Why Don't Providers Identify and Manage Maternal Sepsis? a Mixed-Methods Approach to Developing an Awareness Campaign to Accompany a WHO-Led Multi-Country Study

Why don't providers identify and manage maternal sepsis?

A mixed-methods approach to developing an awareness campaign to accompany a WHO-led multi-country study

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Abstract

Maternal sepsis continues to be one of the greatest contributors to maternal deaths globally. I explored the factors affecting healthcare provider awareness on maternal sepsis in order to better inform a campaign that accompanied a 53-country one-week inception cohort study validating a new definition for this condition. I used a mixed-method approach through semi-structured interviews with 13 study regional and country coordinators, and an online survey collecting responses from 1,071 providers from participating facilities. While 96% of the total sample had heard of maternal sepsis, few (19%) could correctly identify the two necessary criteria for defining it or the correct management of the condition (44%), even after controlling for provider age, qualifications, and region. exposure to training and an online congress were significantly associated with increased knowledge. More respondents were able to recognize essential resources needed for managing maternal sepsis, than there was for identifying it. Fear of making mistakes was one of the main barriers for correct and timely decision-making. Self-confidence and institutional support were low, despite the perception of availability of specific protocols and exposure to training. While most respondents situated maternal sepsis as one of the top conditions affecting women, the majority only saw this occurring in less than 11% of deliveries in their facilities. The results of my project indicate that research studies would benefit from including awareness campaigns as part of their main objectives. In addition to helping attain the overarching research goal, they can also help in obtaining buy-in, and developing and strengthening a sense of community among providers of large multi-country studies.

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List of acronyms

AFRO	Africa Regional Office
CC	Country Coordinator
DELTA	Doctoral Engagement in Leadership and Translation for Action
EMRO	Eastern Mediterranean Regional Office
ERC	Ethics Review Committee
EURO	Europe Regional Office
GLOSS	Global Maternal Sepsis Study
GSA	Global Sepsis Alliance
HIC	High-income country
HRP	Human Reproduction Programme
ICU	Intensive Care Unit
INOSS	International Network of Obstetric Survey Systems
IRB	Institutional Review Board
LMIC	Low- and Middle-income Country
MDGs	Millennium Development Goals
MeSH	Medical Subject Headings
MPA	Maternal and Perinatal health and safe Abortion
PAHO	Pan American Health Organization
PEE	Pre-eclampsia/Eclampsia

PI	Principal Investigator
PPH	Postpartum Hemorrhage
RC	Regional Coordinator
RFP	Request for Proposals
RHR	Reproductive Health and Research
SDGs	Sustainable Development Goals
SEARO	South East Asia Regional Office
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
US	United States
USAID	United States Agency for International Development
USD	United States dollars (currency)
WASH	Water, sanitation and hygiene
WHO	World Health Organization
WPRO	Western Pacific Regional Office
WSC	World Sepsis Congress
WSD	World Sepsis Day

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"You must write a thesis that you are able to write"

Umberto Eco – How to Write a Thesis (1977)

Section I: Introduction

Background

Every year, approximately 300,000 women and 2.8 million neonates die as a result of complications of pregnancy, childbirth, and during the postnatal period (Alkema et al., 2016; Chou, Daelmans, Jolivet, Kinney, & Say, 2015). Pregnancy-related infections are the third most common direct cause of maternal death, representing approximately 11% of all maternal deaths and about 20% of neonatal deaths (Chou et al., 2015; Lozano et al., 2013; Say et al., 2014). Infections, including malaria, dengue, HIV, pyelonephritis and influenza-like illness, are also an important cause of indirect maternal deaths (Lumbiganon et al., 2014). There is great variability in maternal deaths associated with infection across regions, ranging from 10.7% in developing vs. 4.7% in developed countries (Acosta & Knight, 2013; Schutte et al., 2010). Many of these deaths result from sepsis, a potentially life-threatening organ dysfunction caused by an overwhelming host response to infection. Sepsis and other systemic infections account for a high proportion of maternal morbidity as well (Acosta et al., 2014; Karsnitz, 2013; Lumbiganon et al., 2014). A systematic review of severe maternal morbidity in sub-Saharan Africa established a case fatality ratio for sepsis ranging from 0% to almost 73% (Kaye, Kakaire, & Osinde, 2011). Available data on pregnancy-related sepsis from high-income countries state an incidence ranging from 9 to 49 per 100,000 deliveries-years. These data, together with a dearth of information from low- and middle-income countries, illustrate the need to understand how sepsis affects women during pregnancy and childbirth and what is the true burden of disease. Given the variability in the data diagnosing both maternal and neonatal infection can be difficult (Chou et al., 2016; Cortese et al., 2016). Furthermore, the social

determinants of health are also important factors that impact health outcomes (Tunçalp et al., 2014).

Recent reviews of the literature on maternal sepsis revealed a very heterogeneous definition and identification criteria for maternal sepsis. In an attempt to increase consistency, the World Health Organization (WHO) expert consultation group developed a new definition for maternal sepsis as "***a life-threatening condition defined as organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion, or postpartum period***" (World Health Organization, 2017, p. 3).

One of the key barriers to reducing sepsis-related deaths is the difficulty in recognizing the severity of infection by pregnant or postpartum women themselves, their family members, or healthcare providers (Acosta & Knight, 2013). Pregnancy increases women's risk of sepsis because they become more susceptible to infection due to several physiological, immunological, and mechanical changes that occur during this period (Kourtis, Read, & Jamieson, 2014). This difficulty is crucial both for mother and baby since most early neonatal sepsis cases are caused by maternal infection (Cortese et al., 2016). Albeit the existence of clinical tools developed for identifying women at risk, they have limited predictive value for the risk of developing maternal sepsis or identifying women who may require early treatment or critical care due to infection (Arora et al., 2016; Edwards et al., 2015). Furthermore, many of the existing tools are hard to use in poor resource settings, in addition to other health system challenges, such as limited or no access to medication for prevention and treatment that may also hinder providers' capacity to respond to infections (Souza et al., 2013). This set of challenges calls for the need to develop actionable criteria for the identification of presumed maternal sepsis cases, to manage complications and improve outcomes. Clinical tools for predicting and managing maternal sepsis are also needed (Aarvold et al., 2017).

In 2002, the European Society of Intensive Care Medicine, the International Sepsis Forum, and the Society of Critical Care Medicine launched the Survive Sepsis Campaign that included among its goals to increase awareness of sepsis, while improving diagnosis and treatment (Marshall, Dellinger, & Levy, 2010). The development of clinical guidelines that included bundles of care for timely management of sepsis impacted the way that sepsis was managed globally (Levy et al., 2014). However, as noted earlier, these tools have not been validated in resource-restricted settings, nor are they specific to pregnant or postpartum/post-abortion women.

The Sustainable Development Goals (SDGs) launched by the United Nations in late 2015 include, within their goal number 3 of "*ensuring healthy lives and promoting well-being for all at all ages*," specific targets regarding maternal and neonatal mortality ("SDGs .:. Sustainable Development Knowledge Platform," n.d.). The goal for 2030 is to reduce the global maternal mortality ratio (MMR) to less than 70 per 100,000 live births from a baseline of 216 in 2015, and to reduce the neonatal mortality rate to at least 12 per 1,000 live births, down from 19.2 in 2015. The data described above show that there is significant work ahead. It will require concerted work both from a global perspective as well as from a regional and national perspective.

In pursuit of attaining these goals, that while feasible can prove to be challenging for many regions and countries, a global initiative was launched in 2016 to reduce deaths among women and newborns due to sepsis. This Global Maternal and Neonatal Sepsis Initiative spearheaded by WHO and Jhpiego at Johns Hopkins University includes different components, such as research, innovation, service delivery, and advocacy as an integrated approach to achieve its goal. This initiative has the mission to develop solutions aimed at reducing maternal and newborn death related to sepsis, with an overarching goal of accelerating the reduction of preventable deaths. Among the Initiative's objectives are raising awareness and assessing the burden and management of maternal and neonatal sepsis at a global level ("The Global Maternal and Neonatal Sepsis Initiative," 2017). One way in which awareness can be raised is through health campaigns.

Health awareness campaigns

Healthcare provider knowledge and attitudes can be improved through a targeted health communication and health behavior intervention. Health communication campaigns have been used in multiple occasions to increase public awareness on a specific health topic or to improve knowledge or attitudes toward a health-related behavior (Glanz, Rimer, & Lewis, 2002).

Healthcare associated infections are a great contributor to patient infections that lead to sepsis. Many campaigns targeting healthcare providers have been implemented in different settings in the past to reduce infections in healthcare services. Some have targeted hand-washing as a crucial intervention that can reduce the spread of infection, most of them with significant positive results (Gillespie, ten Berk de Boer, Stuart, Buist, & Wilson, 2007; Hugonnet, Perneger, & Pittet, 2002; Murni, Duke, Kinney, Daley, & Soenarto, 2015; Won et al., 2004). Campaigns have also been implemented in healthcare facilities to address other issues affecting healthcare workers: influenza vaccination, equipment sterilization, responsible antimicrobial use, as well as other medical interventions (Gray et al., 2015; Stocker et al., 2012; Uneke et al., 2014; Zielonka, Szymanczak, Jakubiak, Nitsch-Osuch, & Zycinska, 2016). It is worth noting that not all campaigns are the same, and those that seem the most successful are the ones that include multi-modal components (Mazi, Senok, Al-Kahldy, & Abdullah, 2013). When targeting the entire healthcare worker staff, they tend to have better results among nursing staff (Pittet et al., 2000). Nonetheless, there are some campaigns that have shown mixed results, either because their sustained effect is unknown or small, or because they have a limited effect on physicians –an important cadre of workers dealing with patients at risk for or already affected by sepsis (Pittet, Mourouga, & Perneger, 1999; von Lengerke et al., 2017).

The reality is that the impact that awareness campaigns have on behavior change has been deficiently assessed; despite the abundance of awareness campaigns, public health campaigns, and

other media-based interventions for health, few of them have been properly and systematically evaluated for impact, effectiveness, and efficiency (Randolph & Viswanath, 2004). Admittedly, behavior change is complex, complicated, and context-specific (Viswanath, Finnegan, & Gollust, 2015). Many scholars have provided frameworks for understanding health behavior and behavior change, among them the social cognitive theory and the theory of reasoned action (Bandura, 1977; Fishbein & Yzer, 2003). Other ecological models have successfully included the importance of the environment influencing individual behavior and actions (McLeroy, Bibeau, Steckler, & Glanz, 1988). These models and theories provide a backdrop upon which to understand the intricacies and difficulties related to influencing behavior. What seems clear from the campaign examples provided is that targeted, specific, and multimodal actions are more effective.

This written thesis will cover the following sections:

- ***Section I:*** An abstract of the entire project
- ***Section II:*** An introduction to the public health problem.
- ***Section III:*** An analytic platform. This section includes a description of the overall study, my DELTA project, and the methods used for answering my research questions. This last sub-section includes the description of the qualitative and quantitative methods uses for data collection and analysis.
- ***Section IV:*** A results statement. This section presents the results and exhibits, as well as analysis of the findings, including a discussion section and limitations of this project.
- ***Section V:*** A conclusions section. This section synthesizes the information analyzed and collected for this project in terms of challenges and opportunities to increasing provider awareness on maternal sepsis, implications for global maternal health, and offers some recommendations for the future.

"Sepsis is life-threatening, but when caught early and treated promptly, it can be stopped."

GLOSS Awareness Campaign (2017-2018)

Section II: Analytical Platform

My DELTA project was inserted into a broader study that included many different components. In order to better understand the context in which my project was defined and designed, I present with an overview of the entire study. At the broadest level is the Global Maternal Sepsis Study and Awareness Campaign (GLOSS). The awareness campaign which I led is one of the components of GLOSS. My DELTA project, by attempting to respond to my research questions, comprised both the formative and implementation stages of the awareness campaign. See **Figure 1** for a schematic representation of this.

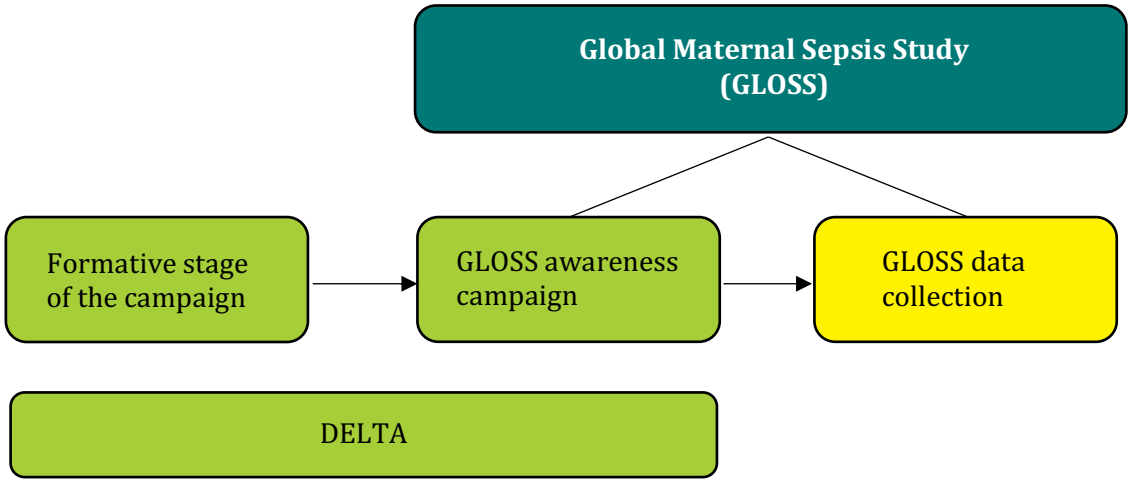

Figure 1. Schematic representation of GLOSS and DELTA

The Global Maternal Sepsis Study and Awareness Campaign (GLOSS)

In order to bridge the knowledge gap identified by the literature, and as a way to validate and test the new definition of sepsis, WHO led a multi-country study to specifically assess the global burden of maternal sepsis ("The Global Maternal and Neonatal Sepsis Initiative," 2017). This study was coordinated by the Maternal and Perinatal Health and Safe Abortion (MPA) Team at the Reproductive Health and Research (RHR) Department at WHO. RHR includes the UNDP-UNFPA-UNICEF-WHO-World Bank Special Program of Research, Development and Research Training in Human Reproduction (HRP). RHR and HRP:

> "*provide leadership on matters critical to sexual and reproductive health through shaping the research agenda, and coordinating high-impact research; setting norms and standards; articulating an ethical and human-rights-based approach; and supporting research capacity in low-income settings*" ("WHO | Department of Reproductive Health and Research," n.d.).

