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SAFETY IN MATERNITY

AN INTERNATIONAL PERSPECTIVE FROM SEVEN COUNTRIES

Report of the Leading Health Systems Network 2018

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FOREWORD

Ensuring the provision of safe care is a priority for all healthcare providers. Through the Leading Health Systems Network (LHSN), World Innovation Summit for Health (WISH) and Imperial College's Institute of Global Health Innovation (IGHI), we have made safer care a key focus of our research over the past four years.

Building on LHSN's 2016 report on patient safety (see *An international perspective on information for patient safety: What can we learn about measuring safe care?* for more information), our network came together again to compare safety culture and safety outcomes in maternity care.

International comparisons are inherently difficult: diagnosis and procedure coding practices vary across countries and systems; structural differences can affect provision of care; and population health characteristics inevitably affect outcomes. While we acknowledge these limitations, our network sees the value in comparing performance to identify areas for improvement and encourage cross-country learning and collaboration. As a specialty, maternity care lends itself well to comparison due to the topic's clear definition, universal importance and relatively simple safety indicators.

This report summarizes the results of this effort and incorporates insights from the literature on providing safe care to mothers.

I hope that this publication will give readers a view into maternity care across the globe and encourage providers to review their own performance with an eye toward improvement.

Professor the Lord Darzi of Denham, OM, KBE, PC, FRS
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EXECUTIVE SUMMARY

The fact that patient safety is an important issue in healthcare is not up for debate. Childbirth is one of the most common reasons for hospital admission globally, and we have made significant progress in making childbirth safer for mothers. However, potentially preventable cases of maternal mortality and morbidity are still all too common.

Seven LHSN member organizations came together to compare safety culture and safety outcomes within maternity, and this report summarizes the results of this effort.

Participating organizations vary greatly in terms of population health and care models, making direct performance rankings irresponsible, if not impossible. However, much can be gained by comparing results with a view to identifying areas for improvement and learning from other systems.

Our results suggest that the organizations in our sample provide fairly safe care, particularly when compared to similar metrics from outside sources. Similarly, safety culture appears positive on the whole, though certain areas such as appropriate staffing levels may warrant further investigation.

Assessing the current care environment is a necessary first step to identify and inform priority areas for improvement. All healthcare providers, even high-achieving performers, have an obligation to continue to improve the safety of their maternity services. Doing so will improve the lives of mothers and babies, and also help to rein in unnecessary costs attributable to unsafe care.

INTRODUCTION

Safety in maternity

Maternity is one of the most important healthcare services globally, with more than 130 million births occurring each year.[1] While we have made great strides in making childbirth safer for mothers, including a 44 percent decrease in the maternal mortality ratio since 1990, there are still more than 300,000 deaths related to pregnancy and childbirth each year globally.[2] Further, many maternal deaths and complications are preventable, highlighting a need for continued focus on safer services.

Much has been published regarding high-level strategies to reduce maternal mortality and morbidity, particularly in developing countries, such as increasing attendance by skilled medical personnel at births and better managing risk factors during pregnancy.[3–5] Similarly, there have been numerous evidence-based publications and toolkits outlining ways to improve the safety of maternity services at the provider level, using strategies such as improved communication and teamwork or implementing evidence-based care interventions.[6–9]

It is not the purpose of this paper to duplicate these efforts or present a comprehensive strategy for healthcare providers to improve the safety of maternity care. Rather, this report provides a comparative view of maternity care across seven disparate health systems:

- Apollo Hospitals (India)
- Hong Kong Hospital Authority (Hong Kong)
- Imperial College Healthcare NHS Trust (England)
- Integrated Care Organization (ICO) Cruces (Spain)
- Raja Isteri Pengiran Anak Saleha Hospital (Brunei Darussalam)
- System X (anonymous)
- Victorian Department of Health and Human Services (Australia)

While outcomes data has been age-adjusted to a standard population to facilitate comparisons, this data should not be used to rank a health system's performance. Instead, it should be used to identify potential improvement opportunities.

It is also important to note that, throughout this paper, we focus on the World Health Organization (WHO) definition of patient safety: "Patient safety is the absence of preventable harm to a patient during the process of health care."[10]

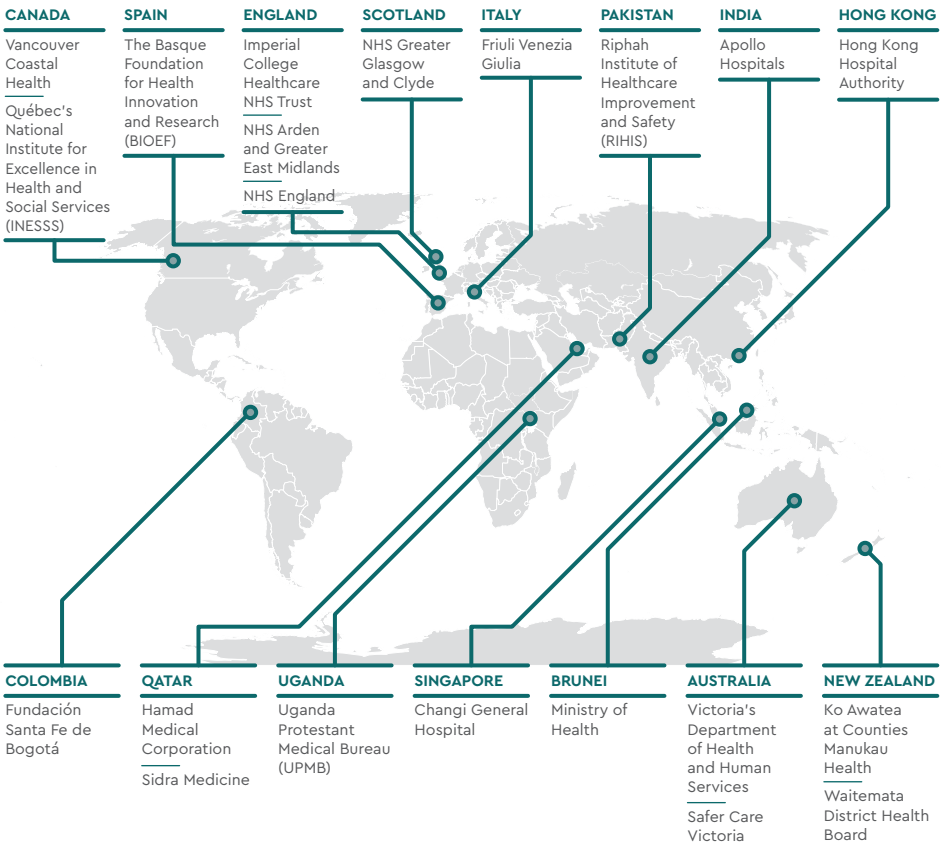
While we acknowledge that safety, clinical effectiveness and patient experience comprise the wider definition of quality in healthcare, we have focused on the more narrow scope of safety for this report.

SECTION 1. LHSN SAFETY IN MATERNITY PROGRAM – OVERVIEW AND METHODS

Overview of LHSN

As outlined in previous publications (see *An international perspective on information for patient safety: What can we learn about measuring safe care?*), LHSN is an international network, hosted at Imperial College London in partnership with WISH, bringing together healthcare organizations and leaders to compare performance, share experiences and learn from each other.

Figure 1. LHSN membership overview



Safety in maternity methods

Building on prior work in the field of patient safety, LHSN undertook a program comparing context, safety culture and safety outcomes within maternity care. An overview of data collection methods is presented below, with further details included in the Appendix.

Context and care models

Imperial College staff distributed a Microsoft Excel-based form to all LHSN members requesting information about: organizational characteristics (for example, number of delivery units, occupancy rates); antenatal care models; staffing models; and population health (for example, prevalence of hypertension). This information provides a wider context in which to view and interpret results from the safety culture and safety outcomes modules.

All seven participating organizations completed this module, though some were not able to provide full information. One organization chose to remain anonymous; their data is presented under the pseudonym 'System X' throughout the report. Results are summarized in Section 2 of this report.

Safety attitudes

To assess safety culture, we sent LHSN organization leads the Safety Attitudes Questionnaire (SAQ) – a freely available, academically validated tool that reviews culture across six domains: teamwork climate; safety climate; job satisfaction; stress recognition; perceptions of management (unit management and hospital management assessed separately); and working conditions.[11] (Questions from the 'stress recognition' section were not included in the final comparative results due to insufficient sampling.)

LHSN organization leads were responsible for identifying survey participants and distributing the survey online using Qualtrics software, and a printed option using a Microsoft Word document. The number of participants and composition by role (for example, nurse, administrative staff, and so on) for each organization can be found in the Appendix.

Survey questions were answered on a 5-point Likert scale, with higher scores indicating a more positive safety culture – though select questions are reverse-scored when higher scores indicate a less positive safety culture.

We then calculated an average score for each organization across the following dimensions:

- Teamwork climate
- Safety climate
- Job satisfaction
- Perception of unit management

- Perception of hospital management
- Working conditions.

Five organizations submitted survey data:

- Apollo Hospitals (India)
- Hong Kong Hospital Authority (Hong Kong)
- Imperial College Healthcare NHS Trust (England)
- Integrated Care Organization (ICO) Cruces (Spain)
- Raja Isteri Pengiran Anak Saleha Hospital (Brunei Darussalam)

Imperial College Healthcare NHS Trust (ICHT) administered the survey independently as part of a separate, trust-wide initiative. ICHT shared the results from their maternity unit for inclusion in this report. Results are summarized in Section 3, and the full survey and more detailed methodology are located in the Appendix.

