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# Collecting data for global surgical indicators: a collaborative approach in the Pacific Region

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## ABSTRACT

In 2015, the Lancet Commission on Global Surgery (LCoGS) recommended six surgical metrics to enable countries to measure their surgical and anaesthesia care delivery. These indicators have subsequently been accepted by the World Bank for inclusion in the World Development Indicators. With support from the Royal Australasian College of Surgeons and the Pacific Islands Surgical Association, 14 South Pacific countries collaborated to collect the first four of six LCoGS indicators. Thirteen countries collected all four indicators over a 6-month period from October 2015 to April 2016. Australia and New Zealand exceeded the recommended LCoGS target for all four indicators. Only 5 of 13 countries (38%) achieved 2-hour access for at least 80% of their population, with a range of 20% (Papua New Guinea and Solomon Islands) to over 65% (Fiji and Samoa). Five of 13 (38%) countries met the target surgical volume of 5000 procedures per 100 000 population, with six performing less than 1600. Four of 14 (29%) countries had at least 20 surgical, anaesthesia and obstetric providers in their workforce per 100 000 population, with a range of 0.9 (Timor Leste) to 18.5 (Tuvalu). Perioperative mortality rate was reported by 13 of 14 countries, and ranged from 0.11% to 1.0%. We believe it is feasible to collect global surgery indicators across the South Pacific, a diverse geographical region encompassing high-income and low-income countries. Such metrics will allow direct comparison between similar nations, but more importantly provide baseline data that providers and politicians can use in advocacy national health planning.

## Key questions

### What is already known about this topic?

- In May 2015, the Lancet Commission on Global Surgery recommended six surgical metrics that would enable countries and their ministries of health to measure surgical care delivery and monitor progress.

### What are the new findings?

- This is the first time these metrics have been collected from the Asia-Pacific region.
- We also document the collaborative approach undertaken in this region and the lessons learnt regarding the methodology and sustainability of data collection, definition of the indicators, the strengths and weaknesses of these metrics, and how they may be used to achieve change.

### Recommendations for policy

- This collaborative effort has shown that it is possible to collect global surgery indicators across a geographical region.
- Such metrics allow direct comparison between similar nations, and provide baseline data from which providers and politicians can advocate for measurable solutions to improve the safe, timely and affordable access to surgical and anaesthesia care.

## INTRODUCTION

Five billion of the world's seven billion population lack access to safe, affordable and timely surgical and anaesthesia care.[1] This leads to preventable mortality, unnecessary disability and uncorrected deformity that negatively impact health and economic activity.[2–5]

The World Health Assembly (WHA) resolution A 68/15 passed in May 2015 addressed the need to 'Strengthen Emergency and Essential Surgical Care and Anaesthesia as a part of Universal Health Coverage'.[6] In order to achieve this in low-income and middle-income countries (LMICs) and improve their ability to deliver emergency and essential surgical care, it is necessary to measure access in terms of capability, capacity, timeliness, safety and affordability.[7 8]

The Lancet Commission on Global Surgery (LCoGS) recommended six surgical metrics that would enable countries and their ministries of health to measure surgical care

delivery and monitor progress.[1] These metrics have been included in WHO's 100 Health Indicators,[9] and four have already been adopted by the World Bank.[10]

In 2015, the Bangkok Declaration encouraged signatories to propagate the Commission's key messages, promote research on access to safe, affordable and timely surgery, and report on the WHO's and the Commission's recommended surgical indicators.[11] Subsequently, Asia-Pacific representatives at the 4th Royal Australasian College of Surgeons (RACS) Global Health Symposium, held in association with the LCoGS in Melbourne in October 2015, resolved to obtain data on the first four of six global surgery metrics for countries in their region.

This paper reports on LCoGS indicators collected in the Asia-Pacific region. It also presents the practical challenges in obtaining the data in low-income countries with limited health information technology.