Within this department, the MPA team leads all research relating to maternal and perinatal health, including safe abortion. They lead the development of clinical guidelines on all issues related to maternal health (e.g., postpartum hemorrhage, antenatal care, safe abortion) as well as clinical and implementation research on these topics.

I was a part of the GLOSS coordinating team at WHO, also comprised of two medical officers with extensive research experience, including leading multi-country studies. On the next coordinating level for GLOSS, there were seven regional coordinators (RCs): one for each of the six low- and middle-income regions participating in the study (Latin America, Europe, Eastern Mediterranean, Francophone Africa, Anglophone Africa, and Asia), and one for the high-income countries (HICs). RCs were the main focal point between WHO in Geneva, and the country teams leading the study on the ground. Additionally, there were country coordinators (CCs) (one per country, for the most

part) who were in charge of leading the study in their countries. Lastly, each participating facility had a coordinator who oversaw data collection and implementation of the study at the facility level. See **Figure 2** for a graphical depiction of the coordinating structure.

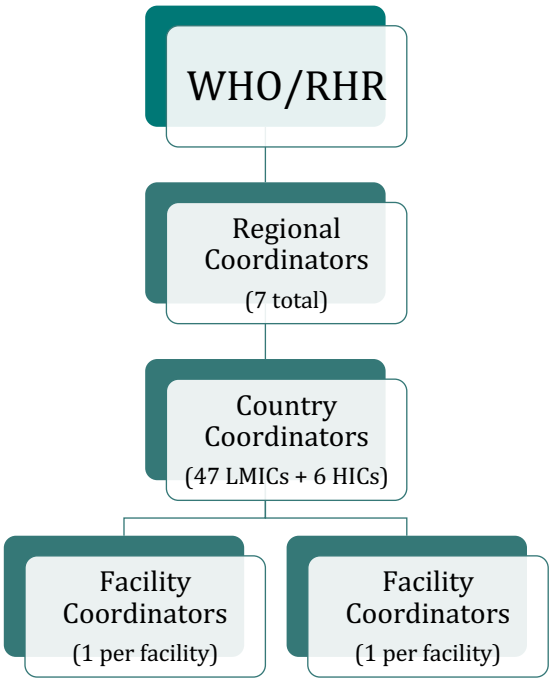

Figure 2. Schematic representation of the coordinating structure for GLOSS

In addition, GLOSS had a technical advisory group that had provided valuable feedback and guidance on the original development of the protocol. This group included researchers, academics, and implementers from different global organizations. GLOSS was funded by Merck for Mothers and USAID, with supplemental money coming from HRP/RHR core funding. A total of USD 2,000,000 was destined for GLOSS; each of the participating low- and middle-income countries was provided with an approximate budget of USD 15,000 for conducting the study in their selected facilities. High-income countries did not receive WHO funding for this study.

GLOSS was implemented in 47 low- and middle-income (LMIC) and six high-income countries (HIC) representing the six WHO regions (see **Figure 3** below). The breakdown of countries per region is as follows: fourteen countries in Africa, six in Francophone Africa, and eight in Anglophone and

Lusophone Africa combined (both belonging to AFRO); six in the Eastern Mediterranean (EMRO); seven in Eastern Europe and Central Asia (EURO); eleven in Latin America (PAHO); and nine in Asia, five in South and South East Asia, and four in the Pacific region (SEARO and WPRO combined).[*] Countries selected to participate were based on prior experience with WHO-led multi-country studies, research capabilities, and interest. Regional coordinators were also selected based on research experience and through other linkages with WHO/RHR (i.e., members of the HRP Alliance or a WHO Collaborating Centre[**]). Country coordinators were selected by the WHO country offices in conjunction with National Ministries of Health, and they each represented a variety of organizations: research institutions, universities and university hospitals, WHO country offices, and ministries of health. All participating high-income countries belonged to an international network of obstetric survey systems (INOSS) coordinated by the University of Oxford in the UK.

[*] WHO divides the world into six regions: AFRO, EMRO, EURO, PAHO, SEARO, and WPRO.

[**] The HRP Alliance is led by the MPA team with the goal to support research and research capacity strengthening in sexual and reproductive health and rights research in low- and lower-middle income countries. WHO Collaborating Centres are institutions (research institutes, universities, or other academic units) designated to perform activities in support of WHO's goals and programs ("WHO | HRP Alliance," n.d.; "WHO | WHO collaborating centres," n.d.).

Figure 3. Participating countries in the Global Maternal Sepsis Study and Awareness Campaign (GLOSS)

Source: Global Maternal and Neonatal Sepsis Initiative website: http://srhr.org/sepsis/about/study/

The study entailed a simultaneous data collection activity in approximately 500 healthcare facilities located in specific geographical areas within the selected countries during the week of 28 November to 04 December 2017 (see **Deliverable 1** for the published paper describing the protocol for this study providing more details on the overarching project (Bonet et al., 2018)). During this week, all women admitted in participating health facilities during pregnancy, childbirth, and up to 42-days postpartum or post-abortion were screened for signs or diagnoses of infection. For each geographical area selected, most (if not all) secondary and tertiary level facilities were selected for inclusion in order to ensure that no women with complications due to infection, possible severe maternal infection, or maternal sepsis were lost to follow-up. Because of this approach, primary stakeholders in this process were healthcare providers.

Objectives of GLOSS:

1- to develop and validate two sets of criteria for the identification of possible severe maternal infection (presumed maternal sepsis) and maternal sepsis (confirmed sepsis);

2- to assess the frequency and the outcomes of maternal sepsis in developing and developed countries;

3- to assess the use of effective practices for prevention, early identification and management of maternal sepsis;

4- to explore levels of awareness about maternal sepsis among healthcare providers.

The goal of including the awareness campaign as part of the larger study was to improve provider ability and sensitivity to identify warning signals, signs, and markers for infection and sepsis among pregnant women or women during childbirth, postpartum or post-abortion during data collection. The idea behind this was to ensure a more accurate depiction of the true burden of maternal sepsis and enable a more targeted development of future interventions aimed at curbing the occurrence of this condition.

The existing evidence from campaigns that have been thoroughly assessed, together with the potential for impact on knowledge, behavior, and awareness, and subsequent improvement of health outcomes, proved sufficiently strong to include a campaign into this study. Additionally, attaching a health campaign to a research study, where it was set to influence the data collection process of a massive initiative was innovative.

The GLOSS awareness campaign

I initially set out to understand the factors that influenced provider awareness around identification and management of maternal sepsis in order to better develop and implement the awareness campaign for GLOSS. This was established as a goal of the Global Maternal and Neonatal Sepsis Initiative and as an objective for GLOSS, under the assumption that awareness was low at baseline.

Health communication campaigns have been used throughout the last decades for a variety of reasons and with a multiplicity of objectives, among which are the following: to incentivize people to adopt a new behavior (e.g., exercise), to give up something harmful (e.g., smoking), to adhere to certain recommendations (e.g., vaccination). The awareness campaign for this study, despite having a somewhat different objective than classic health campaigns, followed some of these same principles and fulfilled several goals and mandates. On the one hand, it met with the Global Maternal and Neonatal Sepsis Initiative's objective of raising awareness on the issue of sepsis among healthcare providers. On the other hand, it was seen as the first of many steps in understanding how sepsis affects women in different regions, with the goal to subsequently improving the timely identification and management of infections to reduce the burden and severity (and mortality) of maternal sepsis. The Department of Reproductive Health and Research at WHO embarked on an activity like this for the first time with this project.

The design and development of the awareness campaign needed to follow a series of sequential steps:

1- Find a communications company that could design and develop the materials necessary to send the message out to participating providers. For this, a request for proposals (RFP) was

put together and disseminated to obtain bids from a variety of companies with experience in global health.

2- Define the scope, tone, objectives, and format of the campaign.
3- Incorporate ideas and foundational knowledge obtained through interviews and a survey of people working in the field across the different regions.
4- Develop an evaluation plan to assess implementation, impact, and success of the campaign.
5- Disseminate the message and materials for the campaign (See **Deliverable 2** for copies of the materials developed for the campaign; all also available on the website for the campaign at http://srhr.org/sepsis/resources/).
6- Analyze the results of the campaign.

An important step in this process was to engage the regional coordinators, and some country coordinators, in the development of the campaign. This was done through a full-day workshop led by the communications company contracted for the development of the materials, where purpose, messaging, and format of the campaign were discussed. For the development of the materials it was important to hear from the people who would be engaged in the campaign and the study on the ground. We agreed to develop materials that focused on a positive message, steering clear from some of the damning feelings that providers are plagued with regarding infections. Since many infections are healthcare associated, accusatory responses are prevalent in many institutions that do not want to be linked with high infection rates. It became paramount, as a result of this workshop, that the materials developed for this campaign should encourage providers to actively seek for improved identification and management of maternal infections and sepsis, to foster champions in this regard.

The central question of my DELTA project required tapping into the voices and experiences of people working in maternal care to get a better understanding of current levels of knowledge,

attitudes, and practices, as well as existing barriers (whether technical, contextual, or systemic) and opportunities to increase provider awareness. The idea behind this was that the knowledge obtained from this activity would help inform the campaign, the development of materials, and the future activities pursued by the Initiative. It would also provide information useful to develop tailored interventions according to trends in practices and knowledge. Since the campaign was aimed at healthcare providers from a variety of different cadres (regarding education, specialization, and exposure to participation in research), I was interested in hearing from a diverse sample. This was the reason behind seeking information from researchers for GLOSS as well as providers in the field working in participating facilities through interviews and the online survey.

One of the first activities organized as part of the awareness campaign was a collaborative effort with the Global Sepsis Alliance (GSA). Building on GSA's successful 2-day online congress on sepsis in 2016, a special spotlight series was planned for 2017. The "World Sepsis Congress Spotlight: Maternal and Neonatal Sepsis" was held on 12 September 2017. Original GLOSS dates had data collection planned for the days around World Sepsis Day (13 September), but administrative delays deemed this impossible (primarily to obtain ethical approvals from WHO and local ethical approvals from all participating countries), postponing data collection to late November 2017. The online congress featured presentations from renowned speakers and allowed for questions from the global audience connected live through an online platform.* The congress marked the soft launch of the GLOSS campaign, helping build momentum for the rest of the campaign to roll out in anticipation of data collection.

The rest of the campaign was launched several weeks before data collection began on 28 November 2017. The materials for the campaign were made available for download from a designated website

* All materials relating to the online congress can be found at: https://www.wscspotlight.org/

for the study, and countries were provided with financial resources for printing and dissemination of materials. The website also included links to the videos from the online congress that had been subtitled into different languages in order to facilitate sharing and viewing across all GLOSS countries. Country coordinators were in charge of promoting the campaign at the local level, and we provided them with guidance for scheduling press releases and other activities. Print materials were available in all study languages (English, Spanish, French, Portuguese, Russian, and Arabic), with two additional languages (Kazakh and Vietnamese) according to need, as expressed by country coordinators. The campaign included infographics and fact sheets on maternal sepsis identification and management, informational posters on the study for women and providers, templates for press releases, social media messaging using HRP's Twitter handle and specific hashtags, and a unique brand that included a logo designed specifically for GLOSS and the Global Maternal and Neonatal Sepsis Initiative.

My DELTA project

Defining my DELTA project was perhaps the most challenging activity I conducted at the early stages of this process. I was approached by WHO to lead the development of an awareness campaign around maternal sepsis. The goal was to increase provider awareness to accompany a research study. I needed to figure out what my contribution to the field of public health would be. The study was enormous and my contribution to it could be too, yet I needed to focus my project to successfully prove engagement in leadership and translation for action. The question was how to fit my DELTA project into this larger one. How was I to carve out a project that was mine, that responded to a personal quest for impacting global maternal health, while followed the overarching mandate to lead a global awareness campaign?

Upon exploring the literature on awareness campaigns and public health messaging, I knew this task would not be easy. Campaigns struggle for audience's attention in an overcrowded market of

messages and other tantalizing approaches (Randolph & Viswanath, 2004). Awareness raising is commonplace, yet oftentimes not well defined (Purtle & Roman, 2015). On the other hand, changing people's behaviors, which should ultimately be the purpose of any campaign, relies on so much more than mere knowledge (Christiano & Neimand, 2017; Glanz et al., 2002). However, as I narrowed my vision and focus on the idea of developing a campaign, I realized that what the project required was some formative research to understand what influenced provider awareness. I needed to accurately and specifically define what I meant by awareness raising in our campaign. The Merriam-Webster dictionary defines awareness as "knowledge and understanding that something is happening or exists" while Wikipedia defines it as "the ability to directly know and perceive, to feel, or to be cognizant of events. More broadly, it is the state of being conscious of something" ("Awareness," 2017; "AWARENESS," n.d.). On the other hand, health behavior sciences have been alluding to awareness and awareness raising for years, with little or varying definitions on what they mean by this. It has been often described at a precursor to action –for example, using the Stages of change theory, awareness could fit as the action able to move a person from the *pre-contemplation* stage to the *contemplation* stage– or as simply having heard of a specific issue (DiClemente et al., 1991; *Making Health Communication Programs Work*, 2004; Dyar, Hills, Seitz, Perry, & Ashiru-Oredope, 2018).

Awareness:

A combination of concepts relating to knowledge, enabling environments, and perceptions of severity of the problem that interrelate to sensitize people towards an idea or a problem.