Safety outcomes

We calculated a total of 11 patient safety indicators (PSIs) for maternity care based on those commonly reported in the literature and through well-established sources, such as the Agency for Healthcare Research and Quality (AHRQ) PSIs for obstetric trauma:[12]

- Eclampsia/eclamptic fits
- Elective caesarean percentage
- In-hospital maternal mortality
- Obstetric trauma (all vaginal deliveries)
- Obstetric trauma (vaginal delivery with instrument)
- Obstetric trauma (vaginal delivery without instrument)
- Postpartum hemorrhage and major obstetric hemorrhage
- Pre-term delivery
- Sepsis

- Severe pre-eclampsia
- Shoulder dystocia.

Data for the outcomes was submitted by email via a Microsoft Excel template, using a combination of International Classification of Diseases' 10th revision (ICD-10) diagnosis codes and Office of Population Censuses and Surveys Classification of Surgical Operations and Procedures' 4th revision (OPCS-4) procedure codes. In the event that codes were not directly applicable due to alternate coding systems, attempts were made to map the most relevant codes based on their definitions. However, regional differences in coding and reporting may account for some of the variation in outcomes, and this should be taken into account when interpreting the data. Full details of the data collection template are included in the Appendix.

All seven healthcare organizations submitted data for this exercise, though not all organizations provided information for all indicators. Results are summarized in Section 4.

SECTION 2. CONTEXT AND CARE MODELS

Myriad factors affect safety and outcomes during pregnancy and childbirth, from baseline health and infrastructure to quality of care provided by health workers. Certain population characteristics – including, but not limited to, socioeconomic status, risk factors such as pre-existing health conditions, age and location (urban/rural) – can lead to higher-risk pregnancies with the potential for poorer safety outcomes.[13–17] Health system characteristics also affect the safety of maternity care, from sufficient resourcing, staffing and facilities, to affordability of and access to care.[18–21]

Quantifying the effects of these factors on safety during childbirth, let alone comparing them across disparate systems, is a complex exercise that is outside the scope of this report. However, as with any international comparison, it is important to take local context into account when interpreting results.

Figure 2 presents a brief overview outlining the context in which participating organizations provide maternity care.

Figure 2. Participant context[22]

Apollo Hospitals

Based in India, Apollo Hospitals is a private healthcare provider that provides primary and acute care throughout the country and in select international locations.

10 maternity units included in data sample	150–700 beds per unit across the organization	88% average occupancy rate	Obstetric and midwife staffing levels vary depending on unit size

ANTENATAL CARE OVERVIEW*

Antenatal care includes a minimum of at least 4 visits, including early registration and first visit in first trimester. These visits include physical and abdominal examinations, hemoglobin (Hb) estimation, urine investigation, 2 doses of tetanus (T.T.) Immunization and consumption of Iron and Folic Acid (IFA) tablets (6 months during antenatal care & 6 months during postnatal care).

*This provides an overview of average antenatal care at the country level.

Raja Isteri Pengiran Anak Saleha Hospital

Raja Isteri Pengiran Anak Saleha Hospital (Brunei RIPAS) is the largest Ministry of Health run hospital in Brunei Darussalam as well as the main referral hospital for the country.

133 beds in maternity unit*

13 delivery rooms

6 teams led by 1 consultant each, senior medical officer and at least 2–3 medical officers

*Total number of beds includes postnatal and antenatal wards.

ANTENATAL CARE OVERVIEW

Approximately 95% of first antenatal visits take place in government Maternal and Child Health Clinics (MCH), with referral to tertiary centre made in a planned and timely manner based on risk factors. Nutritional supplements, antenatal investigations and vaccinations are provided virtually free. On average, pregnant women make approximately 7 antenatal visits throughout pregnancy. Antenatal care typically begins in the first trimester with monthly visits until 28 weeks; then every 2 weeks until 36 weeks and weekly thereafter.

Victorian Department of Health and Human Services

The Victorian Department of Health and Human Services (DHHS) is a publicly funded department that develops and delivers policies, programs and services to support the health and wellbeing of residents in the state of Victoria, Australia.

All births in the state of Victoria included

402 obstetricians*
776 midwives*

*This number represents headcount, not WTE.

ANTENATAL CARE OVERVIEW

Care providers follow the Department of Health's Clinical Practice Guidelines on Antenatal Care, which focus on a woman-centred approach to care. Antenatal care typically comprises 7–10 visits, depending on patient characteristics and history. Assessment of a woman's risk and need for additional care continues throughout pregnancy.

Hong Kong Hospital Authority

Hong Kong Hospital Authority (HKHA) manages Hong Kong's public hospitals and is responsible for providing people-centered preventative, curative and rehabilitation healthcare services.

8 maternity units (all included in sample)	Average of 95 inpatient beds per unit	69.5% average occupancy rate	Average of 196 WTE obstetricians per unit

ANTENATAL CARE OVERVIEW

Antenatal care typically comprises 7–12 checkups depending on how early patients register with their provider and whether the pregnancy is deemed high risk (e.g. medical history or test outcomes).

Imperial College Healthcare NHS Trust

Imperial College Healthcare NHS Trust (ICHT) provides acute and specialist healthcare for a population of nearly two million people in North West London and comprises 5 hospitals as well as an array of community services.

St. Mary's Hospital maternity unit included (private and public)	10 labor rooms

ANTENATAL CARE OVERVIEW

Antenatal care typically comprises 7–10 visits, depending on patient characteristics and history. These visits are typically midwife-led and often take place in community centers rather than the hospital setting.

Integrated Care Organization (ICO) Cruces

ICO Cruces is an integrated care organization, part of Osakidetza, the publicly funded Basque Health Service, which provides universal health services to the population in the Basque Country. The Basque Foundation for Health Innovation and Research (BIOEF) was created to support research, innovation and performance improvement of the service.

1 maternity unit included	45 beds per unit	71.8% average occupancy rate	18 WTE obstetricians and 52 WTE midwives

ANTENATAL CARE OVERVIEW

Antenatal care is provided in outpatient health centres of the area. The first consultation is completed during 8–10 weeks gestation. A total of 10–12 consultations are provided throughout pregnancy, depending on patient characteristics and risk.

System X

System X is a large provider of secondary and tertiary care. It manages 8 hospitals, an ambulance service, and home and residential care services.

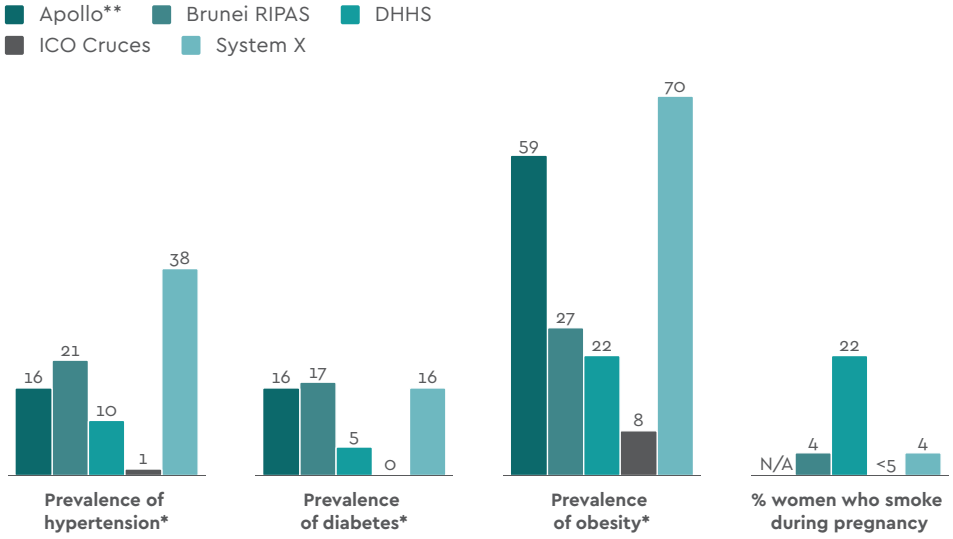
4 delivery units (across 4 hospital sites)	Average of 81 inpatient rooms per unit and 8 delivery rooms per unit	Occupancy rate varies from 55–82%	Obstetrician staffing varies from 5 to 148 WTE per unit, in accordance with size

ANTENATAL CARE OVERVIEW

Antenatal care is provided by System X, with pregnant women being referred for antenatal care checkups as early as 14 weeks if the pregnancy is deemed high risk. For a normal pregnancy, women are referred to outpatients at 32-weeks gestation. Prior to this, care is provided by primary care.

In addition to the context and care model characteristics listed above, performance comparisons should be informed by population health characteristics that can affect outcomes. For instance, for obese women: the odds of developing pre-eclampsia are 3.2 times higher compared to those of healthy weight; the odds of pre-term birth are 1.5 times higher; and the odds of shoulder dystocia are 3.6 times higher.[23] Similarly, smoking increases the risk of pre-term birth and placental abruption; maternal diabetes increases the risk of pre-term birth and emergency caesarean delivery; and maternal hypertension increases the risk of pre-eclampsia and pre-term delivery.[24–26]

Figure 3. Prevalence of risk factors (%)[27]



* General population of women aged 15–45.
** Generalized data based on a study done in the city of Pune, of state Maharashtra, India.
Note: Risk factor data unavailable for HKHA and ICHT.

