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Universal access to safe, affordable, timely surgical and anaesthetic care in Papua New Guinea: the six global health indicators

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Abstract

Background: The unmet global burden of surgical disease is substantial. The Lancet Commission on Global Surgery (LCoGS) estimated that 5 billion people do not have access to safe, affordable and timely surgical care, with 80% of those without access living in low- and middle-income countries. The Milne Bay Province (pop 331 000) of Papua New Guinea, with an archipelago of islands up to 750 km from its capital, Alotau, has only one hospital capable of performing Caesarean Section, Emergency Laparotomy and managing an open fracture, the three Bellwether procedures. This paper aims to report the six Lancet Commission on Global Surgery metrics for Milne Bay Province.

Methods: The study was conducted between January and August 2019. Bellwether access was investigated by a prospective study on 115 patients presenting to hospital. The surgical, anaesthesia and obstetric (SAO) workforce, surgical volume and perioperative mortality rate, were calculated for 2012–2018 from hospital records and operation registers. Financial risk metrics were calculated by surveying 50 patients at discharge from hospital.

Results: Bellwether access: Only 27.8% (n = 32) of the study population (n = 115) experienced less than 2-hours second delay (journey time to hospital). The average SAO provider density was 1.8 per 100 000 population. There were 606 procedures performed per 100 000 with a mean annual perioperative mortality rate of 0.3%. Catastrophic expenditure is a risk for 29% of the population.

Conclusion: Milne Bay Province can perform surgery safely, but there is limited access to timely surgical care when needed with a significant proportion put at financial risk by requiring it.

Introduction

The unmet global burden of surgical disease is substantial. The Lancet Commission on Global Surgery (LCoGS) estimated that five billion people do not have access to safe, affordable and timely surgical care, with 80% of those without access living in low- and middle-income countries (LMICs) like Papua New Guinea (PNG)[1] which has a population of seven million plus.[2] Surgery and anaesthesia are critical to averting premature death, minimizing disability and correcting deformity. Surgical care has also been shown to be a cost-effective health care intervention in LMICs[3,4] and in Milne Bay Province, Papua New Guinea.[5] The 2015 World Health Assembly resolution 68.15 recommended governments in LMICs to strengthen health systems through improving universal access to emergency and essential surgery.[6] In anticipation of this resolution, LCoGS recommended six metrics to measure timely access, capability, capacity, and affordability.[1,7] The World Health Organization and World Bank have included these indicators of surgical care within their information and monitoring systems.[8,9]

The LCoGS metrics have been reported for the Pacific region, including PNG,[10] but there is a need for each province in PNG to report their own metrics to assist with planning to scale up surgery and anaesthesia. Surgery and anaesthesia are critical to averting premature death, minimizing disability and correcting deformity.

This paper aims to report the six Global Health metrics for Milne Bay Province so they may be used for advocacy to our stake holders and development partners in health.

Methods

The study was conducted from January to August 2019 in Milne Bay Province (pop 331 000) which is the largest maritime province in Papua New Guinea. The population was calculated from the PNG national census (2011), assuming a population growth rate of 2.5%.[2] The province is divided into 4 districts but there is only one Bellwether capable hospital, Alotau Provincial Hospital (APH), which has 170 beds and two operating theatres (OTs), the only health service with functioning OTs in the Province. Access to hospital care is challenging because 80% of the provincial population lives in the scattered rural outer islands of the province, with the most remote being up to 750 km away (Fig. 1). There is no pre-hospital system to expedite emergency patients to hospital. APH has an ambulance which is used to transport only a small proportion of patients in the town area. There is no sea ambulance, nor insurance scheme and patients are responsible for funding their own transport to hospital.

Study design

The six individual indicators were defined as per LCoGS[1] and data collected using the methodology reported by other Pacific nations.[10] The indicators measure access to emergency surgery, trained provider density, surgical volume, perioperative mortality rate (POMR), catastrophic expenditure and impoverishing expenditure.