Through our campaign, we wanted providers to be cognizant of maternal sepsis, both as a unique condition with a new definition, but also of the importance of identifying and managing sepsis in a timely manner. Therefore, based on constructs from the behavioral sciences and the health communication theories, I used a specific definition of awareness raising for this project. Being able

to recognize that something is a problem can be defined by whether you know about the topic (knowledge), whether you feel confident about this knowledge and your ability to act on it (enabling environment), and whether you see the issue as a problem or not (perception of severity) (Bandura, 1977; DiClemente et al., 1991; Fishbein & Yzer, 2003; *Making Health Communication Programs Work*, 2004; Viswanath et al., 2015). For the purposes of this project I defined awareness as a combination of these concepts that interrelate to sensitize people towards an idea or problem.

An important question for my DELTA project was: how to increase awareness on such a heterogeneous population of healthcare providers when little was known about them? In the context of this extensive project embarked by WHO, and the novel approach of including an awareness campaign, I set out to understand those factors that impact awareness. This would result in the design and development of a better informed and targeted campaign, together with providing valuable information on health communication in general.

The initial questions I set out to answer were as follows:

What were the factors influencing healthcare provider awareness in identifying and managing maternal sepsis? Among those factors, what were the challenges and opportunities to increase awareness?

Theoretical frameworks

In order to address my central questions, I reviewed both peer-reviewed articles, reports, and other literature to draw upon to provide with the theoretical framework. I needed a solid understanding of both the clinical manifestations of maternal sepsis as well as dexterity in the field of health communications. I also explored publications that provided frameworks to think about making improvements in maternal health, such as the ones provided by the Global Strategy for Women's, Children's and Adolescent's Health 2016-2030, the Ending Preventable Maternal Mortality Strategy , and the Countdown to 2030 collaboration (Boerma et al., 2018; Jolivet & EPMM Working Group, 2015; United Nations, 2015; World Health Organization, Reproductive Health and Research, World Health Organization, & Special Programme of Research, 2015).

I also looked at behavioral health frameworks that provided me with an understanding of the constructs and determinants of health behavior. I looked at behavior change interventions, health communication and social marketing, and socio-ecological models (Bandura, 1977; Fishbein & Yzer, 2003; Glanz et al., 2002; *Making Health Communication Programs Work*, 2004; Viswanath et al., 2015; Wakefield, Loken, & Hornik, 2010). Socio-ecological frameworks of behavior change include intrapersonal, interpersonal, institutional, and community factors, as well as public policy as determinants of behavior (McLeroy et al., 1988; Storey, Hess, & Saffitz, 2015; Weiss & Tschirhart, 1994). I excluded frameworks that did not consider contextual factors and environmental differences, as this project involved such diverse settings.

I also conducted a literature review to get a better understanding of the most recent evidence regarding development and dissemination of health campaigns around infection and sepsis, specifically in reproductive health. For this I conducted a search in PubMed using a selection of MeSH terms defined in conjunction with a librarian at the Francis A. Countway Library of Medicine, which serves the Harvard T.H. Chan School of Public Health. I finalized the selection of terms on 7

August 2017, narrowing my search to publications between the years 2000 and September 2017 (which is when I finished this literature review). This search helped me identify 138 peer-reviewed journal articles that provided with evidence of health campaigns targeting healthcare providers in maternity settings, and many campaigns related to sepsis. I reviewed full-text articles that responded to any of the following criteria: definition and management of sepsis; epidemiology of sepsis; sepsis in maternal population; health campaigns among healthcare providers; pre-post campaign design and evaluation. I excluded all full-text articles that dealt with any of the following: guideline development; specific clinical interventions to reduce sepsis; adherence to protocols and guidelines. This decision was based on what I had predefined as the purpose for my literature review: to explore the use of health campaigns directed towards healthcare providers and the most up-to-date evidence on infections and sepsis. See **Appendix A** for the MeSH terms used for the search and a flowchart depicting the process of selection of papers.

I drew upon all of these frameworks, and the most current literature in the field, to develop questions for the interview guides and the survey, as well as for the development of messaging for the campaign.

Methods

This section provides a description of the methods used during the formative stage of my DELTA project, as well as the methodology used during GLOSS campaign implementation monitoring. The first stage includes qualitative and quantitative methods used to inform the development of the campaign. The second one includes a description of the methodology used to monitor the implementation of the campaign. See **Figure 4** for a depiction of the different components described.

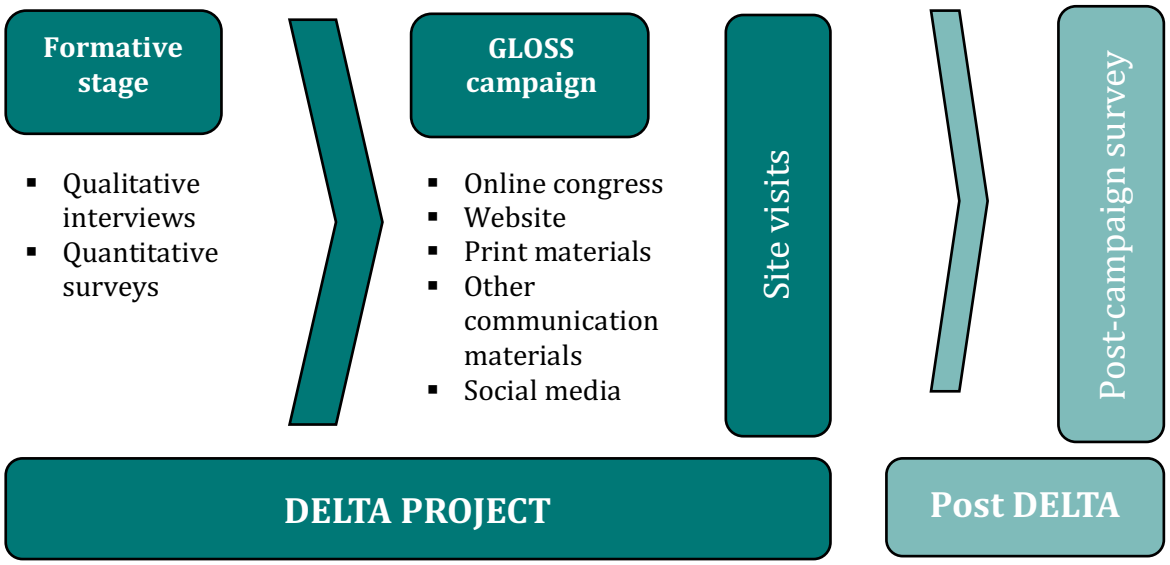

Figure 4. Graphical representation of my DELTA activities

Formative stage

During the formative stage I set out to explore the factors affecting provider awareness in identifying and managing maternal sepsis. Following, a description of the methods used during this stage, starting with the qualitative methods.

Qualitative — semi-structured interviews

Semi-structured interviews are one of the key methodologies used in qualitative research. They are useful to extract in-depth information about a research topic. This technique is good for gathering personal opinions and experiences, and allows for the elucidation of nuances, contradictions, and interpretations the person can have on a specific topic (Mack & Woodsong, 2005). Interviews are preferably conducted in person, although telephone conversations are also valid.

I developed interview guides that provided a structure aimed at obtaining qualitative information on the contextual factors that might influence provider awareness, including barriers and

facilitators, as well as indicators and determinants of maternal health, and perception of maternal health that might shape the identification and management of sepsis. Despite the guides and because of the inherent nature of semi-structured interviews, questions were answered in a different order, not asked if answers were included in a previous comment, and some interviews included additional questions as a result of the flow of the conversation (Hudelson, 1994).

I recruited providers/researchers already engaged with the project for the interviews. The regional coordinators were already actively engaged with the study and, at the same time, were practitioners in their countries. For the most part, they were also researchers. I anticipated that they would be able to provide information from a broad public health perspective, as well as have access to sufficient specific details regarding provider practice. Country coordinators added another layer of insight, as they were mostly linked with ministries of health, academic institutions, or specific hospitals. They were also informed about the study, had had access to the study protocol, and had participated in several calls and engagements with the central research team at MPA (mostly, before my arrival in Geneva). I knew one of the interviewees from prior collaborative work; I met all other interviewees for the first time at the time of the interview. Because the regional coordinators (and some country coordinators) were attending a meeting in Geneva to review study materials and take part in the campaign launch workshop, I used that time for the face-to-face interviews. Phone interviews were held in the subsequent weeks with additional country coordinators representing different regions (e.g., Asia, Latin America, and high-income countries).

In order to schedule the interviews, I sent out an email to all attendees of the meeting that was being planned in Geneva explaining the purpose of the interview and that written informed consent would be required. For the interviews conducted over the phone, a similar email was sent out to targeted country coordinators of regions underrepresented during the first round of interviews,

and I selected the first four that confirmed their availability from regions that I had had little previous exposure through my interviews. I had to reject some additional people who reached out to me because I had reached representation from all participating regions and because of time constraints.

I interviewed a total of thirteen participants: six regional coordinators, six country coordinators, and one provider/researcher. Signed informed consent was obtained from all the interviewees. Nine interviews were conducted in-person while participants were in Geneva for meetings, and four were conducted over the phone (using Skype, WhatsApp, and regular telephone). Ten interviews were recorded; the other three were not recorded because of technical difficulties (two cases) and participant refusal (one case). Seven of the recorded interviews were professionally transcribed and checked by me; the remaining three were transcribed by me (one due to time constraints, the other two because they had been conducted in Spanish). Notes were taken during all interviews, more copiously during the interviews that were not recorded. Three of the interviews were conducted in Spanish and translations of all quotations used in this analysis are mine. See **Appendix B** for a copy of the interview guide, the information sheet, and the consent form.

Analysis plan

For the qualitative data analysis I used grounded theory as a framework to identify emerging topics and themes (Hsieh & Shannon, 2005). Topics were grouped into salient themes. See **Appendix C** for a codebook developed for the qualitative analysis. Atlas.ti (version 1.6.0 for Mac computers) was used for the qualitative analysis.

Quantitative — online baseline surveys

Surveys are typically used to gather data on respondents' existing knowledge on a particular subject (in this case, maternal sepsis) in order to allow for the development of interventions that can address any gaps; they explore respondents' attitudes towards a specific situation (e.g., ability to identify and manage maternal sepsis); and identify respondents' actions (e.g., patterns of practice in identifying and managing maternal sepsis) (Gumucio, 2011).

Despite the limitations presented by surveys –they rely on self-reported data and are subject to response and selection bias– these are considered a good tool to use in communication activities (Stop TB Partnership (World Health Organization), 2008; Sue & Ritter, 2012). Online surveys, particularly, offer the advantages of being low cost, quick, allow for covering a large geographical area, and reduce interview bias (Sue & Ritter, 2012). In this case, using an online questionnaire allowed me to reach a large number of people in many different regions and countries, while remaining low cost. The downside of this methodology was in the requirement of good access to the internet (which, with the population at hand, was very heterogeneous), thus biasing the participation (Sue & Ritter, 2012).

I developed a 32-question online survey to gather information on healthcare provider knowledge, attitudes and perceptions, behaviors/practices, and enabling environments with regards to maternal sepsis identification and management. Twenty-one additional questions were devised for piloting the tool. I decided, *a priori*, to only include in this analysis those surveys that were completed using the online tool; for countries with poor internet penetration, paper copies of the survey were distributed at the local level. Although the paper copies were used for the evaluation of the campaign that I conducted for WHO, I did not include them in the analysis for my DELTA project as collection and data entry of these surveys was not completed until after the timeframe allowed for my DELTA completion.

A plan for the survey dissemination was developed using the dates of in-country data collection as the last activity of the project and working backwards. This planning included developing the questions, pilot testing the survey, translating it into eight languages, deciding on a sampling strategy, disseminating the survey, and analyzing results.

The survey was first piloted during one week in August 2017. For this purpose, I contacted regional coordinators for GLOSS and asked them to forward the survey link to colleagues working in their countries but in geographical areas that were excluded from the study. Participants were given one week to complete an adapted version of the online survey which included 51 questions; 30 were identical to the survey that would be sent out to participants, and the additional 21 were specific to the pilot assessing question validity (were the responses to the questions answering what I wanted to know?), comprehension (did respondents understand the questions?), flow of survey (was there a natural progression of questions?), and detection of potential technical issues (could they access the survey easily with the link provided? Were skip patterns functional? Did the system point out whether a maximum or minimum amount of responses was warranted, according to the question posed?). The pilot survey was available only in English and in the online version (SurveyMonkey*). Modifications were made to the survey as a result of pilot testing, such as the addition of a few more questions, clarification of language, inclusion of a second case vignette, and answer options that reflected the main messaging we were including in our campaign materials.

The final version of the survey included two case vignettes aimed at assessing respondents' knowledge of maternal sepsis. Because maternal sepsis is known to be difficult to identify and manage given that its symptoms can be non-specific, the cases could have elicited different

* I used SurveyMonkey for the online surveys because this was the platform most frequently used by RHR for their online consultations and the one they could support for data collection. SurveyMonkey's data collection and exporting system is slightly different to Qualtrics (the software of choice at HSPH), but similar enough to be compatible. All precautions were made to ensure security and safeguard of data collected through this system.

responses. While attempting not to be too directive, the first case offered a more clear-cut case of maternal infection or sepsis, while the second one could have been attributed to a variety of maternal health conditions, very unlikely to be sepsis. Responses would be deemed correct if, in the first case, they properly indicated the correct management of maternal sepsis if they had accurately identified sepsis as the cause of discomfort for the woman described in the vignette. Respondents would not be penalized for not identifying the correct actions if sepsis had not initially been selected.

For additional questions aimed at capturing respondents' knowledge, some methodological decisions were made ahead of time. This required making a decision to allow the tool to be simple and broad enough; any further adjustments for categorical responses would be made during the analysis phase. Considering that many of the responses were not clear-cut and binary, many questions offered multiple responses (using the option "check all that apply"), making them harder to analyze. For example, there were several questions that asked respondents to select from a variety of options what specific supplies or commodities were essential to identify and manage maternal sepsis. There was an *a priori* understanding that respondents with different qualifications would have different knowledge about this; additionally, the response options included some essential supplies/commodities, some good to have but not essential, and others that were not quite necessary for maternal sepsis identification or management. Vis-à-vis this variability, I decided not to analyze data based on right or wrong answers, but rather focused on patterns of behavior, i.e., looking at the most frequent responses comparing them with the least frequent.