English-speaking countries in the South Pacific were invited to collaborate in the collection of the first four of six LCoGS indicators. To do so, the RACS established a working group through its collegial network with a clinical representative from each country. An information document, containing background information and indicator definitions, and a spreadsheet were distributed via email. The working group was supported by a precollection feasibility survey, an online chat group and regular teleconferences over a 6-month period from October 2015 to April 2016. The representative was asked to seek permission with the appropriate authority in their own country and their data were only included once this permission was granted.

The definition for each indicator was taken from the Global Surgery 2030 report and summarised in table 1. The practical methodology of collecting the LCoGS indicators for each country is presented in table 2. The methodology was guided by the working group to determine a consensus view where previously unanticipated questions arose or seeking further clarification and advice from LCoGS Commissioners or authors (JM, DW).[1]

Fourteen countries provided data in this collaborative process and a summary of the results is presented in table 3.

Financial risk protection indicators were not collected, although there were already modelled estimates for many countries in our region, which are included in table 4. These will likely require adjustment or corroboration by further research.

**Table 1** Description of Lancet Commission global surgical indicators

| Global surgical indicator | Description |
|---|---|
| Indicator 1: access to timely essential surgery | Percentage of the population who can access, within 2 hours, a facility capable of performing the bellwether procedures (caesarean section, laparotomy and open fracture management) |
| Indicator 2: surgical, anaesthesia and obstetric density | Number of physician proceduralist in surgery, anaesthetics or obstetrics per 100 000 population |
| Indicator 3: surgical volume | Total number of surgical cases per 100 000 population |
| Indicator 4: perioperative mortality rate | Deaths occurring after any surgical procedure and before discharge from hospital (%) |
| Indicator 5: risk of catastrophic expenditure due to need for surgical care | Direct out-of-pocket costs from surgical care exceeding 10% of total income or 40% of remaining income after food and housing are accounted for |
| Indicator 6: risk of impoverishment due to need for surgical care | Direct out-of-pocket costs from need for surgical care resulting in falling below poverty line of US$1.25/day. |

## INDICATOR 1: ACCESS TO TIMELY EMERGENCY AND ESSENTIAL SURGICAL CARE

This indicator is defined as the 'proportion of the population that can access, within two hours, a facility that can do caesarean delivery, laparotomy, and treatment of open fracture (the Bellwether Procedures)'.[1] The bellwether procedures serve as a proxy for systems, resources and skill sets needed to perform a broad range of essential surgical operations, and correlate with capability of performing other emergency and essential procedures on WHO's Integrated Management for Emergency and Essential Surgical Care list.[7] Two hours was originally chosen by LCoGS as an estimation of the time from onset of bleeding to death for postpartum haemorrhage.[1]

We considered a hospital to be bellwether-capable if its usual resource allocation allowed it to perform the bellwether procedures the majority of the time. Estimation of the proportion of the population covered was performed by identifying all bellwether-capable facilities and plotting a map to define the 2-hour access zone (table 2). For each hospital, 2-hour access times were dependent on transportation methods and terrain. Population density maps were obtained from government census or surveys to calculate the size and proportion of the total population with access to the bellwethers.

Five of 13 countries (38%) reached the LCoGS target of 80% (table 3).

Access to timely essential surgery (indicator 1) is in principle an easily understandable metric but one of the more difficult to measure. We found the most reliable data were obtained using local knowledge of the hospitals, the terrain and local transport rather than internet-based maps or satellite population density data. In most instances, regional bellwether hospitals had a small number of roads on which patients could travel and the 2-hour zone on these roads could be marked. Although