While the safety outcomes in this report are not adjusted for risk factors in the population, Figure 3 provides context for a number of risk factors that can negatively affect maternal outcomes. These characteristics should be taken into account when reviewing the outcomes data in Section 4. (The risk factors presented were taken from data between 2011 and 2015.)

SECTION 3. SAFETY ATTITUDES

Safety culture

Safety culture is commonly defined as follows:[28]

"The product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management."

Across the last decade, there has been an increasing focus on assessing and improving the culture of safety in healthcare. High-profile errors, such as the Mid Staffordshire NHS Foundation Trust incident in the UK, have highlighted the damage that can occur when staff do not feel empowered to discuss concerns, report errors and effectively collaborate with one another.[29] While the link between a positive safety culture and improved patient outcomes is not necessarily directly linear, there is evidence that a positive safety culture is linked to improved staff and patient outcomes.[30]

Safety Attitudes Questionnaire (SAQ)

The SAQ is a method of measuring the attitude and perceptions of healthcare providers regarding issues that are relevant to the safety of healthcare.[31] In comparison to other medical safety culture surveys, the SAQ has been more widely used and for a longer period of time, and has larger amounts of psychometric data available.[32] Importantly, higher scores on the SAQ are associated with positive patient outcomes and staff experience.[33] This contrasts to other tools, which show a smaller correlation between the response and patient outcomes.[34]

The SAQ was initially validated following administration to 10,000 care providers across 203 clinical areas in three countries.[35] Since then, it has been further validated in a number of different countries, cultural settings and languages.[36,37] The SAQ has been adapted for different care units, including emergency medicine, outpatients and operating room settings.[38–40] Use of the SAQ has been fully validated for comparisons between different hospitals, different care areas and types of caregivers and longitudinal changes in attitudes over time.[41]

Survey results

As discussed in Section 1, we received survey responses from five organizations. Survey questions were answered on a 5-point Likert scale, with higher scores indicating a more positive safety culture. Figure 4 presents the average response across all questions in six dimensions of safety culture, with a higher score representing a more positive safety attitude. Individual questions and respondent composition can be found in the Appendix.

Figure 4. SAQ results overview[42]

	Teamwork climate	Safety climate	Job satisfaction	Perception of unit management	Perception of hospital management	Working conditions
Apollo	4.5	4.7	4.8	4.1	4.2	4.1
Brunei RIPAS	4.1	4.0	4.5	3.7	3.5	3.5
HKHA	4.5	4.3	4.2	4.1	3.7	3.7
ICHT	3.8	3.8	3.7	N/A	N/A	3.3
ICO Cruces	4.8	4.8	4.4	5.0	3.0	4.5

Average response across all questions in dimension: 1–1.5; 1.51–2.5; 2.51–3.5; 3.51–4.5; 4.51–5.

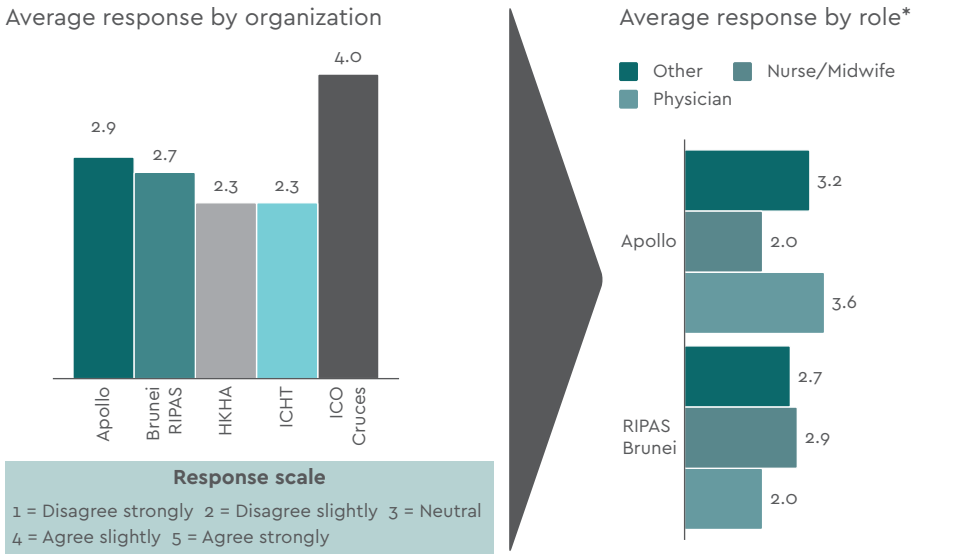
Overall, responses indicate that there is a fairly positive safety culture across all organizations in our sample. Staff generally gave a high rating to their teamwork climate, safety climate, and job satisfaction. Interestingly, both RIPAS and ICO Cruces' responses indicated a less positive safety culture in relation to hospital management, despite having a more positive perception of unit management.

One question, displayed in Figure 5, stood out in the results. Only one organization, ICO Cruces, indicated that staffing levels are sufficient to handle the number of patients. While all organizations in our sample follow safe staffing levels based on professional association recommendations, this area might be worthy of further investigation to better understand staff concerns.

Another area that merits a further look is communication. The ability to openly and safely discuss errors is a pillar of positive patient safety culture. Within our sample, as shown in Figure 6, ease of discussing errors varies across organizations and also by role. In both RIPAS and Apollo, physicians appear to find it easier to discuss errors than nurses, midwives and other staff do.

Figure 5. SAQ results: Staffing levels[43]

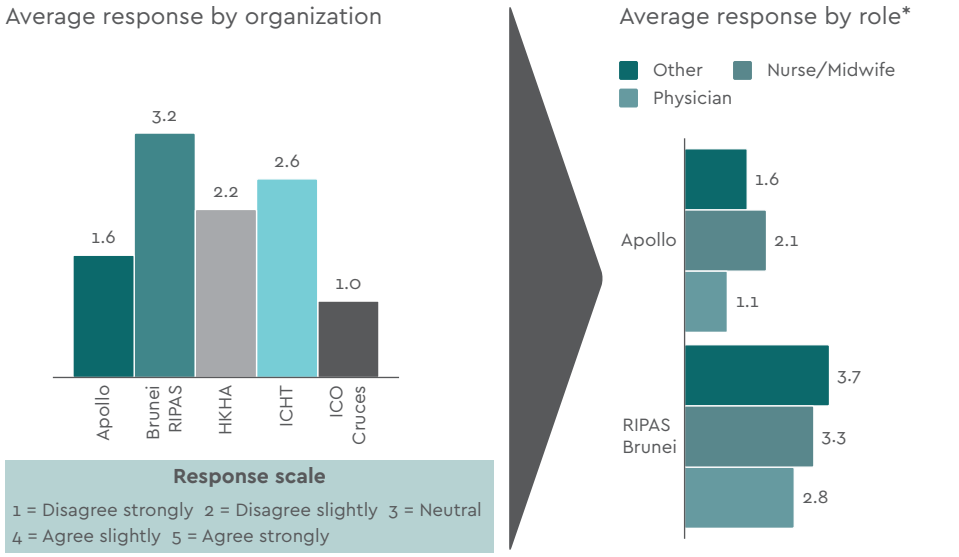
The levels of staffing in this clinical area are sufficient to handle the number of patients



* Where the sample size was sufficient, Figure 5 also shows the average response by role.
Note: Higher scores on this question correspond to a less safe climate.

Figure 6. SAQ results: Discussion of errors[44]

The levels of staffing in this clinical area are sufficient to handle the number of patients

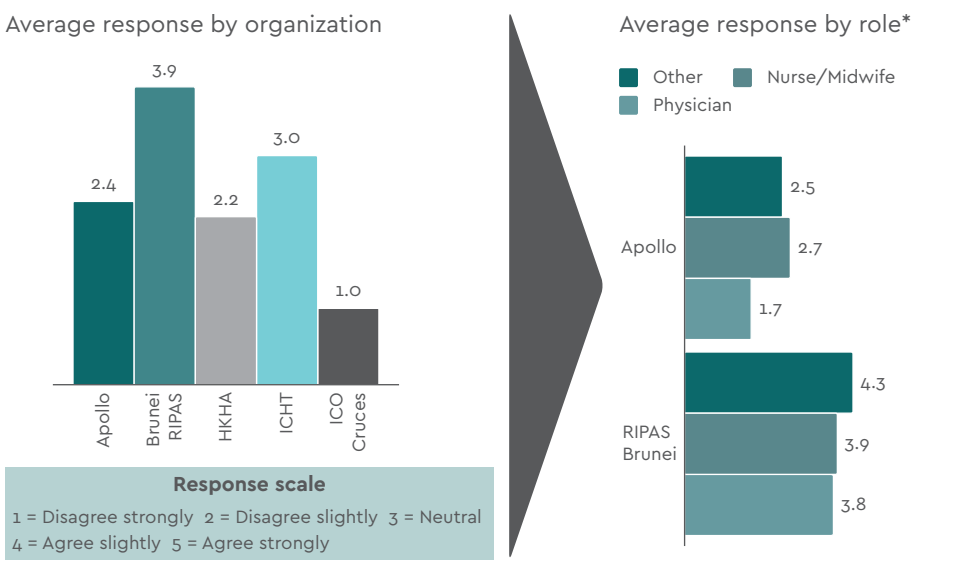


* Where the sample size was sufficient, Figure 6 also shows the average response by role.
Note: Higher scores on this question correspond to a less safe climate.