The survey also included questions aimed at determining respondents' self-confidence in identifying and managing cases of maternal sepsis (depending on their skills and capacities), the support they felt from the facilities in which they worked, and training received in maternal sepsis. Some questions relating to local maternal health conditions were also included to help

contextualize the problem from the perspective of the respondents. I also included a question asking about barriers in making correct and timely decisions. Answer options for all of these questions were based on the literature and what had been extracted from the interviews.

Surveys were available in eight languages: English, Spanish, Portuguese, French, Italian, Russian, Vietnamese, and Arabic. Italian and Vietnamese were included as requested by the country coordinators. The survey was available online through the SurveyMonkey platform for seven of the languages; Qualtrics was used for the Arabic version. This was done because the SurveyMonkey platform is not enabled for languages that are written right-to-left. See **Appendix D** for a copy of the survey (in English) and additional questions and instructions for the pilot survey. The online versions of the survey expired after data collection was closed.

Sampling strategy for the survey

A two-staged snowballing technique was used to create a database of engaged participants. For the first stage, all 47 country coordinators (plus the regional coordinator for the HICs) were sent a link that they in turn sent to the facility coordinators at the local facilities, who in turn were asked to send to providers working in their institutions. The link invited providers to sign up to participate in the Global Maternal Sepsis Study (GLOSS) Awareness Campaign. This sign-up link remained open for three weeks in order to obtain the maximum number of email addresses; a database containing all the collected email addresses was created (and kept confidentially; only study researchers in Geneva had access to this list). In the invitation email, respondents were encouraged to forward the message to their colleagues in the facility where they worked (specifying that they should only forward to colleagues working in their facilities). In addition, each week a welcome email was sent to new respondents registered for the campaign thanking them for signing up and asking them to invite more colleagues to sign up; these emails included a sample message they could add to their communications with their colleagues. Targeted outreach was done with country coordinators of

countries for which there were no participants, urging them to reach out to colleagues in their hospitals.

During the second stage, after the sign-up period was over, an email containing the link to the survey was sent to everyone in this initial database as well as all country and regional coordinators, and all facility coordinators who had already been identified by their country coordinators. As with the sign-up phase, all recipients were asked to forward the link to their colleagues working in their facilities. A sample message was also included in the emails that were sent out, to facilitate the snowballing effect. Weekly reminders were sent through SurveyMonkey. Targeted outreach was made after the study workshop in October 2017 with additional encouragement to forward the survey link to colleagues from participating facilities.

Statistical analysis plan

I first defined the variables able to respond each of the three constructs I was looking to measure through the survey. **Table 1** describes what questions responded to each of the components of awareness raising.

Table 1. Variables used in the analysis

Knowledge	**Enabling environment**	**Perception of disease**
Have you ever heard of the term "maternal sepsis"? (Q10)	*How confident do you feel that you are capable of making the right decision in a case like the one above?* (Q4)	*What are the main conditions causing death and disability among women during pregnancy and/or childbirth in your hospital? Check all that apply.* (Q1)
What two criteria best describe maternal sepsis? (Q11)	*How would you qualify the availability of resources in the facility where you work to help you make the right decisions?* (Q5)	*How many women are affected by maternal sepsis in your facility every year? Give your best estimate (a whole number), given your experience in the facility.* (Q14)

Table 1. (continued)

What would be the first two things (this) woman should receive? (Q2b/Q2a) (with reference to the first case vignette)	*How supported do you feel by the facility in which you work to make the right decision in a case like the one above?* (Q6) *How well does this statement describe your facility: 'The facility where I work doesn't let me handle cases like the one described above'?* (Q7) *Does the hospital you work in have protocols in place for dealing with cases like the one described above?* (Q9) *Have you ever received specific training in how to manage women who present with signs of infection while pregnant, during childbirth, postpartum or post-abortion?* (Q17)	*How many deliveries occur every year, on average, in your facility? Give your best estimate.* (Q16)

I used descriptive statistics to provide frequencies and percentages of responses for each of the selected variables above, together with a few others, such as the ones referring to supplies/commodities needed for identifying or managing maternal sepsis, and the barriers to making correct and timely decisions. I tested these descriptive statistics for significance using logistic regressions. To allow for this analysis, I dichotomized the Likert-type responses. I established statistical significance at $p<0.005$ for all logistic regressions. See **Appendix E** for the codebook utilized for the quantitative data analysis. I used Stata (version 14.2, College Station, TX) for data analysis.

GLOSS campaign implementation monitoring

During campaign implementation I conducted one monitoring activity through two site visits. I describe the methodology used for this activity below.

Site visits and participant observation

I devised a participant observation checklist that I used during my site visits. Participant observation is a methodology that has its roots in classical ethnography (Mack & Woodsong, 2005). A qualitative methodology for obtaining data, participant observation implies having the researcher go to the environment that is the object of study.

Through observing people during site visits, I was able to see how providers naturally behaved and performed, and I used that data to understand some of their attitudes in their normal work settings (Kawulich, 2005). I describe these as site visits because my time in each of the sites was insufficient to be a true participant observation, although I used the checklist developed for this purpose as a guiding document for basing my observations. The methodology offered by participant observations was chosen in order to enhance the qualitative information provided through the interviews. It also allowed me to get firsthand experience of the study and campaign in action through observing and participating in activities relating to the study during my visits. I made the decision of which countries to visit based on practical reasons: language, proximity from each other, development and capacity difference from one site to the other, safety and security clearance, and distance from Geneva. Because data collection began with a one-week identification period simultaneously in all 53 countries, I wanted to be present during that first week where data collectors would be the busiest, and where I would get a better sense of the normal patient flow and activities. I also decided I would visit the sites during the work week as weekends are unusual with regards to staffing and availability of services (e.g., some labs aren't available on weekends). Since the trip would be short, I didn't want to travel too far. This narrowed the selection to two countries

in Africa, for which I spoke the local official languages and where the selected geographical areas were in proximity to international airports. See **Appendix F** for a copy of the participant observation checklist.

Timeline for data collection

Because data was collected throughout the entire DELTA period, for both the formative and implementation stages, I present a timeline for these activities in **Table 2**.

Table 2. Timeline for data collection activities

Activity / Date	07-2017	08-2017	09-2017	10-2017	11-2017	12-2017
Interviews						
Survey (baseline)						
Site visits						

Ethical considerations

All tools used for primary data collection were submitted to WHO's Ethics Review Committee (ERC) and received approval (approval was given to the entire protocol for the study in June 2017, with an amendment dated in October 2017; approval included study data collection and the awareness campaign). The submission included all the considerations that were taken to guarantee participants' confidentiality. Specifically:

a- Interviews: every person interviewed was provided with an information sheet for them to keep, with details on the study and the objectives of the interview. Additionally, interviewees were asked to sign two copies of a consent form; they kept one copy, and I kept the second signed copy that was saved confidentially at a secure location at WHO. Each

interviewee was assigned an ID, and the file linking each ID with the voice record was kept in a separate file to which only the research team had access. Voice files were sent out to transcribe by a transcription company, naming each file according to the interviewees' ID. When analyzing the interviews, most references to each participant's personal identity were omitted, with the exclusion of region in which they work.

b- Surveys: the survey contained an information sheet that included the objectives of the questionnaire and described the study and the campaign. A legend was included in the information sheet indicating that completion of the survey assumed consent to participate. The survey also included written instructions saying respondents were free to leave questions unanswered or have their names removed from the database at any time. Specific geographic and contact information were collected for categorization purposes and to enable specific communication with respondents at post-intervention. Respondents were asked to voluntarily provide the study team with an email address to allow for post-campaign survey outreach.

c- Site visits and participant observation: these were conducted by me in two different participating countries. Specific information about the settings was excluded from the analysis, and no identifiers were recorded during note-taking. There was no record kept of any data that could help determine where each of the notes referred to and these were kept with me at all times.

In addition, all secondary analysis performed for my DELTA project received expedited approval from Harvard's Committee on the Use of Human Subjects' Institutional Review Board (IRB) (IRB17-1857). A copy of their letter of approval can be found in **Appendix G**.

"Genius is one percent inspiration, ninety-nine percent perspiration"

Thomas Alva Edison (c. 1903)

Section III: Results analysis

The goal for this DELTA project was to explore what affected providers' awareness around identification and management of maternal sepsis as a way to better develop, and evaluate, a campaign for GLOSS. In this section I report on the full results for my DELTA project in an attempt to answer my research questions: what are the factors influencing provider awareness, and among these factors what challenges and opportunities arise to increase said awareness? I report on the findings from my semi-structured interviews and online survey first, as these were the basis upon which the campaign was developed (and would later be evaluated). I also report on the campaign itself as well as on the findings from the implementation of the campaign from my site visits. Throughout all my analysis I refer to the regions as defined for this study: Africa (AFRO), Asia (including South East Asia and South Asia), Eastern Mediterranean (EMRO), Europe (mostly Eastern Europe and Central Asia, EURO), Latin America (PAHO), and high-income countries (HICs).

Formative stage

In this initial section I report results from the activities conducted during the formative stage that later informed the development of the campaign. I first report on the qualitative analysis, followed by the results from my quantitative analysis.

Qualitative — semi-structured interviews

In order to ensure that I followed a structured process for designing and reporting on the qualitative data from my interviews, I used Tong, Sainsbury, and Craig's checklist (Tong, Sainsbury, & Craig, 2007).

The interviews lasted on average 40 minutes; interview slots were given on a one-hour basis, but interviewees were told in anticipation that they would last approximately 30-45 minutes. See **Table 3** for characteristics of the people interviewed. During data analysis five major themes and 26 subtopics emerged, very much in line with what I set out to explore through the interviews. These themes largely referred to maternal health conditions (causes of maternal mortality and morbidity) and barriers/facilitators that challenged or enabled addressing said issues. They are each described below including quotes from the interviews supporting this analysis.

Table 3. Demographic characteristics of interviewees

(N=13)

Characteristic	N	%
Sex		
Female	6	46
Male	7	54
Region		
Africa	4	31
Asia	2	15
Eastern Mediterranean	2	15
Europe	1	8
Latin America	3	23
High-income countries	1	8
Role in the study		
External	1	8
Country Coordinator	6	46
Regional Coordinator	6	46
Place of work		
WHO regional office	1	8
Research Institution	6	46
Ministry of Health	1	8
Hospital	5	38

Table 3. (continued)

Education		
Medical doctors	13	100
Obstetrician	12	92
Neonatologist	1	8

Theme I: Awareness campaigns

Part of the goal of conducting these interviews was to learn from people's experiences with awareness campaigns in order to tap into these potential resources when thinking about how to design the GLOSS campaign. Most of the people interviewed were able to reference large, public health campaigns geared towards large populations, such as vaccination, hand-washing, and other country-specific issues. Very few had been involved in campaigns that were designed to accompany a research study. I asked interviewees whether they had experience with multi-country studies and with awareness campaigns.

> *Not to a large extent. Maybe just participated in meetings of the ministry where they are doing some awareness (…) So maybe something there but not as taking the lead on preparing materials for the campaign. (Africa)*

> *No. I mean, relating to this we did some activities for the sexual and reproductive health observatory (…) but it was something very small and within a very closed group which is the observatory. (Latin America)*

When asked what they thought about having an awareness campaign as part of a multi-country study like this one, everyone I interviewed was positive. In posterior conversations and multiple interactions with the country coordinators, I was able to realize that many of them were not entirely sure what the campaign entailed or how it would fit in, but they still thought it was a

positive addition to the study. It was through a continuous effort on my part, and my ability to position myself at the head of this activity, that people at the country level were able to grasp the concept of the campaign, and the objectives of including it as part of the study. During campaign implementation, different countries took the lead in developing their own products to enhance the campaign: several countries conducted continuing medical education symposiums to accompany the World Sepsis Congress Spotlight; one country produced a short video on sepsis during pregnancy and another a video story on a sepsis survivor; another country engaged reporters from the local media to attend a study launch activity; another country engaged local radio and print media to disseminate information about the study; other countries used the materials provided to create novel editions of the informational posters (such as panels, wall-sized calendar of activities).

> *I think I don't have an experience with awareness campaigns but planning the research, and that's why I was thinking this is original, a good idea to have this awareness campaign tethered to the research we are doing. (Africa)*
>
> *It's the campaign actually, to me, that I think is more valuable. (High-income country)*
>
> *One of the good things, brilliant things, that I see in this study is the awareness campaign. (Eastern Mediterranean)*

Theme II: Perinatal health conditions

I wanted to inquire about the main conditions affecting women in each of the countries, regions, and hospitals the interviewees represented. I purposely asked not to look for official statistics because the goal of asking these questions was to explore their perception of the real causes of maternal mortality and morbidity in their countries, as experienced by them as researchers, practitioners, and government officials. Under this theme I did not only look at direct causes of maternal death, probing especially to understand the positioning of infections and sepsis, but also

indirect causes, and causes for morbidity and newborn health. I wanted to know whether they saw sepsis and infections as important factors affecting maternal health. I hypothesized that if they did not see sepsis as a problem, their engagement with the study, and especially with the campaign, would be hindered. Therefore, exploring what they saw as the most important issues affecting maternal health would allow me to better develop messaging for the campaign materials. I asked interviewees to tell me what the main conditions affecting women during pregnancy and childbirth were in their workplace.

> *In my hospital, it is not, no longer like hemorrhage, but if you look the country in general, if you look at rural area, all the country in general, the first one is, during pregnancy, is hemorrhage. PPH is still the main cause of maternal mortality for us. (Africa)*

> *In (my country) it continues to be abortion. The main direct cause of maternal mortality. (Latin America)*

Everyone was able to identify the main causes of maternal mortality, reflecting for the most part, what the evidence shows including regional variations (e.g., postpartum hemorrhage in some regions is outweighed by abortion-related complications in others). Another interesting sub-theme that emerged when talking about infections, especially among some of the interviewees, was the limited attention that infections and sepsis had gained both in the global, as well as in national agendas.