**Table 2** Indicator Collection Methodology

| Country | Population | Bellwether hospitals (n) | Indicator 1 methodology | | Indicator 2 methodology | Indicator 3 methodology | Indicator 4 methodology |
|---|---|---|---|---|---|---|---|
| | | | 2-Hour access zone | Population distribution | SAO density/100 000 | Surgical volume Cases/100 000 | POMR |
| Australia | 23 946 000 | 112 | 200 km radius around bellwether hospitals | Government population statistics | Specialist Medical Workforce Database Medical Board of Australia Australian Institute of Health and Welfare website | Data obtained from already established centralised government database maintained by the Australian Institute of Health and Welfare | Data obtained from Australian Institute of Health and Welfare |
| Timor Leste | 1 300 000 | 3 | Manual contour line created | Government population statistics | Direct contact with clinical directors of hospitals by members of working group | Data obtained from theatre logbook and/or anaesthetic registry of each bellwether hospital; collected by telephone or email enquiry to each hospital (no pre-existing centralised database available) | Prospective data collection in single hospital (2015), representing >85% of surgery performed in the country |
| Fiji | 933 000 | 5 | Manual contour line determined by Fiji Bureau of Statistics | Government population statistics | Medical Workforce Database (Database of the Fiji Medical Council) | Data obtained from theatre logbook registry for each bellwether hospital (5 in total); collected by phone or email enquiry to each hospital (no pre-existing centralised database available) | Retrospective review of patient records in each bellwether hospital to determine POMR within 7 days<br>No pre-existing system to report national POMR |
| Tonga | 103 000 | 1 | Island mapping | Government population statistics | Direct contact and personal knowledge of members of collaborative working group | Pre-existing centralised database maintained by Ministry of Health<br>Established reporting system with data collected from single hospital theatre registry | Data available from Ministry of Health<br>Established reporting system with data collected from single hospital theatre registry and hospital mortality audit/registry |
| Samoa | 187 000 | 1 | Island mapping | Government population statistics | Direct contact and personal knowledge of members of collaborative working group | Data obtained from theatre logbook and/or anaesthetic registry of single bellwether hospital (no pre-existing centralised database available) | Mortality data obtained from hospital death certificates<br>No pre-existing process for collecting POMR |
| Vanuatu | 260 815 | 2 | Manual contour line for each of 3 bellwether hospitals and island methodology | Government population statistics | Direct contact and personal knowledge of members of collaborative working group | Theatre and anaesthetic registers in each of the bellwether hospitals (3-year period 2012–2015 used to calculate annual case volume) (no pre-existing centralised database available)<br>Central health information system exists but considered unreliable for these purposes due to inaccurate and incomplete data | Individual case volumes and postsurgery deaths collected for each bellwether hospital using theatre and anaesthetic registry of procedures checked against hospital records of inpatient deaths and correlated with death certificates<br>National death registry available but of limited use because no record of surgical procedure on this registry |
| Cook Islands | 13 229 | 1 | Island mapping | Government population statistics | Direct contact and personal knowledge of members of collaborative working group | Data obtained from theatre logbook and/or anaesthetic registry of single bellwether hospital (no pre-existing centralised database available) | Single hospital data obtained from theatre registry and hospital mortality registry |