Further, effective and timely communication ensures that appropriate care is provided to patients as quickly as possible – a key safety factor, particularly in emergency situations. Within our sample, as shown in Figure 7, there is wide variation in the perception of communication delays and their effect on

patient care. ICO Cruces, in particular, appears to perform particularly well in this dimension. This comparison, though limited, provides an opportunity for learning from high-scoring organizations.

Figure 7. SAQ results: Communication delays[45]



* Where the sample size was sufficient, Figure 7 also shows the average response by role.
Note: Higher scores on this question correspond to a less safe climate.

However, it is important to note that there are limitations to solely using safety attitudes surveys as a mechanism for improving patient safety culture, as qualitative interviews have been shown to add richer detail about the factors influencing the safety culture of a healthcare setting.[46] Previous studies have noted that attitudes may not be equivalent to real behavior, and that employing a methodology combining SAQs with alternative methods to study patient safety culture (for example, peer observations, group discussions, analysis of incident history and audits) may be worthwhile.[47] Further, our limited sample does not allow us to draw further conclusions about the link between safety culture and outcomes.

SECTION 4. SAFETY OUTCOMES

Pregnancy, unlike many reasons for hospital admission, is not an illness and mothers should expect to go through childbirth without experiencing undue harm. While rare complications and emergency situations are inevitable, adverse events in maternity care are viewed as widely avoidable if women receive appropriate care.[48]

This section provides a comparative view of safety outcomes in maternity for seven organizations. While these indicators do not provide a fully comprehensive view of performance, their evidence-based derivation from routine administrative data makes them roughly comparable across organizations.[49] While all seven healthcare organizations submitted data for this exercise, only some provided information for all indicators. Therefore, the organizations represented vary in Figures 8 to 14 below.

As noted in the foreword, however, the goal of this module was not to provide a performance ranking, with one health system above another. Rather, we hope that this exercise will allow participants to identify areas for improvement within their health systems and provide a springboard for evidence-based performance improvement initiatives.

We also note that local context, regulations, coding practices and structural differences can affect outcomes, in terms of true performance and reporting practices. Results should be viewed with this in mind.

Finally, it is important to consider that outcome indicators, which show whether the right or wrong things happen, do not provide a fully comprehensive assessment of the safety of care; structural and process metrics are also important to consider.[50]

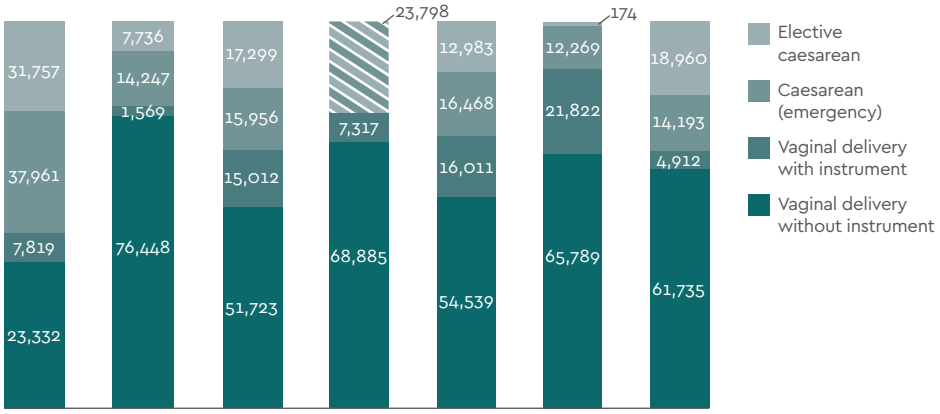
Results

Participating organizations vary widely in size and structure. Organizations submitted outcomes data covering one year of births, ranging from a sample size of 5,185 for RIPAS to more than 76,000 for DHHS. To better enable comparisons, we adjusted the data to standardize for age and report the majority of indicators as rates.

Figure 8 provides an overview of the composition of delivery methods across each organization. There is wide variation among our sample, with the rate of caesarean deliveries ranging from a low of 12,443 per 100,000 for ICO Cruces

to a high of 69,718 per 100,000 for Apollo.* This variation suggests differences in both local practice and patient population. However, it is difficult to make deductions about quality from this metric.

Figure 8. Delivery methods[51]



	Apollo	Brunei RIPAS	DHHS	HKHA*	ICHT	ICO Cruces	System X
# births in sample	6,586	5,185	76,744	22,151	10,109	5,355	39,038

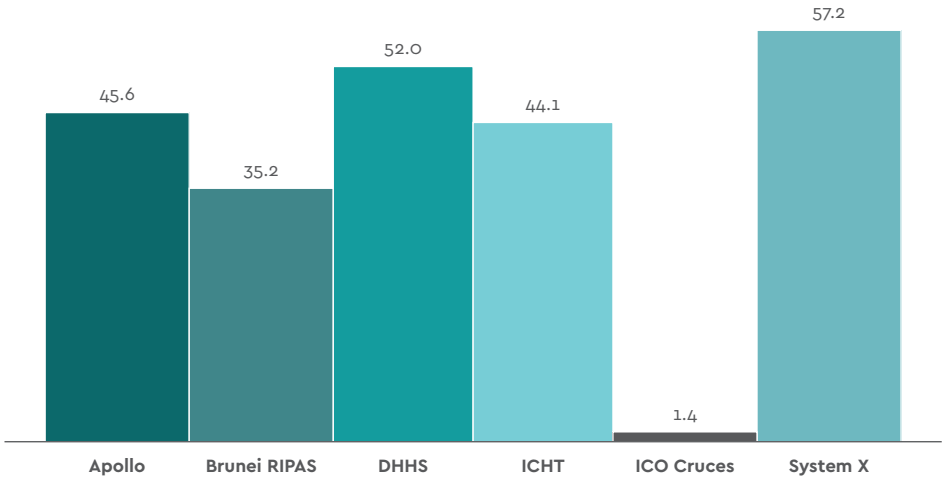
* Emergency caesarean rate for HKHA reflects both emergency and elective caesareans.
Note: Rate per 100,000 deliveries, age-adjusted to standardized population.

While there has been a longstanding view that the 'ideal rate' for caesareans is between 10 and 15 percent of all deliveries, these rates have been increasing around the world for multiple reasons (increasingly complex patients, financial incentives, and so on).[52] A WHO review of caesarean section (c-sections) rates and outcomes concluded that "every effort should be made to provide caesarean sections to women in need, rather than striving to achieve a specific rate".[53]

As c-sections are a major surgery with the potential for complications, many institutions track their elective (non-emergency) c-section rate; this rate varies widely for our sample. Interpreting this metric, however, is also not straightforward, as local context and patient choice contribute significantly. Further, the effects of c-section rates on maternal and pediatric morbidity and future outcomes are unclear.[54]

* In Figures 8 to 14, the Apollo samples include patients who have been referred from other hospitals, including those with pre-existing complications, poor obstetric history or multiple co-morbid conditions.

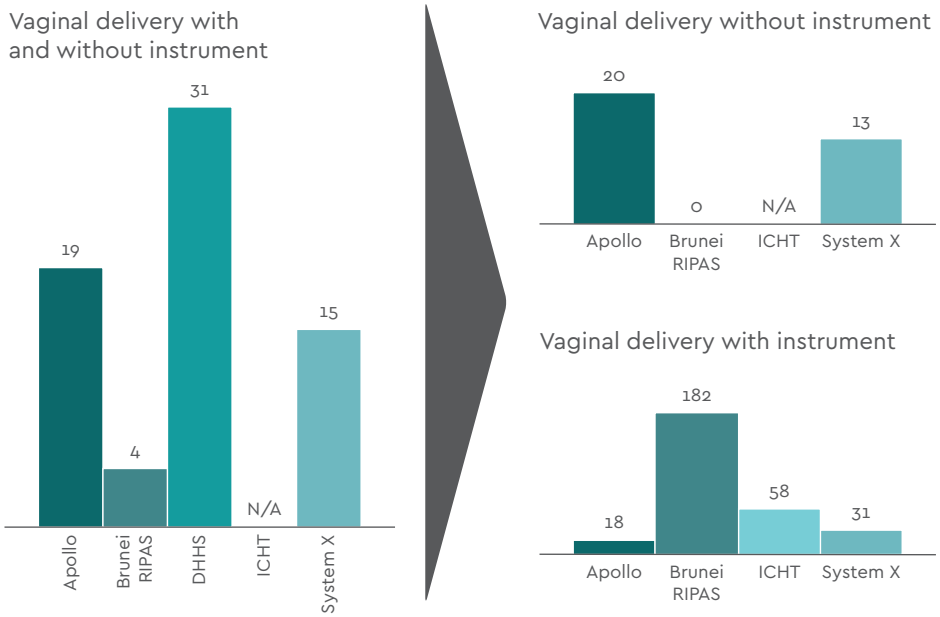
Figure 9. Elective caesarean (%)[55]



Note: % total caesareans, age-adjusted to standardized population.

Obstetric trauma, potentially avoidable tearing of the perineum during vaginal delivery, is a frequently cited safety indicator, used by the Organisation for Economic Co-operation and Development (OECD) as well as being part of the AHRQ PSI set. This complication is considered generally preventable, though risk factors include first vaginal delivery, high birth weight, induced labor, prolonged labor and delivery with instrument.[56]

Figure 10. Obstetric trauma[57]



Note: Rate per 1,000 deliveries, age-adjusted to standardized population.