> *To me sepsis is still not, it's not on the agenda. (Latin America)*

> *In our countries, we are very poor countries. When this minister of health, they just do when WHO says something. So it depends. You know, a lot was done for PPH,*

hemorrhage, so minister of health is just for going according to what WHO says (…). So, until now, we didn't see a real emphasis on infections. (Africa)

This idea of sepsis being somehow hidden was integral to the development of the awareness campaign. Through the campaign we looked to bring infections and sepsis out of the shadows. Most of the global work in maternal health up to date had been around postpartum hemorrhage and hypertensive disorders. Infections and sepsis had received much less attention –and less attention translated into less funding, fewer interventions, and fewer innovations.

Theme III: Determinants of women's health

Through the interviews I wanted to get a sense of what were some of the barriers providers faced in their hospitals, regions and countries, which were precluding them from identifying cases of maternal infections and sepsis. And because many of these barriers were related to what conditions women usually arrived with to the healthcare facilities, this was important to address. Related to this, a theme regarding determinants of health emerged. I was able to classify these determinants using Frenk's classification of basic, structural, proximate, and health status (Frenk et al., 1991). Of these, proximate determinants were the most mentioned; this included things like working conditions, living conditions, lifestyle, and the healthcare system. In order to elicit this, I asked interviewees what they thought were the causes for the conditions that they had identified.

Infections, I think there are still many causes or predisposing factor for infection. To me, I think one of the important cause is about health literacy. I think people still don't have good knowledge about how to prevent themselves from infection, when it's the appropriate time to see doctors. And some of them still use too much drug. (Asia)

For sepsis during pregnancy, I think a lot has to do with conditions relating to nutrition, the food they eat, housing, overcrowding among women. (Latin America)

The population is very diverse and there are areas with high illiteracy, where different languages are spoken within the same country, adolescent pregnancy is commonplace. (Latin America)

Poverty first because sometimes the antenatal care—maybe, the antenatal care not well—the visits are not well done or maybe the lady will even not attend to any clinic during the pregnancy. (Africa)

This issue was extremely interesting to explore with the interviewees, because despite the obvious development differences explained by the countries they represented (some at the low end of low-income countries, others at the high end of middle-income countries, and even some high-income countries), they all identified the importance of external factors that influence the health of the population and particularly the women. Poverty, literacy, and nutrition were signaled as big factors influencing maternal health regardless of the country's level of development and wealth.

Theme IV: Health system barriers

Aside from investigating the underlying causes of the health conditions that most affected women, I also inquired about the challenges that providers faced in their facilities. A variety of different sub-themes emerged, notably: poor availability of resources, difficulties with how health systems were managed, poor quality of care, and lack of protocols. With regards to resources, these did not only include infrastructure and supplies, but also human resources (with regards to training and staffing). These were all interfering, in one way or another, with the provision of care.

You need a higher level of antibiotic (…), there are very few, but they are with the manager, the clinical director of the hospital so that means you have to write. Write a letter to the clinical director, I have this patient, her name is this this and this diagnosis, we did this test and now we need this. This has to go to the clinical director

and then pharmacy, so it can take 2, 3, 4 days until we get the antibiotics, and this can be a real problem. Sometimes in the meantime the woman can die. (Africa)

Lack of training. Yes, yes, to me it's the awareness. (….). And there is no code red for infections. Therefore, it's not seen as a problem… (Latin America)

The level of care is not equal. The background of the physicians and the nurses is not the same. Training is not the same. Even within the country it's not the same. (Eastern Mediterranean)

We, unfortunately, don't have a very strict laid out protocol, so we manage from what our education taught us. (Africa)

Honestly, we still work under the premise of reward and punishment. If the woman gets an infection it is somehow condemnatory to healthcare providers. (Latin America)

In fact, the issue most of the interviewees focused on was the difficulties they encountered in their settings. As all of the people interviewed were medical doctors by training and most of them still held positions in hospitals and other healthcare facilities they were well aware of the challenges faced on the ground while providing care to women during pregnancy, childbirth, postpartum and post-abortion.

Theme V: Health system facilitators

While this was harder to probe and extract significant information about, when asked specifically about any possible facilitators they could identify, many interviewees focused on the dedication and motivation of providers working in the facilities. Others identified different initiatives in their settings that related to infections and sepsis. There were some people that, when probed, were able to identify systems that had been put in place in their facilities to record and provide guidance on

what needed to be done to address infections and sepsis, especially by infection prevention and control units.

> *Team training and simulation training, which has been very effective certainly when dealing with obstetric emergencies. (High-income country)*

> *They are aware that our midwives and nurses, once they find an infection which is beyond their level, they know the right thing to do is to refer that woman. How the family responds to that then is a different question. (Africa)*

> *There have been efforts to prevent infection, universal precautions like we say, use of antibiotics for caesarean sections and use of antibiotics for women who have conditions that could be disposed to infection. (Africa)*

However, this same person continued to say:

> *But those are really narrow responses to these issues. Prevention of sepsis has not received frontal approach. (Africa)*

> *We do in a reactive way, so then we give them antibiotics and we pose more emphasis in hygiene and other issues relating to isolation. (Latin America)*

There was a hunger for more concerted efforts around infection and sepsis reduction, while there was also a suggestion of this being a good time for implementing new actions through the many initiatives that existed at the time to improve maternal health outcomes. This idea resembled the concept of a "policy window" as defined as an opportunity for policy change brought on by the confluence of three streams: problem, policy, and politics (Kingdon, 2010).

An awareness campaign could be seen as an activity able to generate the inertia needed to push providers, policy-makers, and eventually the general public in bringing about change. In summary, it seemed this study with the addition of an awareness campaign for providers came at a ripe time for the global maternal health community.

Quantitative — online baseline surveys

The online survey was open between 29 September and 05 November 2017. Quantitative data collected through the online survey was extracted from the online tools into a spreadsheet (Microsoft Excel, version 15.41 for Mac computers) and later imported into a statistical software for analysis.

Demographics and overall results

A total of 1,144 online surveys were completed; responses from two countries were eliminated from the analysis as they were from countries not participating in the study, together with responses from 63 respondents who indicated working in facilities that did not participate in GLOSS, leaving a total of 1,071 responses. This is the final number of observations I used for all statistical analyses I performed. Because of the methodology used for outreach (snowballing) and because we did not know what the total population of providers across all the participating facilities was, I could not estimate a response rate. However, the total number of responses exceeded almost threefold the number of people who had originally signed up for the campaign (1,144 vs. 445).

Of the 1,071 surveys included in the final database, 131 (12%) respondents did not indicate their country of origin. The majority of survey responses were in Spanish (49%), followed by English (20%); these each covered 11 and 24 countries respectively, representing 20% and 44% of the countries participating in the study. In addition, 3% of responses were in Vietnamese (representing

one country), 5% in Portuguese (two countries), and 8% in Russian (five countries).* **Table 4** provides an overview of the demographic characteristics of respondents.

Most of the respondents were medical doctors, whether physicians or residents (72%), followed by nurses, including auxiliary nurses (13%). Most of the respondents were from public facilities (81%) located in urban areas (93%), and the majority worked in hospitals (75%) which included: maternity hospitals, regional/provincial hospitals, district hospitals, or other types of hospitals. Fifty-two percent of respondents had up to ten years of work experience total, while 64% had less than ten years of work experience in the current facility. Thirty-two percent of respondents were 30 years or younger, 30% between 31 and 40 years old, and 38% were 41 years old or older.

Table 4. Demographic characteristics of respondents to baseline survey (N=1,071)†

Characteristic		N	%
Respondent characteristics			
Age (N=939)			
	<31	302	32
	31-40	285	30
	>40	352	38
Gender (N=940)			
	Male	295	31
	Female	645	69
Qualification (N=940)			
	Nurse/auxiliary nurse	126	13
	Midwife	80	9
	Physician	565	60
	Resident	116	12
	Student*	40	4

* Three countries had responses in more than one language: Lithuania in English and Russian; Egypt in English and Arabic; Lebanon in English and French.

Table 4. (continued)

Other	13	2
Years of experience (N=925)		
<10	480	52
10-20	266	29
>20	179	19
Years of experience in current setting (N=851)		
<10	548	64
10-20	206	24
>20	97	12
Region (N=940)		
Africa (AFRO)	107	11
Asia (ASIA)	52	6
Eastern Mediterranean (EMRO)	30	3
Europe (EURO)	185	20
Latin America (PAHO)	540	57
High-income country (HIC)	26	3
Facility characteristics	N	%
Location (N=940)		
Urban	875	93
Rural	65	7
Type (N=936)		
Clinic	172	18
Health center	32	3
Maternity hospital	237	25
Regional/provincial hospital	282	30
District hospital	82	9
Other hospital	98	11
Other	33	4

* The survey did not specify a category for *student* but during data analysis, and for providing an overview of demographic characteristics of respondents, I have created this separate category. However, for other analyses, I have kept *student* within the *other* category.

Table 4. (continued)

Management (N=933)

Private	145	16
Public	756	81
Social insurance	12	1
NGO	4	0
Other	16	2

†*Because respondents were allowed to leave questions unanswered, N for each question varied*

There were five countries (out of the 47 participating countries from low- and middle-income countries) that had no respondents to the online survey: Afghanistan, Cambodia, Senegal, Sri Lanka, and Tajikistan. There are different explanations for all three countries, as provided by country coordinators. Among them are: accessibility to the internet, language difficulties, and communication difficulties with country coordinators. In fact, because of difficulties with internet access, Tajikistan, Senegal, and Sri Lanka disseminated paper-based surveys (excluded from this analysis). Cambodia, on the other hand, did not implement most of the campaign in their country and therefore decided not to participate in the survey. Likewise, we only received responses from three of the six high-income countries: Italy, Spain, and UK. The UK responses are included in the analysis even though they used campaign materials from the UK Sepsis Trust* and not those created for GLOSS, as theirs is an ongoing, large, successful campaign. **Figure 5** represents all the responses received by country. As becomes evident in the pie chart, there were some countries that were true champions in obtaining the largest number of respondents. These were: Guatemala (N=175), Colombia (N= 133), and Lithuania (N=99).

* The UK Sepsis Trust has had a national campaign geared toward the general public and providers since 2012. https://sepsistrust.org/

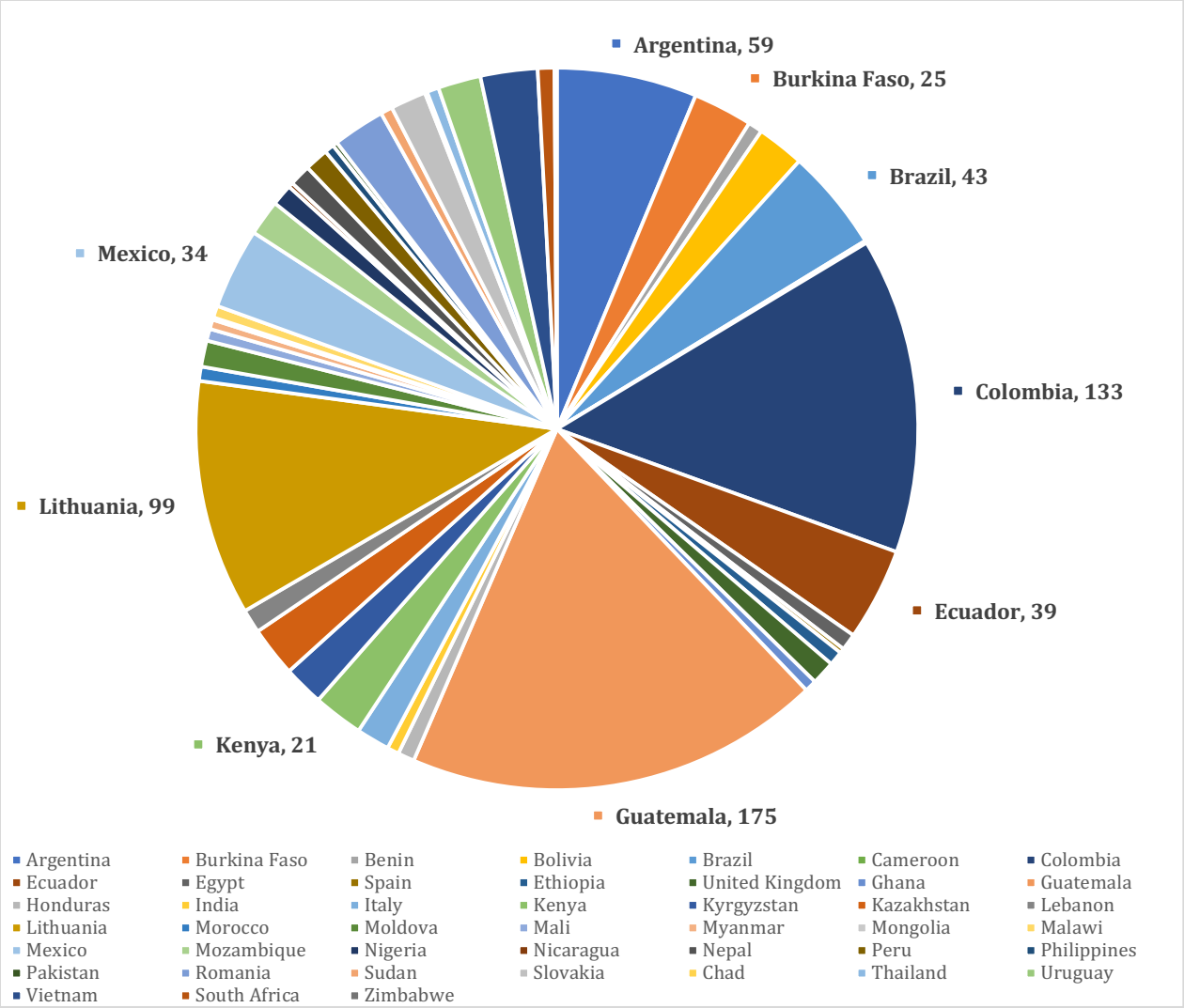

Figure 5. Number of respondents, by country of origin
(N=940)*

**Countries with no respondents were excluded from the figure (Afghanistan, Belgium, Cambodia, Denmark, Netherlands, Senegal, Sri Lanka, and Tajikistan), as well as all the responses where country of origin was missing (N=131)*