Continued

**Table 2** Continued

| Country | Population | Bellwether hospitals (n) | Indicator 1 methodology | | Indicator 2 methodology | Indicator 3 methodology | Indicator 4 methodology |
|---|---|---|---|---|---|---|---|
| | | | 2-Hour access zone | Population distribution | SAO density/100 000 | Surgical volume Cases/100 000 | POMR |
| Solomon Islands | 602 000 | 2 | Island mapping | Government population statistics | Direct contact and personal knowledge of members of collaborative working group | Data obtained from theatre logbook and/or anaesthetic registry from each bellwether hospital (no pre-existing centralised database available) | Mortality data obtained from both bellwether hospitals by direct contact<br>No pre-existing reporting system for POMR |
| Nauru | 10 084 | 1 | Island mapping<br>Single island with entire population within 30 min of hospital | Government population statistics | Direct contact and personal knowledge of members of collaborative working group | Data obtained from theatre logbook and/or anaesthetic registry of single bellwether hospital (no pre-existing centralised database available) | Single hospital data obtained from theatre registry and hospital death certificates |
| PNG | 8 000 000 | 30 | Non-mapping technique<br>Local clinicians used locations of bellwether hospitals and adjacent regions within 2 hours combined with regional population data from Bureau of Statistics to calculate population within the 2-hour zone. | Government population statistics | Member of working group had direct contact with regional directors and annual provincial surgical reports submitted to Ministry of Health.<br>No centralised database available | Data obtained from theatre logbook and/or anaesthetic registry from each provincial bellwether hospital<br>The capital Port Moresby General Hospital data obtained directly from theatre registry and data from 29 referral hospitals obtained through recently presented PNG annual symposium<br>Annual surgical reports, surgical audits, and direct email and telephone contact (no pre-existing centralised database available) | Never previously collected<br>Mortality data from hospital death certificates at major referral hospital (Port Moresby) and audits from regional hospitals collected and presented for a recent surgical symposium |
| New Zealand | 4 452 300 | 20 | Manual contour line | Government population statistics | Medical Workforce Registration Database available from New Zealand Medical Council | Pre-existing centralised database maintained by government/Ministry of Health<br>The calculation uses number of admissions where a General anaesthesia is administered as the measure of surgical volume; hence, two errors are acknowledged but thought to be small (<2% of patients have more than one operation in a single admission and regional anaesthesia without any GA administration is relatively uncommon). Endoscopy is not included in these data. | National Perioperative Review Committee annual reports |
| Micronesia | 102 109 | | Island mapping | Government population statistics | Direct contact with Ministry of Health and clinical directors through working group | Not available<br>No pre-existing centralised database available | Not available<br>No pre-existing centralised database available |

Continued

**Table 2** Continued

| Country | Population | Bellwether hospitals (n) | Indicator 1 methodology | | Indicator 2 methodology | Indicator 3 methodology | Indicator 4 methodology |
|---|---|---|---|---|---|---|---|
| | | | 2-Hour access zone | Population distribution | SAO density/100 000 | Surgical volume Cases/100 000 | POMR |
| Kiribati | 110 000 | 3 | Island mapping | Government population statistics | Direct contact with Ministry of Health and clinical directors through working group | Data obtained from theatre logbook and/or anaesthetic registry of single bellwether hospital (no pre-existing centralised database available) | Mortality data obtained from the three bellwether hospitals by direct contact using hospital death registry and personal logbooks of surgeons<br>No pre-existing reporting system for POMR |
| Tuvalu | 10 800 | 1 | Island mapping | Government population statistics | Direct contact with Ministry of Health and clinical directors through working group | Data obtained from theatre logbook and/or anaesthetic registry of single bellwether hospital (no pre-existing centralised database available) | Single hospital data obtained from theatre registry and hospital mortality registry |

Definition of terms:

- 200 km radius zone: In Australia, where the road infrastructure in remote areas permits ambulance travel at 100 km/hour or more, a 200 km radius around each bellwether hospital was mapped, and cities or towns outside these areas were identified and populations estimated from population data available from the Australian government Bureau of Statistics.
- Manual contour line: contour line determined by local clinicians with knowledge of local geography and travel conditions.
- Island mapping: For archipelago nations comprising population distributed over multiple small islands, the 2-hour access zone included the island of the bellwether hospital (if access to the hospital within that island was less than 2 hours for all regions) and any island where the travel time was less than 60 min by locally available boat (or plane if readily available), which allowed for the complexity and time of transportation in these circumstances.
- Population distribution data: government population statistics: government Bureau of Statistics population from latest census data using smallest available regions/towns/islands.
- Where a region or island was not entirely within the contour line, a binary decision was applied to the population of the entire region based on a visual estimate of the percentage of land area contained within the 2-hour access contour line. If it appeared that 50% or greater of the land area of the region was within the contour line, then this region's population was included within the <2 hour access group; otherwise the population was considered outside the 2-hour access zone.
- SAO density: the number of SAOs working in a country was estimated using either a medical workforce database (necessary and available in Australia, New Zealand and Fiji) or direct contact with the Ministry of Health or clinical directors by members of the working group. In nations where the number of SAOs was less than 20, senior clinicians knew each SAO, and clinical directors in bellwether hospitals were able to confirm current levels of SAO workforce.
- Surgical volume: either pre-existing centralised database maintained by government/Ministry of Health or data obtained from theatre and/or anaesthetic registry of each bellwether hospital where no pre-existing centralised database was available.