Indicator 1: access to emergency surgery (Bellwether procedures) within 2 h

A prospective observational study was carried out on 115 consecutive patients who underwent one of the three Bellwether procedures (emergency caesarean section, emergency laparotomy and open fracture management) at APH. The times for each of the three delays were measured (delay in deciding to travel to hospital, duration of journey to hospital and the time from arrival at hospital until commencement of anaesthesia was recorded. The value given for indicator 1 was reported only as the second delay, the journey time to hospital.[1]

Indicator 2: surgeon, anaesthetist and obstetrician provider density per 100 000

The surgeon, anaesthetist and obstetrician (SAO) numbers were calculated using the current SAOs at APH including, qualified and practising surgeons, obstetricians, and anaesthetists and non-physician anaesthetic scientific officers.

Indicator 3: surgical volume

The surgical volume for APH is the number of procedures done in APH OT per year under any form of anaesthesia. The case load was contributed by counting all those performed under general surgeons, the obstetrician and gynaecologist, and the ophthalmologist as well as those done by visiting specialist surgeons. General practitioners do not perform surgery in APH OT, nor are there private practitioners performing surgery elsewhere in the Province.

Indicator 4: the POMR

The numerator for POMR was the number of deaths before discharge from the hospital or within 30 days of the procedure,

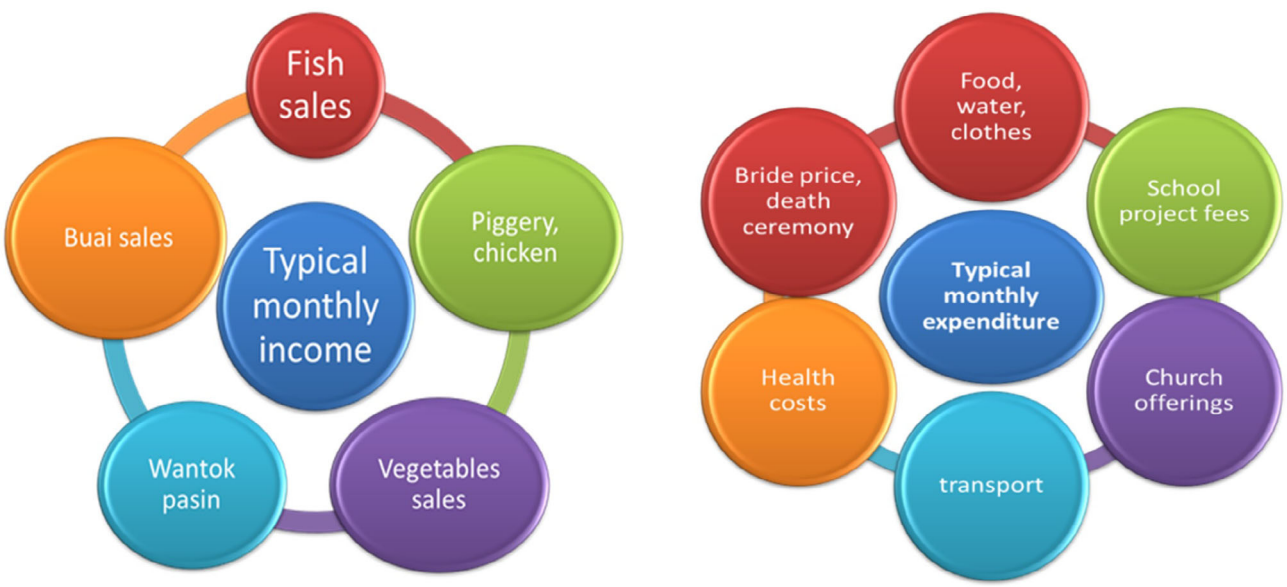

Fig 1. Components of income and expenditure used to calculate the financial risk.