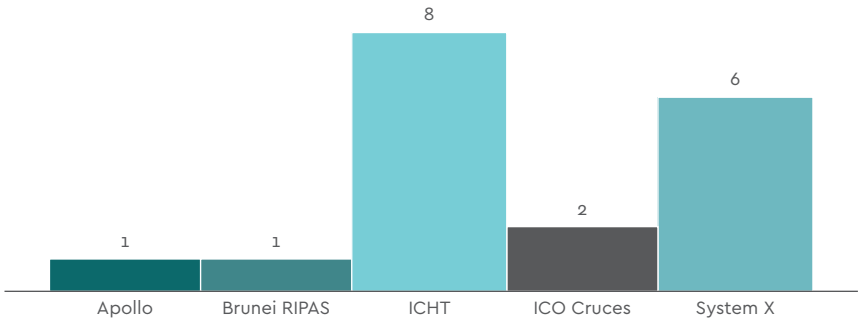
Within our sample, as shown in Figure 10, obstetric trauma rates are roughly in line with those of the OECD (though are not identically age-adjusted), with OECD rates ranging from 1 to 31 per 1,000 vaginal deliveries without instrument

and 8 to 171 per 1,000 vaginal deliveries with instrument.[58] It is also important to note that the sample size for RIPAS' vaginal deliveries with instrument is very low when compared to the other systems, which could potentially skew the results slightly.

Shoulder dystocia is defined as "a delivery that requires additional obstetric maneuvers to release the shoulders after gentle downward traction has failed".[59] Inappropriately managed shoulder dystocia carries a high risk of permanent injury and morbidity to both mother and fetus, so appropriate training and management are essential.[60] Though shoulder dystocia is considered unpreventable, there are several risk factors that can allow for closer monitoring, including macrosomia (larger than average birth weight), maternal diabetes, obesity, advanced maternal age, induction of labor and prolonged labor.[61]

Within our sample, as shown in Figure 11, shoulder dystocia is quite rare. This is in line with the literature, which indicates that the incidence of shoulder dystocia is typically between 2 and 30 per 1,000 vaginal births.[62] However, these figures should be viewed with a critical eye, as there is evidence of significant variation in diagnosing shoulder dystocia – as its diagnosis is subjective depending on case severity – and also of underreporting.[63]

Figure 11. Shoulder dystocia[64]



Note: Rate per 1,000 vaginal deliveries, age-adjusted to standardized population.

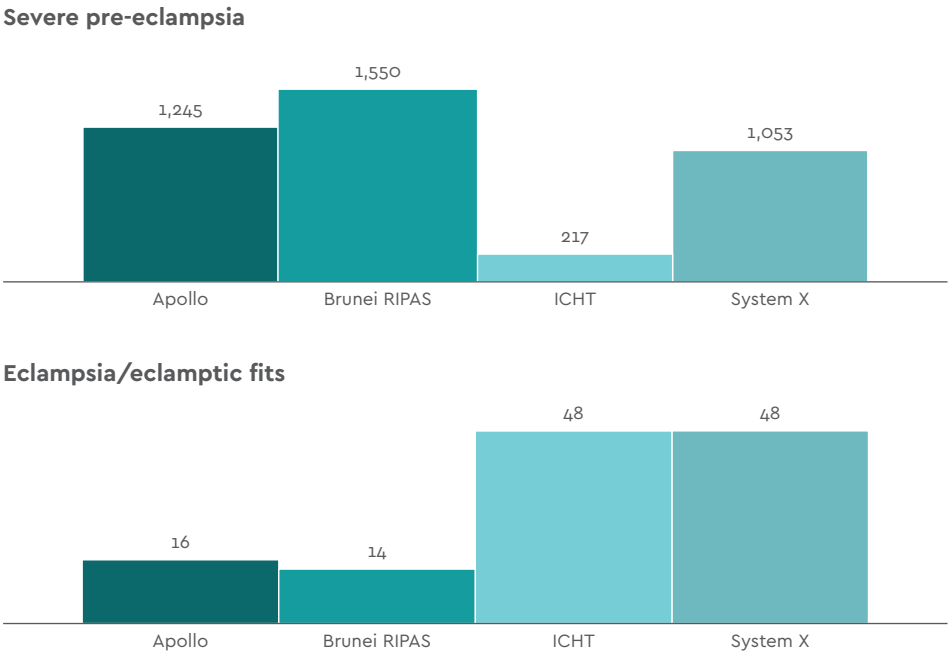
Pre-eclampsia is a hypertensive disorder also characterized by proteinuria (excess of protein in urine); if this condition is not properly identified and managed, it can lead to the development of eclampsia, a dangerous condition resulting in seizures.[65] There are several risk factors for developing pre-eclampsia – including obesity, multiple gestation, advanced maternal age and family history – though appropriate management and care during antenatal care should prevent the condition from progressing. This is why many organizations track incidence as a safety metric.[66]

Pre-eclampsia affects approximately 2–8 percent of pregnant women, though the WHO estimates that the incidence is approximately seven times higher in developing countries, relative to developed countries.[67,68] Rates for

pre-eclampsia in our sample, as shown in Figure 12, are slightly lower than this estimate – potentially due to careful management of those at risk during pregnancy or potentially due to measurement differences.

According to the literature, rates of eclampsia vary from to 44 per 100,000 births in Sweden to 66 per 100,000 births in Scotland to 86 per 100,000 births in an Australian region.[69–71] These estimates are roughly in line with rates from our sample, as shown in Figure 12, though RIPAS and Apollo have relatively lower rates.

Figure 12. Pre-eclampsia and eclampsia[72]

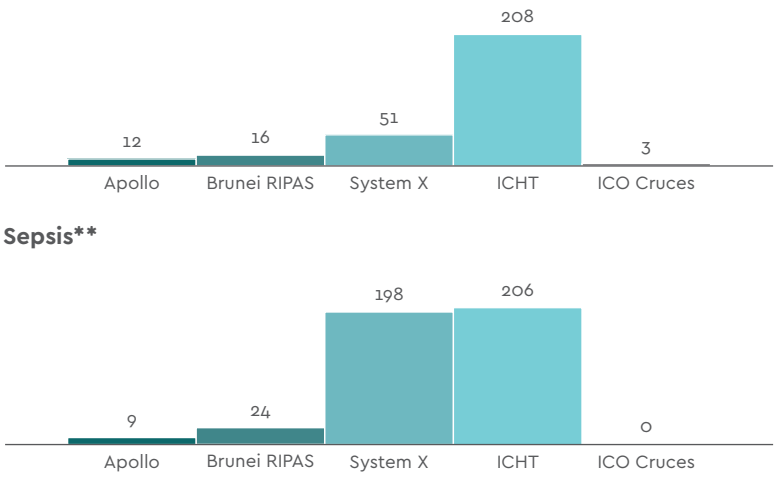


Note: Rate per 100,000 deliveries, age-adjusted to standardized population.

Postpartum hemorrhage is a loss of blood volume greater than 500ml within 24 hours of delivery, with major hemorrhage volume exceeding 1,000ml.[73] Postpartum hemorrhage is one of the leading causes of maternal mortality worldwide, though the vast majority of these deaths occur in low-income developing countries.[74] Further, postpartum hemorrhage contributes significantly to maternal morbidity; one study from Canada estimated that postpartum hemorrhage caused more than 50 percent of severe maternal morbidity.[75]

Postpartum hemorrhage rates vary widely, with estimates from roughly 2 to 8 percent across a sample of developed countries.[76,77] However, studies suggest that wide variation in rates may be due to varying practices in reporting and coding as well as the imprecise nature of estimating blood loss visually, particularly for minor hemorrhage.[78] Rates from our sample as shown in Figure 13 were, on the whole, lower than what is typically reported in the literature, with the exception of ICHT, which had a relatively high hemorrhage rate. It is unclear to what extent reporting and coding rates contribute to this discrepancy.

Figure 13. Postpartum hemorrhage and sepsis[79]



* Rate per 1,000 vaginal deliveries, age-adjusted to standardized population.
** Rate per 100,000 deliveries, age-adjusted to standardized population.