PNG, Papua New Guinea; POMR, perioperative mortality rate; SAO, Surgical, Anaesthesia and Obstetrics specialists.

**Table 3** Results of global surgical indicators by country

| Country | Population | Indicator 1 (%) Access <2 hours | Indicator 2 SAO/100 000 SAO density | Indicator 3 Case/100 000 Surgical volume | Indicator 4 (%) POMR |
|---|---|---|---|---|---|
| Nauru | 10 084 | 100 | 30 | 7130 | 0.24 |
| Tuvalu | 10 837 | 56 | 18.5 | 3417 | 1.0 |
| Cook Islands | 13 229 | 88 | 22 | 6758 | 0.11 |
| Micronesia | 102 109 | Not available | 7 | Not available | Not available |
| Tonga | 103 000 | 85 | 14 | 5061 | 0.24 |
| Kiribati | 110 000 | 65 | 8.2 | 1718 | 0.11 |
| Samoa | 187 000 | 68 | 1.6 | 1552 | 0.82 |
| Vanuatu | 260 815 | 44 | 3.2 | 1277 | 0.28 |
| Solomon Islands | 602 000 | 20 | 2.5 | 868 | 0.46 |
| Fiji | 933 000 | 67 | 5.8 | 1490 | 0.83 |
| Timor Leste | 1 300 000 | 50 | 0.9 | 433 | 0.84 |
| Papua New Guinea | 7 500 000 | 20 | 2.3 | 1264 | 0.5 |
| New Zealand | 4 452 300 | 90 | 43 | 5308 | 0.43 |
| Australia | 23 946 300 | 98.85 | 63.9 | 10 156 | 0.19 |

POMR, perioperative mortality rate; SAO, surgical, anaesthesia and obstetrics.

**Table 4** World Bank estimated risk of catastrophic expenditure or of impoverishment due to need for surgical or anaesthesia care (http:www.data.worldbank.org/indicator)

| Country | Population | % Risk of catastrophic expenditure* (direct OOP costs) | % Risk of impoverishment <US$1.25 per day (direct OOP costs) |
|---|---|---|---|
| Nauru | 10 084 | Not available | Not available |
| Tuvalu | 10 837 | 0 | 17 |
| Cook Islands | 13 229 | Not available | Not available |
| Micronesia | 102 109 | 31 | 51 |
| Tonga | 103 000 | 8 | 16 |
| Kiribati | 110 000 | 0 | 34 |
| Samoa | 187 000 | 5 | 18 |
| Vanuatu | 260 815 | 14 | 37 |
| Solomon Islands | 602 000 | 5 | 57 |
| Fiji | 933 000 | 21 | 24 |
| Timor Leste | 1 300 000 | 16 | 72 |
| Papua New Guinea | 7 500 000 | 29 | 56 |
| New Zealand | 4 452 300 | 8 | 2 |
| Australia | 23 946 300 | 5 | 1 |
| Worldwide | 7.1 billion | 44 | 47 |

*Catastrophic expenditure is greater than 10% of annual income or 40% of remaining income after food and housing costs.
OOP, out-of-pocket costs for surgical care.

this process was feasible in smaller countries or regions with a population of one million or less, it would be more challenging and less practical for larger populations with an extensive transport network.