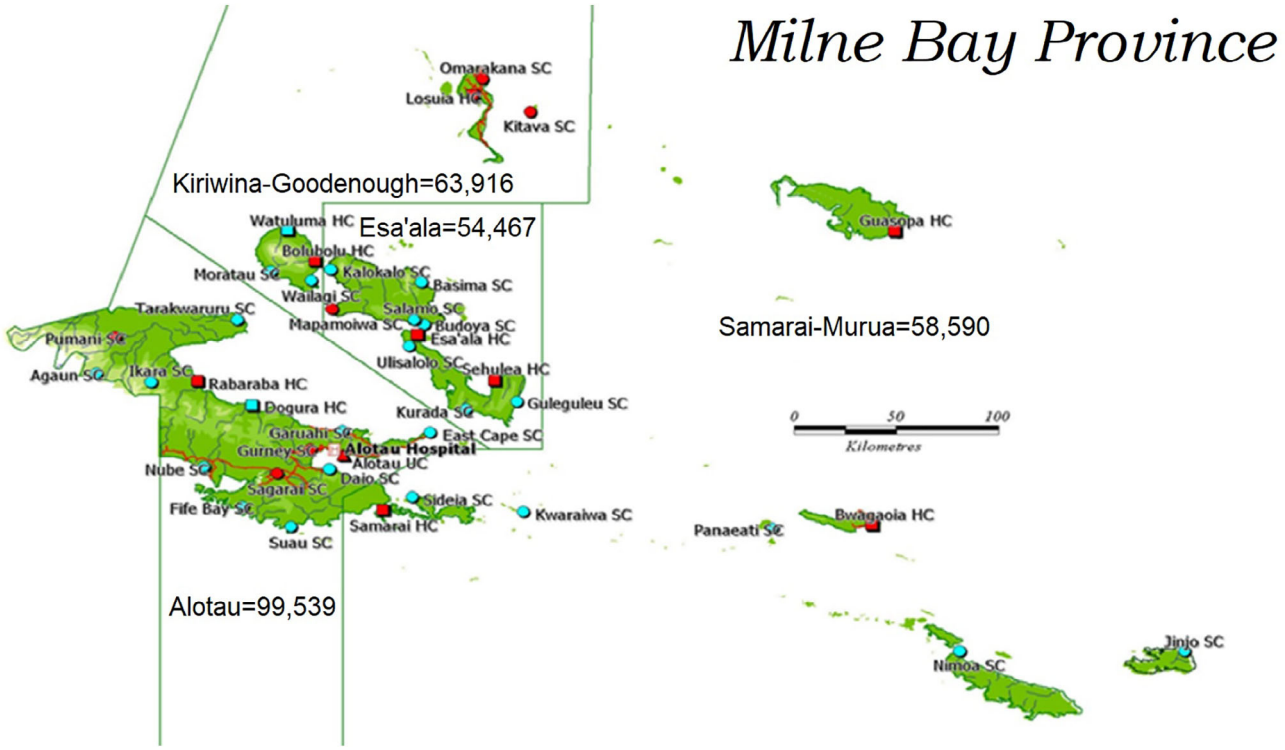

Fig 2. The map of Milne Bay Province and its four districts with each district population derived from 2011 PNG National census.

whichever is sooner.[1,11,12] The denominator was the surgical volume or number of procedures.[11] The POMR for APH was calculated for each year from 2012 to 2018.

Indicators 5 and 6: catastrophic expenditure and impoverishment

By definition, catastrophic expenditure is direct cost of health and surgery costing more than 10% of income or more than 40% of annual income after subtracting the costs of food and accommodation. Impoverishing expenditure is defined as direct out of pocket costs of healthcare and surgery resulting in people living below the poverty line, calculated at both US$ 1.25 and US$ 2 per day.[1] To determine this indicator, a prospective survey was done on 50 patients, admitted for surgery from four districts in Milne Bay Province. We used standard financial risk protection survey forms provided by Harvard Medical School's Program in Global Surgery and Social Change,[13] made available through Mark Shrime in