Knowledge and practices on maternal sepsis

Providers were asked questions that referred to their knowledge on maternal sepsis, as well as some that referred to healthcare practices around maternal infections and sepsis. Some of the questions related to how they would best identify sepsis, others about how they would manage sepsis, and in one instance, respondents were asked to answer whether they had heard about

maternal sepsis. In an effort to capture all possible responses and not direct respondents towards any specific answer, many questions offered a "check all that apply" response. For one question, a ranking system was developed for the analysis. This question (question 11) asked that respondents identify two criteria that best defined maternal sepsis. The expected answer was *infection* plus *organ dysfunction*, as per the recent definition of maternal sepsis. All of the other options were markers for either infection or organ dysfunction (i.e., fever or elevated white blood cell count as markers for infection; and altered mental status, elevated heart rate, excessively rapid respiration, and low blood pressure as markers for organ dysfunction). Although I report on those respondents that were able to identify these two specific response options (infection and organ dysfunction), I also explored responses using two additional category answers: one for those that were able to identify either infection or organ dysfunction plus one of the markers for the other (e.g., infection plus altered mental status or organ dysfunction plus fever) and another for all other combinations (e.g., fever plus infection or fever and abnormal white cell count). There were two case scenarios presented in the survey, one of which was most likely describing a case of maternal sepsis. Respondents, however, were not penalized for not identifying sepsis as the condition presented in the case; rather, I looked at answers for appropriate management of infection or sepsis only among those that selected infection/sepsis as the possible cause (i.e., selected *antibiotics* and *fluids* for question 2b if they had selected infection/sepsis for question 2a). For questions asking respondents to identify essential supplies or commodities necessary for identifying or managing maternal sepsis, I report on frequencies, as respondents had the option to mark all the response options as deemed applicable.

Overall, practically everyone had some knowledge on maternal sepsis; 96% said they had heard about maternal sepsis before. While in 84% of the countries the percentage of respondents who had heard of maternal sepsis was above 90, in 6% of countries this number was 50 or less. Despite

overall high levels of knowledge under this question, there were differences in what they knew and the depth of their knowledge. This can be visualized in **Figure 6**.

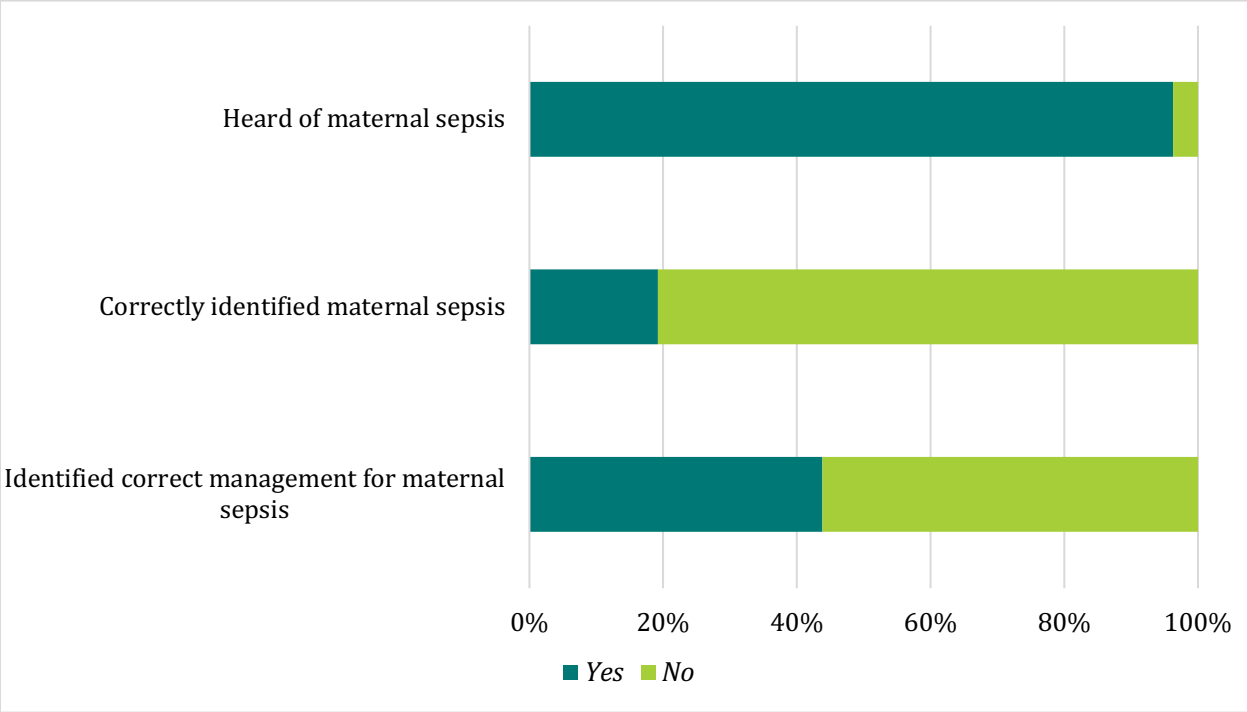

Figure 6. Overall knowledge on maternal sepsis

For example, when it came to being able to identify the two criteria that best described maternal sepsis, only 19% of respondents were able to specifically respond to the options *infection* and *organ dysfunction*. In only 24% of countries, at least half of the respondents were able to identify these criteria correctly, while in 36% of countries no respondents were able to answer this question correctly. Further, 7% of the overall sample was able to identify infection and a marker for organ dysfunction (i.e., altered mental status, elevated heart rate, excessively rapid respiration, or low blood pressure), while 10% identified organ dysfunction plus a marker for infection (i.e., abnormal white cell count or fever). Contrastingly, 82% of respondents identified markers for infection or organ dysfunction but neither of the two (i.e., checked off altered mental status, elevated heart rate, excessively rapid respiration, low blood pressure, abnormal white cell count, or fever). However,

when looking at the frequencies of responses for each of the options, the ones garnering the most amount of answers were fever (617 responses) followed by infection (406 responses).

Forty-four percent of respondents were able to correctly identify *antibiotics* and *fluids* as the two main things a woman with suspected infection/sepsis should receive. In 31% of countries, the percentage of respondents who were able to correctly identify management of maternal sepsis was over 75, while in another 34% of countries no respondents were able to answer this correctly.

Table 5 provides an overall depiction of respondent knowledge according to each of these questions and by respondent characteristics. **Appendix H** presents this information disaggregated by country. The reason for including this table is to illustrate differences between countries, especially knowing that over 30% of the sample was comprised of respondents from only three countries: Colombia, Guatemala, and Lithuania (the first two belonging from one same region).

Table 5. Knowledge about sepsis by respondent characteristics

Characteristic	Had heard about maternal sepsis (N=1,057) [A]			Correctly identified the two criteria to define maternal sepsis (N=671) [B]			Correctly identified management of sepsis when maternal sepsis was suspected (N=276) [C]		
	n*	N*	%	n*	N*	%	n*	N*	%
Overall	*1,018*	*1,057*	96	*129*	*671*	19	*121*	*276*	44
Age	*898*	*935*		*124*	*564*		*107*	*229*	
<31	286	302	95	34	181	19	42	92	46
31-40	276	283	98	46	175	26	33	66	50
>40	336	350	96	44	208	21	32	71	45
Gender	*899*	*936*		*124*	*565*		*107*	*229*	
Male	278	293	95	37	180	21	41	76	54
Female	621	643	97	87	385	23	66	153	43

Table 5. (continued)

Qualification	*899*	*936*	p<0.05[†]	*124*	*565*	p<0.05[†]	*107*	*229*	p<0.05[†]
Nurse/aux nurse	123	126	97	5	81	6	13	43	30
Midwife	71	80	89	6	43	14	7	16	44
Physician	544	561	97	86	339	25	50	106	47
Resident	116	116	100	24	73	33	32	48	67
Other	45	53	85	3	29	10	5	16	31
Years of experience	*887*	*921*		*122*	*553*		*106*	*222*	
<10	463	479	97	64	292	22	65	137	47
10-20	257	264	97	31	156	20	24	54	44
>20	167	178	94	27	105	26	17	31	55
Region	*899*	*936*	p<0.05[†]	*124*	*565*	p<0.05[†]	*108*	*229*	p<0.05[†]
AFRO	98	105	93	9	62	15	10	25	40
ASIA	46	51	90	6	34	18	2	12	17
EMRO	27	30	90	1	22	5	2	6	33
EURO	177	185	96	35	90	39	6	32	19
PAHO	525	539	97	64	338	19	85	149	57
HIC	26	26	100	9	19	47	3	5	60
Received specific training on maternal sepsis	*919*	*956*	p<0.05[†]	*125*	*577*		*110*	*235*	p<0.05[†]
Yes	557	562	99	81	346	23	88	149	59
No	362	394	92	44	231	19	22	86	26
Attended the WSC Spotlight	*900*	*936*		*124*	*564*	p<0.05[†]	*107*	*227*	p<0.05[†]
Yes	173	176	98	42	105	40	39	50	78
No	727	760	96	82	459	18	68	177	38

[(A)] Answered YES to the question: "have you ever heard of the term *maternal sepsis*?" (Question 10)

[(B)] Answered INFECTION and ORGAN DYSFUNCTION to the question: "what two criteria best describe maternal sepsis?" (Question 11).

[(C)] Answered FLUIDS and ANTIBIOTICS to the question: "what would be the first two things a woman should receive," when the respondent answered INFECTION/SEPSIS to the question: "what would you first think could be causing her to feel this way?" (Question 2b i- and v- if answer to question 2a was iv-).

Table 5. (continued)

[*]Where n represents the frequency and N the denominator (i.e. n= the number of respondents with a specific characteristic who answered correctly, N= the total number of respondents with a specific characteristic who answered that question)

[†]Indicates differences that are significant at $p<0.05$ when performing Pearson χ^2 test. I used these results to define what variables to include in my logistic regression models.

What these results show is that there were four factors that most affected respondent knowledge: having attended the World Sepsis Congress (WSC) Spotlight on Maternal and Neonatal Sepsis, qualifications, region, and having received specific training on maternal sepsis. Age, gender, or years of work experience, did not seem to influence knowledge on maternal sepsis.

WSC affected respondent knowledge on identification and management of maternal sepsis, while not on whether they had heard of maternal sepsis before. It is important to note that only 19% of all respondents attended the WSC Spotlight (when considering missing responses, this number decreased to 16%). Most of the attendees were from PAHO and physicians; there were more physicians that did attend than those that did not, and among respondents from Europe there were more respondents that did not attend than those that did. More than twice the respondents could identify the two criteria for maternal sepsis depending on whether they had attended the congress or not (40% vs. 18%). Similarly, 78% of respondents who had attended the congress correctly identified the expected management for maternal sepsis, compared to 38% who did not attend the congress.

Residents and physicians were the ones that most frequently correctly identified two criteria for maternal sepsis (33% and 25%) as well as correct management (67% and 47%). Nurses were the least likely to identify the two criteria for defining maternal sepsis (6%), as well as for identifying the correct management of sepsis (30%). On the other hand, providers from HICs and Europe were the ones most likely to correctly identify the two criteria for maternal sepsis (47% and 39%) while respondents from HICs and PAHO were the ones most likely to identify the correct management for

maternal sepsis (60% and 57%). In contrast, providers from the Eastern Mediterranean were the least likely to identify the two criteria for maternal sepsis (5%), yet their European counterparts were the ones least likely to identify the correct management for maternal sepsis (19%).

I looked at each of the three components of maternal sepsis knowledge separately to assess for statistically significant differences between them, and also analyzed for provider characteristics that might explain the differences. I first looked at the component "having heard of maternal sepsis" according to respondent characteristics. The characteristics I was interested in looking at that might explain any differences in knowledge were: age*, qualification, region, having received specific training, and having attended the WSC. I used logistic regression to see how each of these characteristics affected having heard about sepsis separately. Having received specific training in maternal sepsis was the only variable that was associated with increased odds of having heard of maternal sepsis (OR 9.85). On the other hand, being a midwife or having a qualification checked as "other" were associated with decreased odds of having heard of maternal sepsis (as compared to physicians) (OR 0.25 and OR 0.18). After controlling for age, region, having received training, and having attended the WSC, the variables that remained significant were having received training (OR 10.53) or being a midwife (OR 0.23) (at $p<0.005$) [Full model: $Y_{sepsis\text{-}know} = \beta_0+\beta_1 \text{age}+\beta_2 \text{region}+\beta_3 \text{qualifications}+\beta_4 \text{training}+\beta_5 \text{WSC}+ \varepsilon$].

The other two components of knowledge offered more interesting results, since overall levels of knowledge of identification and management of maternal sepsis were low and there were some visible differences in responses. I performed the same analysis than above, first to determine whether any of the characteristics selected had an impact on respondents' ability to correctly identify maternal sepsis. In this case, having received specific training did not have a significant

* I included age because, although it didn't have a significant impact on knowledge, it was a variable that affected enabling environments. I decided to use the same predictors in all my models.

impact, whereas having attended the WSC Spotlight or region (being from Europe or a high-income country compared to being from Africa) were associated with increased odds of maternal sepsis identification (WSC OR 3.07; Europe OR 3.75; and HIC OR 5.3). Being a nurse was associated with decreased odds of being able to identify maternal sepsis (compared to being a physician) (OR 0.19). After controlling for other factors (age, region, having received specific training, having attended the WSC), having attended the WSC Spotlight and belonging to Europe remained significantly associated with increased odds of knowing how to correctly identify the two criteria for maternal sepsis (WSC OR 3.99 and Europe OR 4.86, at $p<0.005$), while being a nurse continued to be associated with decreased odds of correctly identifying maternal sepsis (OR 0.18). [Full model: $Y_{sepsis\text{-}identify} = \beta_0+\beta_1\,age+\beta_2\,region+\beta_3\,qualifications+\beta_4\,training+\beta_5\,WSC+\varepsilon$].