Geography certainly had a major influence on timeliness of access to the bellwether procedures. Some countries such as the Solomon Islands and Vanuatu consist of small island archipelagos spread over vast expanses of the Pacific Ocean, and populations on remote islands had poor access to the bellwethers. Similarly, Timor Leste and Papua New Guinea (PNG) are challenged by regions with mountainous terrain, and limited transport services with consequent low rates of access to the bellwethers. Small island nations where the majority of the population live on a few islands (Nauru, Cook Islands and Tonga) achieved at least 80% bellwether access within 2 hours.

Plotting bellwether access should assist in national surgical planning. In one country with just 50% population coverage, 80% of the population were within 2 hours of the country's five provincial hospitals, but only three of these were bellwether-capable. Hence, upgrading the two non-bellwether-capable hospitals will provide 80% coverage.

In the future, it would be helpful to measure bellwether access over time and report it in national surgical plans. Shortages of essential supplies, or temporary loss of trained surgical, anaesthesia and obstetrics (SAO) providers, can compromise the ability to deliver a service. In LMICs these challenges mean some hospitals are unable to guarantee the bellwether services all of the time. Attempting to accurately record the proportion of time that the bellwether procedures can be performed would undoubtedly make the collection of this metric too burdensome. However, further research in LMICs on

the impact of interruptions to service would be valuable in determining the impact of when the bellwethers are not deliverable.

## INDICATOR 2: SURGICAL, ANAESTHESIA AND OBSTETRIC WORKFORCE DENSITY

LCoGS defined SAO workforce density as the 'number of specialist surgical, anaesthetic, and obstetric physicians who are working per 100 000 population'. This definition excludes non-physician providers such as nurse anaesthetists. We also excluded visiting international specialists who were in a country temporarily, trainees who required direct supervision by a specialist and SAOs who had not provided clinical care in the past year.

The SAO total was gathered from specialist registration boards in larger nations or obtained by each country's representative on the working group in smaller nations who used their knowledge of the workforce if no registry existed (table 2).

Four of 14 (29%) countries reached the LCoGS target of 20 SAOs per 100 000 population with a range of 0.9–63.9 (mean 15.9; median 7.6) (table 3).

The SAO density in our region shows marked disparity between countries but generally reflects the true specialist physician workforce and is consistent with other reports from the region.[12] For most LMICs, there is a considerable shortfall, well below the desired 20–40/100 000. As such, future health workforce planning will need to include SAO providers based on predicted medical specialist graduates and alternative providers. In the Pacific, particularly the smaller island nations, an international visiting workforce often delivers the highly specialised elective procedures.[13 14]

We believe it is appropriate that the workforce comprising specialist medical teams is not counted in SAO numbers despite their contribution to surgical volume. However, the exclusion of non-physician SAOs, particularly nurse anaesthetists, does challenge the ability to interpret the metric. Where a country has a significant number of non-physician SAO providers, adhering to the LCoGS definition of SAO density will underestimate the true clinical workforce. We would advocate for reporting this metric, but that each country collects data on all cadres of SAOs and hence recognise the true nature of their workforce. Physician non-specialist and non-physician SAO providers also need to be counted and reported. Timor Leste exemplifies the need to do so, where anaesthesia is largely provided by 23 nurse anaesthetists, and only 3 supervising anaesthesia physician providers. This effect was also evident in PNG and is anticipated to be even more prominent in some countries in Sub-Saharan Africa, where non-physician proceduralists comprise a significant part of the workforce.[15–18]

## INDICATOR 3: SURGICAL VOLUME

Surgical volume (SV) is defined as the number of 'procedures done in an operating theatre, per 100 000 population per year'[1] at bellwether-capable facilities and other surgical facilities. As per the LCoGS definition, a procedure was included if performed in an operating theatre regardless of the type of anaesthesia—for example, endoscopy and cases performed under local anaesthesia. Data were obtained from electronic reporting systems or theatre logbooks when the former was not available. Cases performed by or under the supervision of non-SAO specialists (eg, visiting teams) were included, although these visiting specialists were not counted for SAO density.