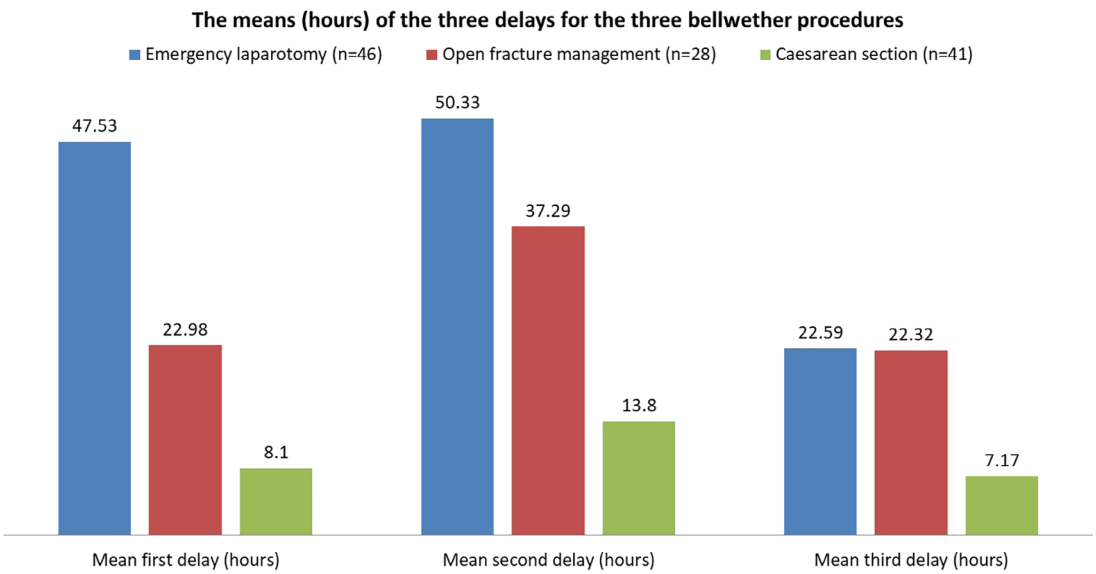

Fig 3. The mean hours at each stage of delay for the three Bellwether procedures.

Table 1 Showing the progressive population of Milne Bay Province with the required SAOs and the current number of SAOs in the province

Year	Population	On the ground SAOs/cumulative population	Required SAOs/100000	SAOs/100000	Deficit SAOs/100000
2012	285 975	6	57	2.0/100000	−51
2013	293 124	6	58	2.0/100000	−52
2014	300 452	6	60	0.99/100000	−54
2015	307 963	6	62	1.95/100000	−56
2016	315 662	7	63	2.2/100000	−56
2017	323 554	7	65	2.16/100000	−58
2018	331 643	6	66	1.8/100000	−60
2019	339 934	5	68	1.5/100000	−63

SAO, Surgeons, Anaesthetists and Obstetricians per 100 000.

collaboration with the Pacific Island Surgical Association, the Association of Surgeons of Papua New Guinea and the Royal Australasian College of Surgeons.[13,14] The survey collects data on three topics, monthly income, monthly expenditure and hospitalization costs (Fig. 2).

Monthly income was calculated from vegetables sales, fish sales, piggery farming, chicken farming and betel nut sales. Monthly expenditure included transport, food and grocery, bride price contributions, funeral expenses, church offerings and tithes, school project fees, and monthly health-associated costs. Hospitalization expenses included direct and indirect costs such as transport, attendees' costs, doctors' and operation fees, investigation costs for imaging and blood tests, payments for food during the admission, other dressing and bandages charges.

Research and ethics clearance

MBPHA research committee granted approval for the research. All patients and relatives recruited in the study for indicators 1, 5 and 6 consented to participate in the study.

Results

Indicator 1: bellwether access

A prospective observational study was carried out on 115 patients. Forty-one had emergency caesarean sections, 46 had emergency laparotomies (six for female genital tract sepsis) and there were 28 open fractures. There were 72 females and 43 males with a mean age of 29.78 years, ranging from 20 to 40 years. The causes of emergency caesarean were obstructed labour,[15] breech presentation,[9] fetal distress,[8] placenta praevia,[4] previous caesar in labour or prolonged labour,[3] pre-eclampsia.[2] The causes of laparotomy were perforated appendix,[13] bowel obstruction,[13] abdominal trauma,[8] gynaecological[6] for bleeding, sepsis or perforation, and six others.

The patients were grouped into the different districts of origin and referrals. Alotau Rural district (n = 41), Alotau Urban district (n = 10), Kiriwina-Goodenough District (n = 22), Esa'ala District (n = 22), Samarai-Murua District (n = 19) and one from Central Province (Fig. 2).