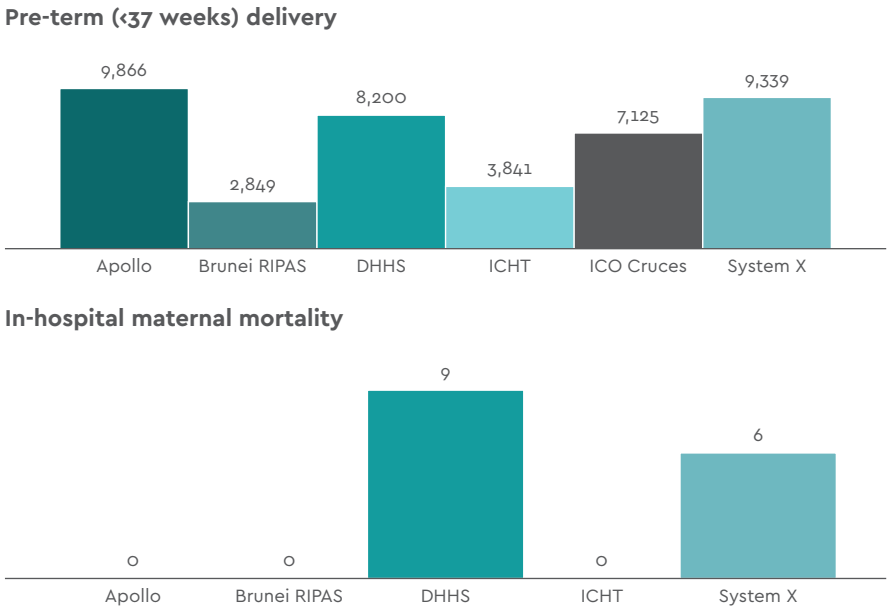
Sepsis is defined as "infection plus systemic manifestations of infection".[80] Sepsis accounts for over 10 percent of maternal deaths worldwide, though most of these deaths occur in low-income countries. Studies suggest, however, that maternal sepsis rates have been rising in some high-income countries, contributing significantly to maternal morbidity.[81]

Within our sample, as seen in Figure 13, rates of sepsis varied widely from 0 in ICO Cruces to 206 per 100,000 births at ICHT. While the literature notes limitations in sepsis measurements and comparisons, these rates are in line with outside estimates, which range from 0 to 400 per 100,000 deliveries across a range of European countries.[82, 83]

Pre-term births occur at less than 37 weeks gestation and are the leading cause of neonatal deaths worldwide.[84] While the cause of pre-term birth remains unknown in up to 50 percent of pre-term births, there are several risk factors that contribute to pre-term births including: infection, such as malaria, urinary tract infection, HIV and syphilis; lifestyle factors such as smoking and excessive alcohol consumption; and maternal factors such as advanced maternal age, low maternal age, and low body mass index (BMI).[85]

Within our sample, shown in Figure 14, pre-term delivery rates vary from 2,849 per 100,000 deliveries to 9,866 per 100,000. This is in line with the world-wide average rate of approximately 11.1 percent of deliveries. However, this varies by income level, with low-income countries having an average pre-term delivery rate of 11.8 percent of total deliveries as compared to 9.3 percent for high-income countries.

Figure 14. Pre-term deliveries and maternal mortality[86]



Note: Rate per 100,000 deliveries, age-adjusted to standardized population.

As mentioned in the introduction, maternal mortality – deaths due to pregnancy or childbirth complications – has decreased drastically over the last few decades and this burden lies primarily in the developing world.

Within our sample and shown in Figure 14, in-hospital maternal mortality rates range from 0 to 9 per 100,000 deliveries. These rates are in line with World Bank estimates and the OECD average of 14 per 100,000 live births.[87] Notably, most organizations in our sample have significantly lower maternal mortality rates than their country's average.

CONCLUSION

Despite making great strides in improving the safety of maternity care, we still have much work to do. The number of women harmed while receiving care is still unacceptably high. We must continue to strive to make maternity units safer and reduce morbidity associated with care. Doing so will not only improve the lives of mothers but also potentially reduce avoidable costs related to additional procedures, longer hospital stays, litigation and further ill health.

The cost of treating a single case of sepsis in the developed world setting, for instance, is estimated to be upwards of $20,000.[88, 89] Treating postpartum hemorrhage can contribute an additional $1,900 to $3,000 per delivery.[90] Malpractice claims due to unsafe care also contribute. In the UK, the average payout over the period from 2000 to 2010 for a malpractice claim relating to perineal trauma was £70,754.73 and £414,083.33 for shoulder dystocia.[91] There are also potentially significant costs associated with the psychological consequences from birth trauma, although these are more difficult to measure.[92]

Improvement starts with examining the current care environment. How strong is our safety culture? Do all staff feel comfortable expressing safety concerns? Is safety viewed as the responsibility of every staff member? What safety outcomes do we achieve? Where can we improve, and where should we focus our energies?

Through LHSN, we connect a group of healthcare leaders and organizations who are committed to continuous improvement and learning from one another. While inter-organizational and international comparisons are difficult and have many limitations, we believe the value of such comparisons is in starting a dialogue. We thank the seven organizations that have worked diligently to provide accurate data. We hope that this piece of work will be useful in identifying priority improvement areas and, ultimately, making care safer for mothers and babies.

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APPENDIX

Methodology

The appendix provides additional detail on the methodology described in Section 1 of this report.

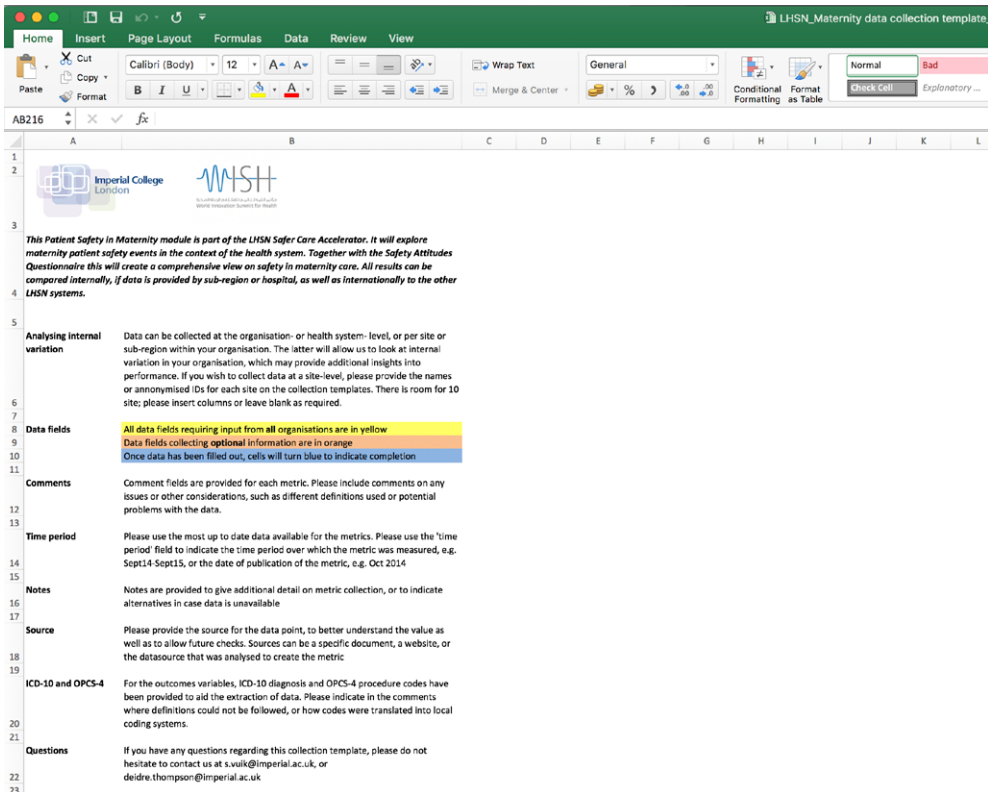
Context and safety outcomes

Context and safety outcomes overview

The data request for the context and safety outcomes modules was distributed to participants electronically as a Microsoft Excel file. The file has three tabs:

- 'Cover page': containing instructions for how to complete the document
- 'Context': questions about the organization's structural and demographic information
- 'Outcomes': request for metrics, by ICD-10 diagnosis codes and OPCS-4 procedure codes, broken down by age band and, if applicable, maternity site
- The figures below contain screenshots of tabs from the data request for each category.

Figure A1. 'Cover page' tab



LHSN_Maternity data collection template

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This Patient Safety in Maternity module is part of the LHSN Safer Care Accelerator. It will explore maternity patient safety events in the context of the health system. Together with the Safety Attitudes Questionnaire this will create a comprehensive view on safety in maternity care. All results can be compared internally, if data is provided by sub-region or hospital, as well as internationally to the other LHSN systems.

Analysing internal variation — Data can be collected at the organisation- or health system- level, or per site or sub-region within your organisation. The latter will allow us to look at internal variation in your organisation, which may provide additional insights into performance. If you wish to collect data at a site-level, please provide the names or annonymised IDs for each site on the collection templates. There is room for 10 site; please insert columns or leave blank as required.

Data fields
- All data fields requiring input from **all** organisations are in yellow
- Data fields collecting **optional** information are in orange
- Once data has been filled out, cells will turn blue to indicate completion

Comments — Comment fields are provided for each metric. Please include comments on any issues or other considerations, such as different definitions used or potential problems with the data.