Local representatives identified all operating facilities. All facilities prospectively maintained a written or electronic theatre logbook or registry. In some countries, the Ministry of Health already collected these data and made it available to the authors. Where no pre-existing reporting process was available, the theatre logbook totals were individually collated over a defined period and an annual SV was calculated and subsequently converted to an SV density using the population values reported by the World Bank. The authors are confident that this process captures the majority of all surgical procedures in each country. Although minor procedures in private facilities may not have been identified, they are expected to be a relatively minor contribution to surgical services in the countries of this region.

Five of 13 (38%) countries reached the Commission target of 5000 surgical procedures per 100 000 population, with a reported range of 433–10 156 (mean 3572; median 1718) as represented in table 3.

SV was designed to reflect health system capacity to deliver emergency and essential surgical/anaesthesia care. Some countries already had a system of regular reporting of surgical activity or volume in place, while for others this was a labour-intensive process requiring manual collection of data from theatre logbooks in each operating facility.

In smaller nations, numbers are small enough to enable accurate data collection, but in larger nations this approach is unlikely to be practical or sustainable. To achieve a sustainable and minimum standard of reporting, each country must maintain a registry of all operating facilities, and mandate recording of all procedures in a theatre logbook with annual reporting of surgical activity by urgency, age range, gender, procedure group/specialty and method of anaesthesia. This standard has already been adopted by WHO.

## INDICATOR 4: PERIOPERATIVE MORTALITY RATE

Perioperative mortality rate (POMR) is defined as 'all-cause death rate before discharge in patients who have had a procedure in an operating theatre, divided by the total number of procedures, presented as a percentage'.[1 19–21] This is a critical safety metric, which has been previously adopted by the WHO Safe Surgery Saves Lives initiative.[22–24]

In our region there was large variation in collection of mortality data. Some hospitals kept a reliable mortality register. In these instances they were used to perform a case review and determine which patients had a procedure during that inpatient stay. If no existing mortality register existed, then POMR was calculated using a prospective method over a 6-month period (eg, Timor Leste). The variations for each country are reported in table 2.

POMR was collected for 13/14 countries and ranged from 0.11% to 1.0% (table 3).

WHO and LCoGS recommend POMR be recorded as death before discharge after a procedure performed in an operating room.[1 22–24] It is not practical in LMICs to attempt to measure POMR at 30 days because of the challenges of follow-up. The reported correlation between the POMR at 7 days and POMR at 30 days, even in LMICs, gives some confidence that POMR measured only before discharge is reliable and interpretable.[25 26] We would also argue that any country or health service that is providing a surgical service but does not know whether patients survive to leave hospital is seriously deficient in providing quality assurance to the populations they serve.

New Zealand and Tonga were the first countries in this region to report POMR nationally.[19] In this region the POMR varies from the lowest result of 0.11% (Cook Islands) to the highest of 1.0% (Tuvalu). We interpret these data to indicate a suitably high standard of surgical and anaesthetic care, but there is still an almost tenfold variation between some countries. Further study will need to be done to help interpret this result and tease out the relative contributions of quality of surgery and anaesthesia affecting POMR compared with the many other factors such as age, case mix, operation type, American Society of Anaesthesiologists (ASA) grade and delayed presentations with advanced pathology.

