24 h of a surgical procedure
When feasible POMR collection including seven-, 14-, and 30-day periods.
Implementation of standardized surgical registries made available to respected unifying body such as the WHO and the World Development Indicators Bank to facilitate the validation period of POMR.

Operating Room Registry

Data Collection Form

Transferred from another hosp

○ *Yes* ○ *No* *If yes, which one:* ____________________

Patient Demographics

Patient Name

Patient Phone Number

Identification Number, if any

Origin of patient (suburb, locality, district, area)

Region

District

Age

Sex

○ ***Male***

○ ***Female***

Patient arrived from

○ *Home/Prehospital*

○ *Emergency Room*

○ *Ward*

○ *ICU*

○ *Recovery Room*

Date & time of arrival

/ / , :

In the Operating Room

Initial vitals in the OR

○ *Blood Pressure:*

○ *Heart Rate:*

○ *Respiratory Rate:*

○ *Temperature:*

○ *O_2 Saturation:*

Type of Case

○ *Elective*

○ *Emergency* *(non-injury related)*

○ *Injury*

ASA

○ *1*

○ *2*

○ *3*

○ *4*

○ *5*

○ *6*

Operation

Post-operative diagnosis

Procedure(s) performed (Please indicate all procedures performed)

-

-

Body Site

○ *Brain*

○ *Eye*

○ *Neck*

○ *Spine*

○ *Chest*

○ *Vascular Trunk*

○ *Pelvis*

○ *Abdomen/Groin*

○ *Urologic*

○ *Obstetric/Gynecologic*

○ *Extremities – Orthopedic*

○ *Extremities – Soft Tissue*

○ *Extremities – Vascular*

○ *Other*

Anesthesia

○ *Local*

○ *Regional*

○ *Epidural*

○ *Spinal*

○ *General*

Emergency indicator (when applicable)

○ *Infection*

○ *Obstruction*

○ *Perforation*

○ *Ischemia*

○ *Hemorrhage*

Is this procedure a re-intervention during the same visit?

○ *Yes*

○ *No*

Supplemental

○ *Prophylactic Abx*

○ *Blood products*

○ *Thromboembolic prophylaxis*

Disposition

○ *Home*

○ *Ward*

○ *ICU*

○ *Transferred to another facility*

Mortality

○ *Intraoperative death*

○ *Death within 24 Hours*

○ *Death within 7 days*

○ *Death within 14 days*

○ *Death within 30 days*

◀**Fig. 6** Example of recommended variables to be collected for operating room registries and POMR

rate do not risk adjust, these metrics are targeted to a population that is more heterogeneous than the acute care surgery population. These findings, in addition to our own, emphasize the need for increased disease severity reporting in order for it to function in the adjustment of POMR.

Our study had several limitations. The data collected and discussed in this article are limited to that found in the published literature. Furthermore, much of these data are based on retrospective collection methods. Our study is also limited by the lack of robust publication quality as demonstrated through the MINORs criteria (Fig. 2). It is also important to mention that although POMR is the only recommended health metric specific to surgery, it only evaluates death occurring during the operative and post-operative course. While this does have the potential to make an impact on addressing postoperative outcomes, many areas along the surgical timeline remain unaddressed such as the preoperative period. With that being said POMR specifically evaluates surgical disease that has resulted in a surgical procedure and is tremendously valuable for assessment of quality assurance and improvement during this process.

Our findings demonstrate that a diverse range of LMICs are currently collecting POMR data, however, significant inconsistencies in the methodology of reporting are frequent. The potential of POMR to function as a global indicator for safe surgical care cannot be over stated. Adequate POMR reporting can be used to monitor and improve surgical outcomes as well as support resource allocation. However, significant progress must be made in the variables collected in conjunction with POMR. While timing of POMR collection is crucial for comparative analysis additional variable collection, including patient demographics, is important to better understand POMR rates for specific patient populations. The existing literature is limited in the standardized use of this potential health metric. POMR has been identified as an important health metric for quality of surgical care; there remains a significant variability in data collection for such purpose. We propose an approach to improve the utility of POMR as a health metric and suggest a validation process through standardized registries. We also recommend the following:

(1) The use of registries including age/gender, standardized markers of illness severity upon presentation and in the operating room, time to surgery, diagnosis, and time of POMR collection.

(2) Recording POMR for each patient in the following periods: death occurring intraoperatively or within 24 h of a surgical procedure. Longer postoperative periods including seven, 14, and 30 days may help clarify additional factors influencing postoperative outcomes (Table 4). However, this may be labor-intensive and not feasible within an LMIC setting.

(3) Implementing standardized surgical registries made available by a reputable, respected unifying body such as the WHO and the World Development Indicators Bank to facilitate the validation period of POMR in a consistent and standardized fashion [9].

In Fig. 6, we suggest a potential operating room registry developed at the Centre for Global Surgery at the McGill University Health Centre that could be used to better collect operating room data on patients. Its use in non-proprietary and collaborative work is encouraged. It is important to note that this registry includes possible data from other surgical specialties. This was done to minimize the number of registries in the operating room and facilitate relative data collection. In addition, the registry includes several time points for POMR collection. This is not meant to be a laborious process but to assess the most feasible time point to collect POMR in clinically strained environments.

The suggested approach above will then set the stage for the implementation of POMR as a reliable health metric which may be used in hospital, regional, national, and global quality assurance and improvement programs. In order for this sizable request to be fulfilled, implementations must be made at the hospital level. Involvement of the Ministry of Health to make surgical data collection a national priority will aid in spearheading the standardization and use of POMR as a surgical health metric. Reported differences in POMR between institutions will hopefully provoke quality assurance cascades to identify reasons for this variability and aid in addressing the shortcomings of a health care system.

Compliance with ethical standards

Conflict of interest All authors disclose no conflicts of interest.

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