Initial Findings of Perioperative mortality in low-, middle-, and high-income countries: A multilevel meta-regression analysis

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Background/Rationale: There is currently limited information regarding how many people die during the perioperative period globally. Previous work has found estimates ranging in the low percentages but given the volume of surgery provided annually, the difference in estimates translates to differences in potentially hundreds of thousands or even millions of deaths ever year in absolute numbers. The primary objective of this analysis is to examine time trends in global perioperative mortality from bellwether procedures through a systematic review and multilevel meta-regression analysis. Secondary objectives were to assess cause specific mortalities as a proportion of overall POMR and their trends.

Methods: Five databases were searched for studies investigating adults undergoing a bellwether procedure and reporting the number of deaths among participants published between 2014-2021. Articles underwent title/abstract screening by a single author, full-text screening by two independent authors, and data extraction by a single author.

A traditional meta-analysis examined the estimated incidence of POMR and was compared to a 3-level model that accounted for clustering at the country level. To assess time trends in POMR two meta-regression models were constructed, a traditional one and a 3-level model. These models both used a logistic regression model to estimate the effect of the median year of data collection on the odds of POMR adjusted for potential confounding variables including average age of participants, proportion of elective surgery, proportion of laparoscopic surgery, proportion of the sample identified as female, average ASA value of the sample, the HDI value of the country at the median year of data collection and the length of time that the sample was followed for.

Results: We identified 32,728 publications after initial deduplication of which 488 publications comprising 9,288,604 participants were eventually included in the initial POMR analysis. This sample included 71 countries representing all WHO regions. Globally we estimated POMR to be

between 0.54% and 1.16% (Table 1) depending on whether the effect of clustering at the country level was accounted for. When examining time trends in POMR, neither the unadjusted (not shown) nor the adjusted models estimated that there were significant increases or decreases in the odds of POMR (Table 2).

Discussion: We estimated that globally POMR among bellwether procedures is between 0.54% and 1.16% depending on whether a traditional meta-analysis is used versus a 3-level model. The analyses investigating time trends failed to show that POMR was decreasing, irrespective of the method or adjustment. A particular strength of this study is the use of a 3-level model. We believe this method leads to a more accurate estimation of the pooled estimate of POMR, and corresponding coefficient estimates in the logistic regressions, as it captures the higher order clustering that can occur due to country level factors. Additionally, we provide POMR estimates for all three bellwether procedures, both combined and stratified. While this is a considerable strength of the meta-analysis, we are unable to generalize beyond bellwether procedures as there are not yet high-quality studies assessing how well these procedures proxy all surgical procedures in the context of POMR.

Table 1: Estimated POMR (%)

Bellwether Sample	Traditional meta-analysis	95%CI	3-level meta-analysis	95%CI
All bellwethers (n=488)	0.54%	0.44-0.67%	1.16%	0.91-1.48%
Cesarian Section (n=50)	0.09%	0.03-0.23%	0.32%	0.16-0.66%
Laparotomy (n=425)	0.63%	0.51-0.79%	1.33%	1.01-1.75%
Treatment of Open Fracture (n=13)	1.48%	0.62-3.46%	1.53%	0.65-3.56%

Table 2: Adjusted Odds Ratio of POMR over time (per year, centered in 2010)

Bellwether Sample	Traditional meta-regression	95%CI	3-level meta-regression	95%CI
All bellwethers (n=60)	1.004[1]	0.924-1.092	1.024[4]	0.925-1.133
Cesarian Section (n=19)	0.925[2]	0.799-1.072	0.0938[5]	0.008-1.163
Laparotomy (n=58)	0.999[1]	0.917-1.086	1.081[4]	0.996-1.174

Treatment of Open Fracture (n=10)	0.959[3]	0.709-1.297	1.246[6]	0.948-1.638

[1] Adjusted for proportion of elective surgery, proportion of laparoscopic surgery, proportion of sample identified as female, average age of sample, average ASA of sample, HDI value, and follow-up time

[2] Adjusted for average age of sample, proportion of elective surgery, HDI value, and follow-up time

[3] Adjusted for average age of sample, HDI value, and follow-up time

[4] Adjusted for proportion of elective surgery, proportion of laparoscopic surgery, proportion of sample identified as female, average age of sample, average ASA of sample, HDI value, follow-up time and country

[5] Adjusted for average age of sample, proportion of elective surgery, HDI value, and follow-up time and country

[6] Adjusted for average age of sample, HDI value, follow-up time, and country