Time period — Please use the most up to date data available for the metrics. Please use the 'time period' field to indicate the time period over which the metric was measured, e.g. Sept14-Sept15, or the date of publication of the metric, e.g. Oct 2014

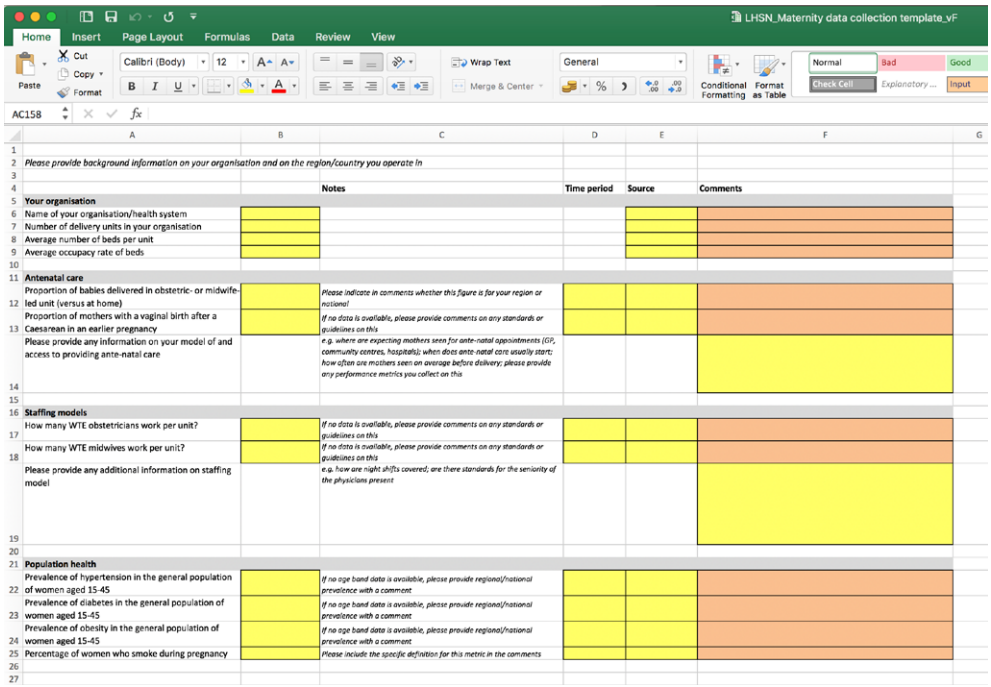
Notes — Notes are provided to give additional detail on metric collection, or to indicate alternatives in case data is unavailable

Source — Please provide the source for the data point, to better understand the value as well as to allow future checks. Sources can be a specific document, a website, or the datasource that was analysed to create the metric

ICD-10 and OPCS-4 — For the outcomes variables, ICD-10 diagnosis and OPCS-4 procedure codes have been provided to aid the extraction of data. Please indicate in the comments where definitions could not be followed, or how codes were translated into local coding systems.

Questions — If you have any questions regarding this collection template, please do not hesitate to contact us at s.vuik@imperial.ac.uk, or deidre.thompson@imperial.ac.uk

Figure A2. 'Context' tab



LHSN_Maternity data collection template_vF

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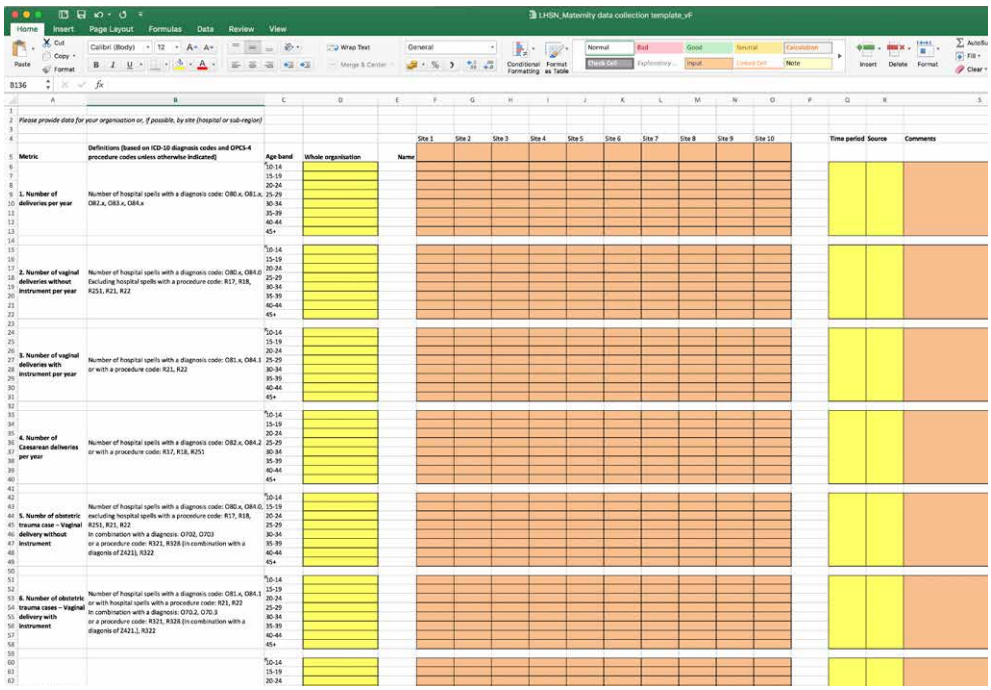
Please provide background information on your organisation and on the region/country you operate in

		Notes	Time period	Source	Comments
Your organisation					
Name of your organisation/health system					
Number of delivery units in your organisation					
Average number of beds per unit					
Average occupacy rate of beds					
Antenatal care					
Proportion of babies delivered in obstetric- or midwife-led unit (versus at home)		*Please indicate in comments whether this figure is for your region or national*			
Proportion of mothers with a vaginal birth after a Caesarean in an earlier pregnancy		*If no data is available, please provide comments on any standards or guidelines on this*			
Please provide any information on your model of and access to providing ante-natal care		*e.g. where are expecting mothers seen for ante-natal appointments (GP, community centres, hospitals); when does ante-natal care usually start; how often are mothers seen on average before delivery; please provide any performance metrics you collect on this*			
Staffing models					
How many WTE obstetricians work per unit?		*If no data is available, please provide comments on any standards or guidelines on this*			
How many WTE midwives work per unit?		*If no data is available, please provide comments on any standards or guidelines on this*			
Please provide any additional information on staffing model		*e.g. how are night shifts covered; are there standards for the seniority of the physicians present*			
Population health					
Prevalence of hypertension in the general population of women aged 15-45		*If no age band data is available, please provide regional/national prevalence with a comment*			
Prevalence of diabetes in the general population of women aged 15-45		*If no age band data is available, please provide regional/national prevalence with a comment*			
Prevalence of obesity in the general population of women aged 15-45		*If no age band data is available, please provide regional/national prevalence with a comment*			
Percentage of women who smoke during pregnancy		*Please include the specific definition for this metric in the comments*			

Figure A3. 'Outcomes' tab



Safety outcomes data specification

The following ICD-10 diagnosis codes and OPCS-4 were used to calculate outcome metrics. In the event that codes were not directly applicable due to alternate coding systems, coding definitions were used to map the most relevant codes. All data was age adjusted to a standard population to improve comparability. However, regional differences in coding/reporting may account for some of the variation in outcomes, and this should be taken into account when interpreting the data.

Figure A4. Safety outcome metric definitions

Metric	Definitions (based on ICD-10 diagnosis codes and OPCS-4 procedure codes unless otherwise indicated)
Number of deliveries per year	Number of hospital spells with a diagnosis code: O80.x, O81.x, O82.x, O83.x, O84.x
Number of vaginal deliveries without instrument per year	Number of hospital spells with a diagnosis code: O80.x, O84.0 Excluding hospital spells with a procedure code: R17, R18, R251, R21, R22
Number of vaginal deliveries with instrument per year	Number of hospital spells with a diagnosis code: O81.x, O83.x, O84.1 or with a procedure code: R21, R22
Number of Caesarean deliveries per year	Number of hospital spells with a diagnosis code: O82.x, O84.2 or with a procedure code: R17, R18, R251
Number of obstetric trauma cases – vaginal delivery without instrument	Number of hospital spells with a diagnosis code: O80.x, O84.0, excluding hospital spells with a procedure code: R17, R18, R251, R21, R22 in combination with a diagnosis: 0702, 0703 or a procedure code: R321, R328 (in combination with a diagnosis of Z421, R322
Number of obstetric truma cases – vaginal delivery with instrument	Number of hospital spells with a diagnosis code: O81.x, O84.1 or with hospital spells with a procedure code: R21, R22 in combination with a diagnosis: O70.2, O70.3 or a procedure code: R321, R328 (in combination with a diagnosis of Z421.1, R322
Number of severe pre-eclampsia cases	Number of hospital spells with a diagnosis code: O14.1
Number of eclampsia/ eclampic fit cases	Number of hospital spells with a diagnosis code: O15.x
Number of shoulder dystocia cases	Number of hospital spells with a diagnosis code: O66.0
Number of postpartum hemorrhage and major obstertric hemorrhage cases	Number of hospital spells with a diagnosis code: O72.1, O72.2
Number of in-hospital maternal mortality cases	Number of hospital spells with a diagnosis code: O80.x, O81.x, O82.x, O83.x, O84.x, where the discharge method is death or with a diagnosis code: O95.x, O96.x, O97.x
Number of pre-term (<37 weeks) delivery cases	Number of hospital spells with a diagnosis code: O60.x
Number of sepsis cases	Number of hospital spells with a diagnosis code: O85.x
Number of elective Caesareans	Number of hospital spells with a diagnosis code: O82.0 or with a disagnosis code: R17

Figure A5. Safety outcomes data population and source

Organization	Population included	Data year
Apollo Hospitals (Apollo)	Hospitals from the following regions: Delhi, Chennai, Bangalore, Vanagaram, Madurai, AFMH, Karaikudi, Cradle Jayanagar, Cradle Koramangla, and Karappakkam	October 2014–October 2015
Brunei & Darussalam Ministry of Health (Brunei RIPAS)	Raja Isteri Pengiran Anak Saleha Hospital	2015
Victorian Department of Health and Human Services (DHHS)	State of Victoria	2013
Hong Kong Hospital Authority (HKHA)	Kwong Wah Hospital, Princess Margaret Hospital, Prince of Wales Hospital, Pamela Youde Nethersole Eastern Hospital, Queen Elizabeth Hospital, Queen Mary Hospital, Tuen Mun Hospital, and United Christian Hospital	2015
Imperial College Healthcare NHS Trust (ICHT)	Imperial College Healthcare Trust (public/private)	2016
Basque Country (ICO Cruces)	ICO Cruces	2016
System X	Four hospitals providing maternity services	2015