Australia and New Zealand have already reported the influence of age and urgency,[27] while New Zealand has reported on low-risk procedures and ASA status, as well as some specific procedural groups.[28–30]

In Australia and New Zealand the operation urgency is an influential risk factor, with emergency and elective POMRs varying tenfold.[27–30] Many LMICs have much higher proportions of emergencies than electives, and where this is so they should perhaps compare emergency and elective POMRs separately. In some Pacific countries, the POMR could vary by a factor of 2 depending on whether SV includes low-risk endoscopy and local anaesthetic cases. To make safety and quality comparisons, POMR should perhaps be based on case mix and include specific condition or procedure mortalities, such as emergency laparotomy. It is also important to include obstetric and gynaecological cases as these form a considerable proportion of the SV in LMICs, have a low mortality, and consequently their omission from POMR rate could skew the metric towards higher rates.

Once POMR is reported, there is an opportunity for each nation to use its rate to measure improvements in surgical and anaesthesia care. In the future POMR may be reported by urgency and procedure group at least to enable benchmarking between countries. However initially effort must go into countries learning to report their own POMRs, and monitor improvements in the delivery of surgical and anaesthesia care through this safety metric.

## INDICATORS 5 AND 6: FINANCIAL RISK PROTECTION

We did not collect data on the financial risk protection indicators (table 4), having extracted these for the Pacific Region from the World Bank's indicators on catastrophic expenditure and impoverishment by the need for surgery.[10] The rates range from 0% to 30% for catastrophic expenditure and from 1% to 72% for impoverishment. For impoverishment, four countries—Micronesia, PNG, Solomon Islands and Timor Leste—were above the worldwide average of 44%.

Healthcare payments predicted from modelling in the Asia-Pacific region appear to be high,[31–33] so national health plans need to address how healthcare, including surgery and anaesthesia, can be provided affordably. We plan further studies to assess the actual, as opposed to modelled, risk of catastrophic expenditure and impoverishment incurred through the need for surgery.

## CHALLENGES OF COLLECTING GLOBAL SURGICAL METRICS AND SUCCESS THROUGH COLLABORATION

There is considerable diversity between nations whose populations range from 10 000 in Nauru to 7.5 million in PNG, and 24 million in Australia. Our precollection survey indicated that no nation had a system in place that would enable these data to be reported immediately. Each country perceived that at least one or more of the indicators would be challenging to collect and would require significant individual effort to obtain the data. The authors observed that collaboration between nations provided both motivation and assistance during the data collection process, resulting in 13 of 14 countries achieving the first four Lancet Commission global surgery indicators.

This paper demonstrates the feasibility and benefits of a collaborative approach of collecting LCoGS indicator data in the South Pacific despite the challenges presented by diverse geography, population density, and within low-income countries a lack of infrastructure. The success was in part a result of many years of partnership between RACS and the Pacific Island countries in surgical training and provision of specialist surgical services in the region.[13 14]

## STRIVING TOWARDS UNIVERSAL ACCESS TO EMERGENCY AND ESSENTIAL CARE

In order to realise the WHA's resolution A 68/15 on universal access to emergency and essential care,

local advocacy must include surgery and anaesthesia in national health plans as has occurred in PNG.[34]

The metrics themselves should inspire each nation to develop a sustainable reporting system that will inform planning for surgery nationally. The effectiveness of interventions designed to improve surgical and anaesthesia care delivery can be measured using the current indicators as a baseline.

Only then will there be progress towards universal access to safe, affordable surgical and anaesthesia care when needed, and a strengthening of Asia-Pacific health systems.

## CONCLUSION

This is the first report of a regional approach to collecting the Lancet global surgical indicators. Data collection from 14 nations has led to a greater understanding of access to timely, safe and affordable surgery in our region and globally.

This report also demonstrates the practicality of collecting LCoGS indicators across a diverse range of nations and should act as encouragement for other nations and regions to take up the challenge. Our experience with this collaborative approach suggests alliances with regional organisations and professional bodies can be influential. Specialty colleges and associations have an opportunity to provide leadership, advocacy and promoting further research into global surgery.

Ministries of health should use these metrics to help formulate their national health plans, and report them to WHO to provide a local and regional perspective as to how surgical care delivery is contributing to the goal of universal health coverage.

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