When looking at providers' ability to identify the correct management of maternal sepsis different trends appeared. Having attended the WSC Spotlight and having received specific training were both significantly associated with increased odds of identifying the correct management of maternal sepsis (WSC OR 5.68; training OR 4.20). After controlling for other factors (age, region, having received specific training, having attended the WSC), having received training lost statistical significance, while being a nurse -compared to being a physician- gained statistical significance with decreased odds of identifying correct management (OR 0.18 at $p<0.005$). Having attended the WSC continued to be statistically significant (WSC OR 8.60 at $p<0.005$). [Full model: $Y_{sepsis\text{-}management} = \beta_0+\beta_1\,age+\beta_2\,region+\beta_3\,qualifications+\beta_4\,training+\beta_5\,WSC+\varepsilon$]. See **Appendix I** for results from the different models I used.

Of note, among the 82% of respondents that were able to identify markers for infection or organ dysfunction while not identifying either of the two directly, responses were not very different (question 11). Differences between responses were significant ($p<0.05$) depending on respondents' qualifications, region, and attendance to the WSC Spotlight. Upon performing logistic regression

these differences continued to maintain statistical significance [Full model: $Y_{sepsis\text{-}identify\text{-}markers} = \beta_0 + \beta_1$ age$+\beta_2$ region$+\beta_3$ qualifications$+\beta_4$ training$+\beta_5$ WSC$+ \varepsilon$, not shown].

I later looked at provider practices around identification and management of maternal sepsis. Laboratory testing, blood culture, and thermometers were the options most frequently selected as the supplies/commodities essential to identifying maternal sepsis. The options least likely selected were diagnostic imaging and rapid test for infectious diseases. The supplies/commodities that were considered essential for managing maternal sepsis by the vast majority (practically all respondents) were antibiotics, followed by fluids, and access to high dependency/intensive care units; the options less likely to be selected were blood transfusions and other antimicrobials. For this analysis I just looked at overall frequencies. **Table 6** depicts the frequencies with which providers identified specific supplies or commodities.

Table 6. Respondent views on supplies essential for identification and management of maternal sepsis

(N=1,071)

	N*	%*
Supplies/commodities essential for identification of maternal sepsis		
Laboratory (hematology/biochemistry)	864	81
Blood culture	739	69
Thermometer	667	62
Blood pressure apparatus	502	47
Serum lactate measurement	413	39
Urine output measurement	391	37
Rapid test for infectious disease	285	27
Diagnostic imaging	232	22

Table 6. (continued)		
Supplies/commodities essential for management of maternal sepsis		
Antibiotics	968	90
Fluids	781	73
Intensive care/high-dependency unit	668	62
Oxygen	630	59
Urine output measurement	491	46
Other antimicrobials	237	22
Blood transfusions	179	17

**N and % don't add up because response were not mutually exclusive (i.e., allowed for "check all that apply")*

Enabling environments

High levels of knowledge do not always translate into correct actions. In order to explore this, providers were asked about the availability of resources in their facilities, the support they received from their work environments, and how empowered they felt to make correct decisions when faced with women with signs of infection or sepsis. The survey also asked respondents whether their facilities had protocols to deal with maternal sepsis, as well as whether they had received specific training on management of infections. All of these questions fell under what I have defined as enabling environments for the correct identification and management of maternal sepsis.

The first three questions were Likert-scale type questions asking respondents to choose between five response options: *very, somewhat, neutral, not much, not at all*. I report on overall frequencies for all the questions in this category (enabling environment). As is visible in **Figure 7**, with regards to confidence, availability of resources, and support from their facilities, respondents were more or equally likely to indicate the second most favorable response (e.g., *somewhat confident*). For example, 46% of respondents said they felt *somewhat* confident of being capable of making the right decision and 43% indicated that resources were *somewhat* available. For the question where

respondents were asked to indicate whether their facilities did not allow them to handle cases of maternal sepsis, 33% responded that this statement was *completely incorrect* yet 32% said this last statement reflected their facilities *very well or somewhat well*.

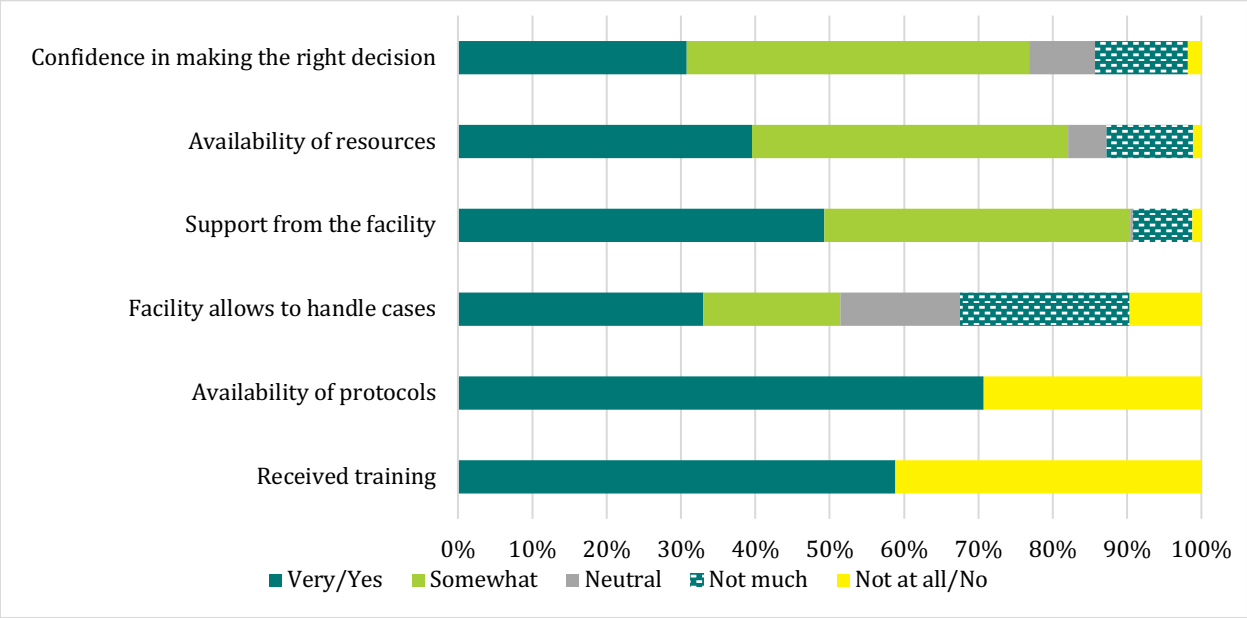

Figure 7. Enabling environment for identifying and managing maternal sepsis

Descriptive statistics on responses to each of these six questions, by provider characteristics are available in **Table 7**. Of note is that older providers, compared to younger providers, responded more favorably to questions regarding confidence in making the right decisions (36% vs 23%), availability of resources (46% vs. 37%), and being allowed to handle sepsis cases (43% vs. 21%)

Nurses were likely to respond positively to all questions under this construct: confidence (32% vs. 27% of midwives and 29% of residents), availability of resources (60% vs. 38% of physicians), being allowed to handle sepsis cases (34% vs. 24% of midwives), availability of protocols (85% vs. 67% of physicians), as well as having received specific training (74% vs. 58% of midwives and physicians). The only question where physicians fared better than nurses was under being allowed

to handle sepsis cases (39% vs. 34%), which makes sense given their qualifications. Of note, a large proportion of nurses belonged to one country (Colombia) where nurses made up 53% of that country's sample; 84% of all nurse respondents were from three countries in one region (Argentina, Colombia, and Guatemala, all belonging to PAHO).

Respondents with more than 20 years of experience were more likely to respond that there were resources always available (53% vs. 35%) and being allowed to handle sepsis cases (43% vs. 27%) as compared to those with less than 10 years of experience.

Respondents from HICs were the ones presenting the lowest level of confidence in making a correct and timely decision when faced with a woman with maternal sepsis compared to their counterparts from other regions (8% vs. 45% in Africa). One possible explanation for this is that, given higher levels of knowledge or more exposure to training and protocols, providers from high-income countries are more aware of the risks and therefore feel less confident among their colleagues in other regions. On the other hand, respondents from HICs were the ones most likely to respond that there were protocols available (92% vs. 58% in Asia) and that they had been trained in maternal sepsis (92% vs. 62% in Africa, 49% in Asia, 44% in EMRO, and 39% in Europe).

Respondents from the Eastern Mediterranean, Asia, and Africa were least likely to respond that they felt institutional support (30% in Eastern Mediterranean, 28% in Asia, and 30% in Africa vs. 67% in HICs). Respondents from Africa and Eastern Mediterranean were least likely to respond that there were sufficient resources available for handling maternal sepsis (16% in Africa and 21% in EMRO vs. 64% in HICs).

Table 7. Enabling environment for identifying and managing maternal sepsis by respondent characteristics

Characteristic	Very confident of making right decisions (A)		Resources always available to make right decisions (B)		Facility allows to handle sepsis cases (C)		Very supported by facility in making right decisions (D)		Availability of protocols for maternal sepsis (E)		Received specific training on maternal infections (F)	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Overall	*324*	*30*	*417*	*39*	*348*	*32*	*474*	*44*	*752*	*70*	*565*	*53*
Age	*930*	*p<0.05†*	*927*	*p<0.05†*	*927*	*p<0.05†*	*848*		*934*		*931*	
<31	70	23	111	37	63	21	126	46	213	71	172	58
31-40	94	33	99	35	104	37	123	49	193	68	159	56
>40	125	36	157	46	147	43	168	52	256	73	220	63
Gender	*931*		*928*		*928*		*849*		*940*	*p<0.05†*	*932*	
Male	100	34	107	37	113	39	120	46	192	65	182	62
Female	189	30	260	41	201	32	297	50	471	73	370	58
Qualification	*931*	*p<0.05†*	*928*	*p<0.05†*	*928*	*p<0.05†*	*849*	*p<0.05†*	*940*	*p<0.05†*	*932*	*p<0.05†*
Nurse/aux nurse	40	32	75	60	43	34	77	66	107	85	92	74
Midwife	21	27	29	38	19	24	27	36	63	79	46	58
Physician	187	34	213	38	218	39	247	49	381	67	327	58
Resident	33	29	42	36	30	26	49	48	82	71	67	59
Other	8	15	8	15	4	8	17	37	30	57	20	38

Table 7. (continued)

Years of experience	*918*		*914*	*p<0.05†*	*914*	*p<0.05†*	*836*		*925*		*918*	
<10	130	27	164	35	126	27	200	46	333	70	279	58
10-20	94	35	109	41	109	42	124	52	189	71	155	59
>20	62	35	93	53	77	43	91	55	131	73	115	65
Region	*931*	*p<0.05†*	*929*	*p<0.05†*	*928*	*p<0.05†*	*850*	*p<0.05†*	*940*	*p<0.05†*	*931*	*p<0.05†*
Africa	47	45	17	16	52	50	29	30	69	64	66	62
Asia	6	12	16	31	18	35	13	28	30	58	25	49
EMRO	7	23	6	21	4	14	7	30	22	73	12	44
Europe	45	25	85	47	64	35	91	54	126	68	73	39
Latin America	181	34	228	42	161	30	264	53	391	72	351	66
High-income	2	8	16	64	14	56	14	67	24	92	24	92
Received specific training on maternal sepsis	*951*	*p<0.05†*	*947*	*p<0.05†*	*949*	*p<0.05†*	*866*	*p<0.05†*	*955*	*p<0.05†*		
Yes	211	38	263	30	221	30	300	57	459	81	n/a	
No	84	22	115	47	97	25	125	37	212	54	n/a	
Attended the WSC Spotlight	*931*		*928*	*p<0.05*	*928*	*p<0.05†*	*849*		*940*		*932*	*p<0.05†*
Yes	66	38	85	38	85	49	92	58	131	74	136	78
No	225	30	284	49	230	30	328	47	533	70	416	55

(A) Answered VERY CONFIDENT to the question "how confident do you feel that you are capable of making the right decision in a case like the one above?"

Table 7. (continued)

(B) Answered ALWAYS AVAILABLE to the question "how would you qualify the availability of resources in the facility where you work to help you make the right decisions?"

(C) Answered COMPLETELY INCORRECTLY to the question "how well does this statement describe your facility: 'The facility where I work doesn't let me handle cases like the one described above'?"

(D) Answered VERY SUPPORTED to the question "how supported do you feel by the facility in which you work to make the right decision in a case like the one above?"

(E) Answered YES to the question "does the hospital you work in have protocols in place for dealing with cases like the one described above?"

(F) Answered YES to the question "have you ever received specific training in how to manage women who present with signs of infection while pregnant, during childbirth, postpartum or post-abortion?"