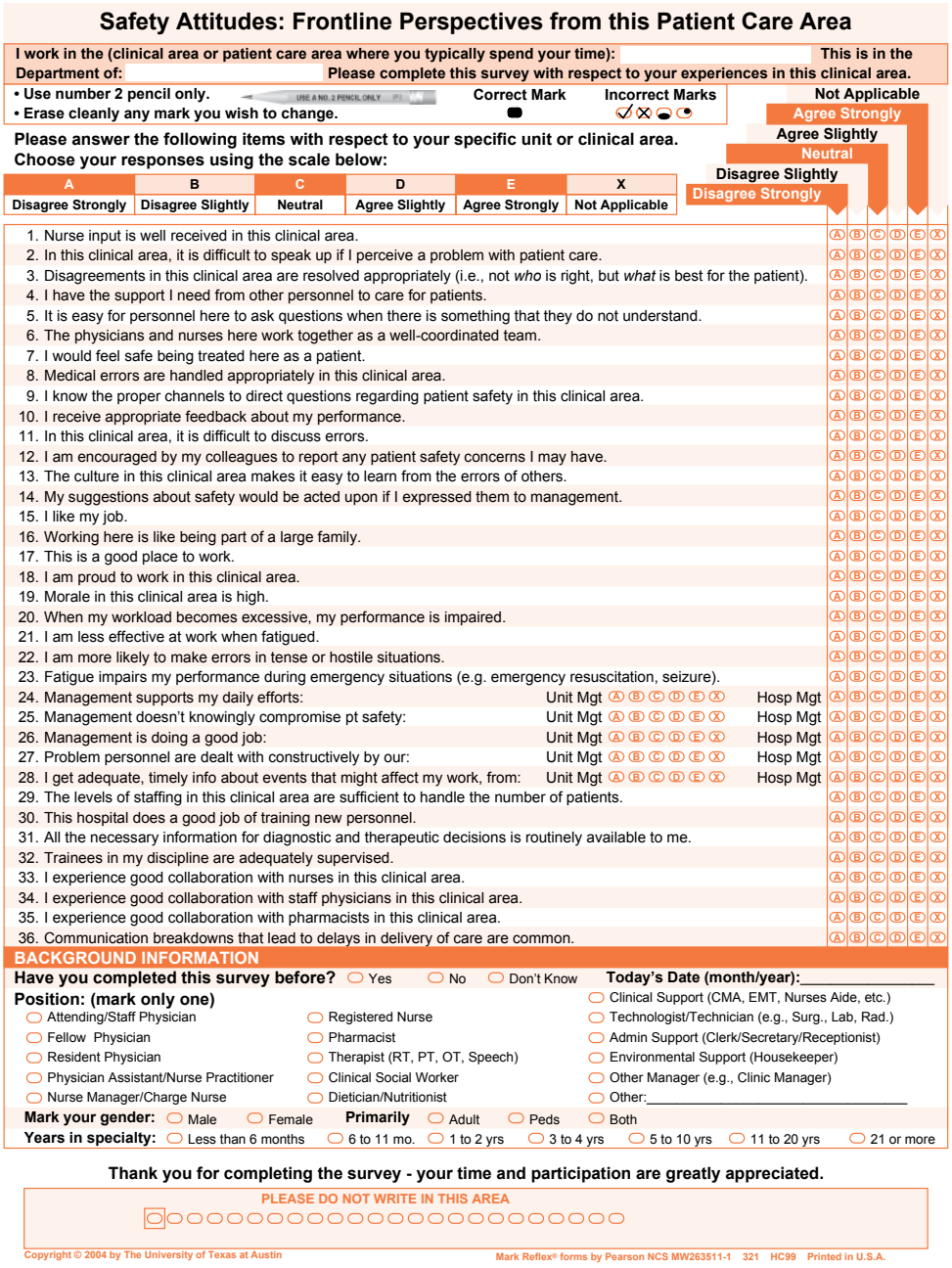
Safety culture

Safety culture overview

We loaded the SAQ into Qualtrics, an online survey tool. Participating organizations were then provided with a publicly accessible link to distribute the survey internally. Some staff filled in the survey using a paper copy, which was then scanned and returned to Imperial staff via email.

Figures A6 and A7 provide an overview of questions included in the SAQ as well as the breakdown of participants by organization.

Figure A6. SAQ



Safety Attitudes: Frontline Perspectives from this Patient Care Area

I work in the (clinical area or patient care area where you typically spend your time): **This is in the Department of:** **Please complete this survey with respect to your experiences in this clinical area.**

- **Use number 2 pencil only.**
- **Erase cleanly any mark you wish to change.**

Correct Mark **Incorrect Marks**

Please answer the following items with respect to your specific unit or clinical area.
Choose your responses using the scale below:

A	B	C	D	E	X
Disagree Strongly	Disagree Slightly	Neutral	Agree Slightly	Agree Strongly	Not Applicable

Not Applicable
Agree Strongly
Agree Slightly
Neutral
Disagree Slightly
Disagree Strongly

1. Nurse input is well received in this clinical area.
2. In this clinical area, it is difficult to speak up if I perceive a problem with patient care.
3. Disagreements in this clinical area are resolved appropriately (i.e., not *who* is right, but *what* is best for the patient).
4. I have the support I need from other personnel to care for patients.
5. It is easy for personnel here to ask questions when there is something that they do not understand.
6. The physicians and nurses here work together as a well-coordinated team.
7. I would feel safe being treated here as a patient.
8. Medical errors are handled appropriately in this clinical area.
9. I know the proper channels to direct questions regarding patient safety in this clinical area.
10. I receive appropriate feedback about my performance.
11. In this clinical area, it is difficult to discuss errors.
12. I am encouraged by my colleagues to report any patient safety concerns I may have.
13. The culture in this clinical area makes it easy to learn from the errors of others.
14. My suggestions about safety would be acted upon if I expressed them to management.
15. I like my job.
16. Working here is like being part of a large family.
17. This is a good place to work.
18. I am proud to work in this clinical area.
19. Morale in this clinical area is high.
20. When my workload becomes excessive, my performance is impaired.
21. I am less effective at work when fatigued.
22. I am more likely to make errors in tense or hostile situations.
23. Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure).
24. Management supports my daily efforts: Unit Mgt Hosp Mgt
25. Management doesn't knowingly compromise pt safety: Unit Mgt Hosp Mgt
26. Management is doing a good job: Unit Mgt Hosp Mgt
27. Problem personnel are dealt with constructively by our: Unit Mgt Hosp Mgt
28. I get adequate, timely info about events that might affect my work, from: Unit Mgt Hosp Mgt
29. The levels of staffing in this clinical area are sufficient to handle the number of patients.
30. This hospital does a good job of training new personnel.
31. All the necessary information for diagnostic and therapeutic decisions is routinely available to me.
32. Trainees in my discipline are adequately supervised.
33. I experience good collaboration with nurses in this clinical area.
34. I experience good collaboration with staff physicians in this clinical area.
35. I experience good collaboration with pharmacists in this clinical area.
36. Communication breakdowns that lead to delays in delivery of care are common.

BACKGROUND INFORMATION

Have you completed this survey before? Yes No Don't Know **Today's Date (month/year):**_____

Position: (mark only one)

- Attending/Staff Physician
- Fellow Physician
- Resident Physician
- Physician Assistant/Nurse Practitioner
- Nurse Manager/Charge Nurse
- Registered Nurse
- Pharmacist
- Therapist (RT, PT, OT, Speech)
- Clinical Social Worker
- Dietician/Nutritionist
- Clinical Support (CMA, EMT, Nurses Aide, etc.)
- Technologist/Technician (e.g., Surg., Lab, Rad.)
- Admin Support (Clerk/Secretary/Receptionist)
- Environmental Support (Housekeeper)
- Other Manager (e.g., Clinic Manager)
- Other:_____

Mark your gender: Male Female **Primarily** Adult Peds Both

Years in specialty: Less than 6 months 6 to 11 mo. 1 to 2 yrs 3 to 4 yrs 5 to 10 yrs 11 to 20 yrs 21 or more

Thank you for completing the survey - your time and participation are greatly appreciated.

PLEASE DO NOT WRITE IN THIS AREA

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Figure A7. SAQ participant information

Organization	No. participants	Participants breakdown
Apollo Hospitals (Apollo)	40	Admin support: 7 Attending/staff physician: 2 Dietician/nutritionist: 3 Fellow physician: 4 Other: 3 Other manager: 3 Pharmacist: 2 Registered nurse: 11 Resident physician: 3 Technologist/technician: 2
Brunei & Darussalam Ministry of Health (Brunei RIPAS)	29	Attending/staff physician: 4 Midwife: 7 Nurse manager/charge nurse: 3 Other: 2 Other manager: 1 Physician assistant/nurse practitioner: 1 Registered nurse: 9 Resident physician: 2
Hong Kong Hospital Authority (HKHA)	13	Attending/staff physician: 1 Fellow physician: 10 Nurse manager/charge nurse: 2
Imperial College Healthcare NHS Trust (ICHT)	66	Admin/clerical: 8 Allied health professional: 3 Nursing/midwifery: 52 Pharmacist: 1 Physician: 2
ICO Ezkerraldea-Enkarterri-Cruces (ICO Cruces)	87 (this group completed the questionnaire by consensus, rather than individually)	Auxiliary nurses: 20 Midwives: 28 Registered nurses: 15 Physicians: 24

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