The commonest transport used was out board motor dinghies (n = 57), followed by ambulance vehicles (n = 35) and then private vehicles (n = 22). Only five patients were transported by air. The average delay before arriving at APH after the onset of illness was 78.3 hours for all three Bellwether procedures combined (n = 115). The mean delays in hours for each of the three Bellwether procedures are shown in Figure 3. Only 27.8% (n = 32) experienced less than a 2-h second delay. Combining the first and second delay, only 16 (14%) patients requiring a Bellwether procedure reached hospital within 2 h of the onset of symptoms (Fig. 3).

The most common reason for first and second delays was unavailability of transport, representing 63% (n = 72) and 58% (n = 67) of the study population, respectively. Preoperative workup and awaiting blood for transfusion were the most common reasons for the third delay affecting 70% (n = 80). For patients requiring caesarean section, there was an average total delay of 52 h before reaching the OT, for emergency laparotomy (n = 46) it was 78 h, and for open fracture, 101 h (Fig. 3).

Indicator 2: SAO trained provider density per 100 000 population

The average SAOs for APH, MBPHA and Milne Bay Province over the period 2012–2018 was 1.8 per 100 000 population, well

Table 2 Actual surgical volume, with deficit calculated against the LCoGS target and POMR for the years 2012–2018

Year	Total procedures/ population	Required total procedures for given population (5000 procedures/100 000 population)	Deficits (number of procedures not done)	Surgical volume/100 000 population	Perioperative deaths	Perioperative deaths
2012	1862/285975	14 299	−12 434	651/100000	3	0.16
2013	1673/293124	14 656	−12 983	571/100000	5	0.29
2014	1782/300452	15 023	−13 241	593/100000	5	0.28
2015	2292/307963	15 398	−13 106	744/100000	5	0.22
2016	2074/315662	15 783	−13 709	657/100000	11	0.53
2017	1855/323554	16 178	−14 323	573/100000	4	0.22
2018	1507/331643	16 582	−15.075	454/100000	6	0.40
Average				606/100000	6	0.30

LCoGS, Lancet Commission on Global Surgery; POMR, perioperative mortality rate.

Table 3 The current Global Health indicators of Alotau Provincial Hospital (APH), Milne Bay Province (2019)

Indicator	LCoGS by 2030	APH/MBPHA (2012–2019)
1. Access to emergency surgery	80% within 2 h of surgery capable hospital	14% within 2 h
2.Provider density	20 SAOs per 100 000 population	1.8 SAOs per 100 000 population
3.Surgical volume	5000 per 100 000 population	606 procedures per 100 000 population
4.POMR	100% of population tracking (80% by 2020) 0.5–1.5% POMR	0.3% POMR
5.Catastrophic expenditure	Elimination of catastrophic expenditure on surgery	29% of the population is at risk of catastrophic expenditure
6.Impoverishing expenditure	Elimination of impoverishing expenditure on surgery	43% of the population has impoverishing expenditure

LCoGS, Lancet Commission on Global Surgery; POMR, perioperative mortality rate; SAO, surgical, anaesthesia and obstetric.

below the LCoGS of 20/100 000 and with a growing deficit as the population increased at a rate of 2.5% *per annum* (Table 1).

Indicator 3: surgical volume per 100 000 population

From 2012 to 2018, the three units, obstetrics and gynaecology O&G (699–972 cases), surgery (652–1247 cases) and ophthalmology (120–164 cases), did from 1673 to 2292 procedures. This equates to an average of 606/100 000 (454–744/100 000). To achieve the LCoGS target of 5000/100 000 we would need to have performed 8–10 times as many or 14 299–16 582 procedures per year (Table 2).

Indicator 4: the POMR

The number of postoperative deaths for each year between 2012 and 2018 is small, with two to three deaths per year after O&G procedures (n = 14; PMR 0.2–0.3%) and one to seven deaths per year (n = 24; POMR 0.3–0.4%) after surgical procedures. There were no deaths from fractures and there was only one ophthalmological death over the 7 years. The combined POMR for all specialties and procedures ranged from 0.16% to 0.53%, with a mean POMR of 0.3% annually (Table 2).

Indicators 5 and 6: catastrophic and impoverishing expenditure

Before the need for surgery, 96% of the surveyed patients were already at or below the national poverty line (US$ 7.44 per person per day). The at-risk population in PNG was estimated by extrapolating the actual direct medical and non-medical costs reported by the survey participants to a statistical representation of the income distribution in the PNG population. Considering total direct costs (including medical and non-medical expenses); the risk of impoverishment is 11% at the US$ 2 per day threshold; and at the US$ 1.25 per day threshold, 6.6% of the PNG population are at-risk of impoverishing expenditure. Twenty-nine per cent of the PNG population are at risk of catastrophic expenditure due to direct costs (including medical and non-medical expenses) if they require surgery.

Discussion

The Lancet Commission and Global Health recommended six indicators to measure access to safe, affordable and timely surgery and anaesthetic care (Table 3).[1,15] These indicators have been incorporated into World Health Organization's Core Health Indicator set and the World Bank Health Development Indicators and are accepted as relevant, practical and valid.[8,9] This study has shown that it is feasible to collect these metrics for Milne Bay Province, despite its challenging geography in terms of access to its only Bellwether capable hospital (Table 3).

Each province in PNG will have to do similar work to measure these indicators and then to develop its own plan to improve access and reduce the avertable disease burden due to surgical conditions. PNG is currently in the early stages of its data collection and some hospitals and provinces are only developing processes to collect all the required data. By reporting the six Global Health indicators for APH and Milne Bay Province, our team have developed a methodology that can be followed by other hospitals in PNG and the Pacific.[10]

The study on Bellwether access in our region was not based on estimated times from geo-spatial mapping[16] but rather by real journey times and only patients who reached hospital were included. However, our study did measure the real delays and identified that lack of transport has a major and real impact, regardless of distances by road or overseas. It is only by doing such a study in the local setting, as was published recently from Timor Leste,[17] that one is able to move from assumed or modelled access data to what is actually occurring on the ground and why. Once done for a particular Province or region, it may not need to be repeated for at least 3 years.

The study of access is limited by not being able to report on patients who failed to reach hospital or who never attempted the journey. For example, we know of one woman in labour who died in transit after a journey of over 48 h. For the year 2019, an unpublished study in the Alotau district did 108 verbal autopsies of deaths that did not reach hospital, with 33 likely surgical (mainly trauma and cancer) and three obstetric causes. This suggests that the number of surgically related deaths occurring outside hospital is substantial, despite the POMR being low, and the service provided being safe, but can only help those patients who reach hospital.

The study on the real direct medical and non-medical costs has shown how the Harvard financial risk survey can be modified for PNG, particularly with regards the components from which to make income and expenditure calculations (Fig. 2). The calculation of impoverishment and risk of impoverishment is beset by a high proportion of the population living at or below the poverty line. For this reason, catastrophic expenditure which is based on direct

medical costs comprising more than 10% of annual income is easier to calculate. However, the costs of transport are considerable, especially for those living in remote islands, and it is clear that a major cause of delay was not, the first – failure to appreciate the value of going to hospital – but rather even before the second delay of the journey time itself – how to find a mode of transport as well as meet the cost of travelling to hospital.

There is much that needs to be done to scale up surgical services to meet the LCoGS targets by 2030 (Table 3). Knowing where we are at and the magnitude of the gap is at least the right place to start. It provides real data for advocacy, planning and investment.[7,18]

Although our POMR is low, despite many late presentations, the service, for those who can access it, delivers safely. However, we can still learn to improve the safety and quality of service provided by reviewing individual mortalities on a case by case basis and by identifying preventable factors where patients suffer morbidity or mortality.[19–21] The strong public health message, is that surgical, anaesthetic and obstetrics care will save more lives when there is greater access and less delay.

The burden of untreated surgical disease[22] and the untreated but surgically avertable death rate needs to be formally studied given the limited access our population have to safe, timely and affordable surgery. Our current surgical delivery metrics are indeed poor (surgical volume and SAO/100 000) in terms of population coverage, and not improving. Milne Bay Province as a whole deserves more timely access to a health service with greater surgical capacity.

The provincial data can be used to help develop an efficient and achievable provincial version of the national surgical obstetrics and anaesthetic plan for PNG, a national planning process currently in progress following the 2017 Medical Symposium on access to safe affordable and timely surgery and anaesthesia.[23,24]

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Conflicts of interest

None declared.

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