†*Indicates differences that are significant at $p<0.05$ when performing Pearson χ^2 test. I used these results, together with those from Table 5 to decide which variables to include in my logistic regression models. I did not include years of experience because I used age as a proxy. Since gender was only significant in one case I excluded it from my models.*

In order to analyze whether there were significant differences in these responses according to respondent characteristics, such as qualifications, age, region, whether they had received specific training on maternal sepsis, or whether they had attended the WSC Spotlight, I dichotomized the variables. I assigned a 1 to the most favorable response (e.g., responding they felt *very confident* about being capable of making the right decision) and 0 to the combination of all the others (i.e., *somewhat confident, neutral, not very confident,* and *not confident at all*). I then performed logistic regressions and I report here all instances in which the associations were statistically significant, after controlling for the covariates indicated above.*

Having received training in maternal sepsis was associated with increased odds in all variables: confidence (OR 2.08), availability of resources (OR 1.90), feeling supported (OR 2.29), being allowed to handle cases (OR 1.80), and reporting availability of protocols (OR 6.46). On the other hand, being a nurse -compared to being a physician- was only sometimes associated with any of these variables; it was associated with increased odds of reporting resources were always available and that they felt supported by their facilities (OR 2.50 and OR 1.91). Contrastingly, being a respondent from a high-income country or Asia was associated with decreased odds of feeling confidence (OR 0.08 and OR 0.17) and being from Europe was also negatively associated with responding they had received specific training (OR 0.44). On the other hand, being from Europe, Latin America, or a HIC was associated with increased odds of responding that resources were always available (OR 6.49, OR 4.49, and OR 7.82), and being from Europe or Latin America was also associated with increased odds of reporting feeling supported by their facilities (OR 3.71 and OR 2.75). Having attended the WSC was associated with increased odds of reporting having received training in maternal sepsis (OR 2.57) and that their facilities allowed them to handle cases of

* I also performed additional analyses by dichotomizing the variables assigning a 1 to the answers *very* and *somewhat*, and a 0 to the remaining options (analysis not shown). Although odds ratios changed, and statistical significance in some instances too, the direction remained the same in all cases and the differences did not warrant further discussion.

maternal sepsis (OR 1.80). Being younger was associated with decreased odds of stating they were allowed to handle maternal sepsis cases (OR 0.54). See **Appendix J** for a detailed output of the final models used for these regressions [Full models: $Y= \beta_0+\beta_1$ age$+\beta_2$ region$+\beta_3$ qualifications$+\beta_4$ training$+\beta_5$ WSC$+\varepsilon$].

The survey also asked about existing barriers with regards to making correct and timely decisions when faced with a case of potential maternal sepsis (question 8). **Figure 8** shows the distribution of responses to the different options available. The options included: "I'm afraid of making a mistake," "I've never seen cases like these," "my supervisor doesn't let me handle them," "I'm not sure I know the correct signs," "we don't have a way to triage/treat/manage cases like these in my hospital," and "other." Respondents were asked to check up to two options and there was no option for "not applicable;" this might explain why 34% of respondents checked "other" as their sole answer. On the other hand, 35% of respondents felt the greatest barrier resided in feeling afraid of making a mistake, followed by 16% indicating that they felt unsure they knew the correct signs. The other barriers obtained between 12-13% of responses (having never seen cases of maternal sepsis, not being allowed by their supervisors to act, and having no systems or protocols in place for responding to such cases).

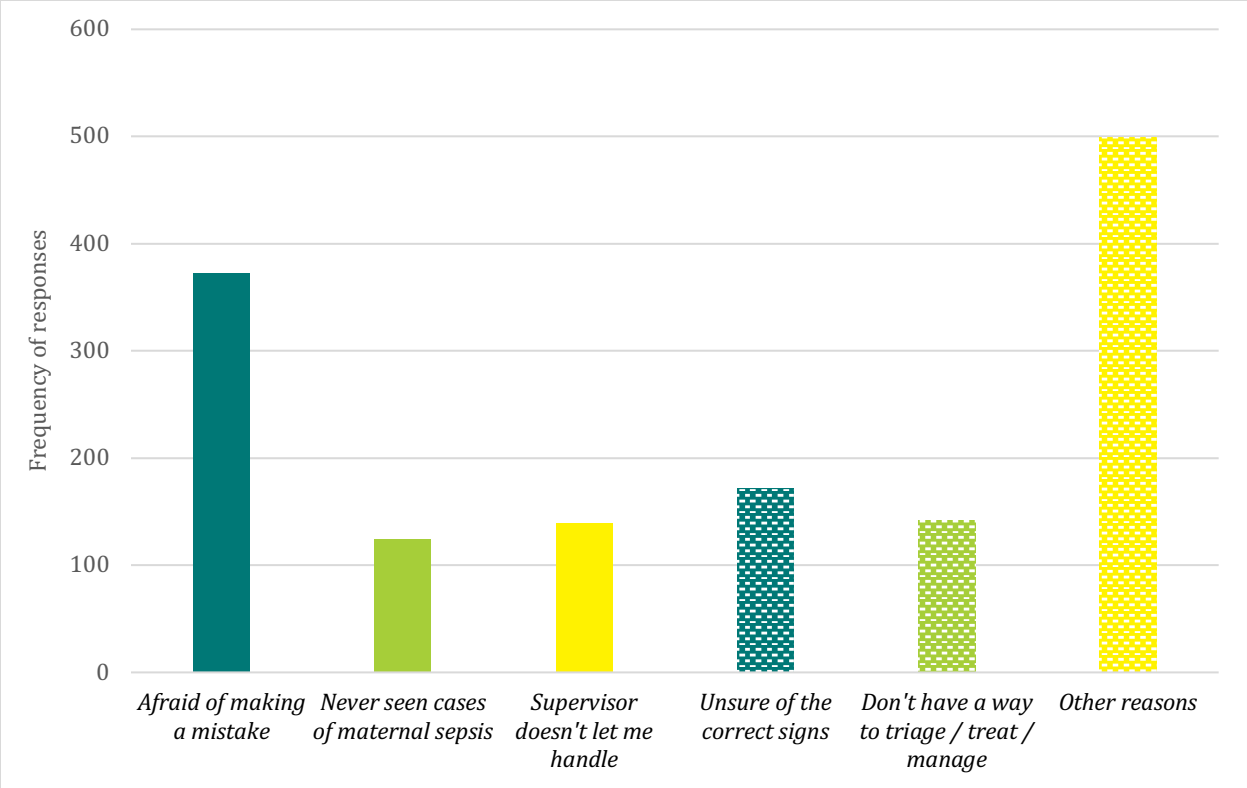

Figure 8. Barriers to making correct and timely decisions

An interesting view on the enabling environment includes comparing responses to the Likert-scale questions with responses regarding barriers in making correct and timely decisions. Respondents who answered that they felt afraid of making a mistake would be expected to also respond that they felt not too confident or not confident at all in making the right decisions. Paradoxically, of the respondents indicating that they felt afraid of making a mistake, 51% classified their level of confidence as *somewhat confident*; this increases to 72% when including responses for *very confident* and *somewhat confident*. Likewise, among the respondents indicating that there was no way to triage/treat/manage cases of maternal sepsis in their facilities, 57% felt the resources needed to make right decisions were *always available* or *somewhat available*. Lastly, among respondents indicating that they felt their supervisor did not allow them to handle cases of maternal sepsis, 85% described the level of support from their facilities as *very supported* or

somewhat supported. These responses seem contradictory leading me to think that despite their confidence, feeling supported by their facilities, and feeling that resources were always or most of the times available, respondents also feel that the fear of making a mistake, feeling their facilities have no way to handle cases of maternal sepsis, and the lack of supportive supervision are barriers to making correct and timely decisions. These two items are not necessarily opposite for respondents, but rather their fear of making mistakes coexists with confidence in making right decisions.

On the other hand, some of the components of enabling environments were associated with components of knowledge. For example, there was a relationship between having heard of and being able to identify the correct management of maternal sepsis, and feeling resources are always available, feeling supported by their facilities, and having received specific training. There was no significant relationship between being able to correctly identify maternal sepsis and any of the components of enabling environments.

Perceptions of the burden of disease

The last concept I wanted to explore with this project was provider perception of the gravity of maternal sepsis in their environments. Some of the interviewees had identified that sepsis lacked attention, funding, and political force in their regions. I was interested in seeing what providers on the ground felt.

The main condition affecting women, according to the majority of respondents, was hemorrhage (69%), followed by pre-eclampsia/eclampsia (61%), and then sepsis (54%). This ranking was the same among all regions with the exception of Europe where sepsis was placed in second place and embolism in third. Providers were asked to provide an estimate number of women affected by sepsis in their facilities every year. Since respondents were asked to estimate and not validate their responses against any reliable statistics, the ranges offered in their responses do not provide much

inherent information, yet they provide a very interesting insight into what respondents see as important. On average, providers in Africa and Latin America were the ones most likely to estimate larger number of women affected by maternal sepsis, compared to Europeans and Asians. No specific trends were identified with regards to the relationship between confidence or feeling of institutional support and their perception of maternal sepsis as a big (or small) problem.

When comparing the estimates respondents provided for maternal sepsis to the estimates provided for annual deliveries in their facilities, some interesting information was revealed. For example, for 92% of respondents the number of women affected by maternal sepsis in their facilities represented less than 11% of the total number of deliveries per year in their facilities. Further, 80% of respondents identified that percentage as being less than 5%, while 8% indicated that the number of women affected by maternal sepsis represented more than 11% of total deliveries. Of note, among this latter group, 5% belonged to the group that thought that the number of women affected by maternal sepsis was over 20% (**Table 8**). I used the cutoff points of 5%, 7%, 11% and 20% because, although data is scarce with regards to frequency of maternal infections, some studies have estimated this number to be 7% (Dolea & Stein, 2003). In addition, it is estimated that about 20% of maternal infections are a result of caesarean sections (Biccard et al., 2018; van Dillen, Zwart, Schutte, & van Roosmalen, 2010).

These data will be interesting to see vis-à-vis the data obtained through the Global Maternal Sepsis Study, where estimates on numbers of maternal sepsis per facility will be available.

Table 8. Burden of maternal sepsis as a proportion of deliveries as perceived by respondents (N=807)†

Number of cases of maternal sepsis/number of deliveries per year	N	%
<5%	647	80
≥5 - ≤7%	46	6
>7 - ≤11%	45	6
>11 - ≤20%	27	3
>20%	42	5

† *N excludes missing responses and responses where the percentage exceeded 100%*

GLOSS campaign implementation monitoring

During this phase the GLOSS campaign was launched, and I conducted a monitoring activity through site visits. For the development of the campaign we looked to influence the three components of awareness raising included in my working definition: increasing knowledge, fostering enabling environments, and impacting provider's perception of the burden of disease. Data obtained through the interviews highlighted the gaps in availability of resources. The survey revealed that knowledge was overall low (despite the fact that most respondents had heard of maternal sepsis before) and that provider's work environment did not enable good awareness. The online congress had significantly increased knowledge on maternal sepsis, specifically on criteria for defining maternal sepsis and management, that were low throughout. This information was used to develop and fine-tune the campaign.

GLOSS Campaign

With the information gathered during the formative stage, we created materials for the campaign where we provided basic information on maternal sepsis (definition, prevention, identification, and management) focusing on feasible actions that did not require very complex medical interventions.

By making this campaign visible and ubiquitous in the facilities, it had the potential to drive attention towards the importance of dealing with maternal sepsis in attempting to improve maternal health. The campaign, although devised as an activity where providers were mere consumers of the messaging, included a call to action for involvement in the campaign and especially with the study. The campaign's tagline was "Stop sepsis!"

The campaign was implemented in all GLOSS participating countries. There was one country that did not engage with the GLOSS campaign locally as they expressed not having the capacity to disseminate the materials or conduct any activities, and another one that had no participants to the online congress. Country coordinators were provided with a checklist for implementation to guide them through the activities and actions needed to execute the campaign successfully (see **Appendix K** for the checklist).

The campaign had a soft launch through the online congress on 12 September and with the website that went live on 13 September. It was officially launched on 06 November 2017. The campaign included several components, as detailed below.

Online congress

The World Sepsis Congress Spotlight: Maternal and Neonatal Sepsis was a free, entirely online, collaborative effort between WHO and the GSA. Through a full-day program, 25 speakers from around the globe presented the most current evidence around maternal and neonatal sepsis. Dr Tedros Adhanom Ghebreysus, Director-General of WHO, opened the congress through a short video stating the importance and timeliness of this congress. There were four sessions; each one had several presenters and a moderator who coordinated questions from the audience. The sessions covered the following topics:

1. Sepsis: the challenges of medicine, politics, and society
2. Maternal sepsis

3. Neonatal sepsis
4. Updates on sepsis

Over 8,000 people from 152 countries registered for the congress, 69% of them from LMICs, including 46 of the 47 LMICs and all HICs participating in GLOSS. There was a total of 4,412 unique viewers and the maximum number of concurrent viewers was 921, meaning they were all online simultaneously during any one of the sessions. The presentation on maternal sepsis was the most popular of the four and included five presentations from colleagues at WHO, GLOSS, and the field. The sessions were recorded, and they were later made available on YouTube and for download as a podcast; the maternal sepsis session had over 1,300 views on the YouTube channel (by 31 January 2018). We promoted and disseminated the videos and podcasts through the GSA website and network as well as through the GLOSS website and network, and the HRP website. The YouTube videos were closed-captioned and subtitles were made available 104 languages, including all study languages.

GLOSS website

We created a dedicated website for the study, which was designed to live past the study as a website for the Initiative (http://srhr.org/sepsis/). The site was first made live on 13 September with minimal content. It includes information about the Initiative, the study, resources for the campaign, and a news section. Content on the campaign was uploaded sequentially as it became available so that all functionalities and downloadable materials were uploaded onto the website by 06 November 2017, official start date for the campaign.

Although the website is in English, the resources page is available in eight languages (English, French, Spanish, Portuguese, Russian, Arabic, Vietnamese, and Kazakh). The decision to include Vietnamese and Kazakh was based on specific needs and requests from the country coordinators of those countries. In fact, for those two countries, translations were made by the country team and

not by professional translators. This is another indication of country engagement with the campaign.

Throughout the campaign implementation, and ongoing, news articles were uploaded onto the website including updates from the field. We also used this platform to feature some of the activities and materials developed by the countries, such as informational videos, a video story on a pregnant woman who survived sepsis, and photographs of the campaign being launched on the ground and of other promotional materials that countries created (t-shirts, leaflets, bookmarks, wall-sized calendars, decals).

Print materials

All GLOSS participating countries were provided with a small budget to cover professional printing of the materials, expecting that they be print in A3 poster size. We calculated between four and twelve bundles of materials (each bundle containing one of each of the print materials developed) depending on size and volume of each participating facility. Country coordinators were asked to work together with facility coordinators to ensure that all materials were in display by the official start date of the campaign. We suggested that they post the materials in each of the wards where data collectors were supposed to search for eligible women, as applicable (e.g., antenatal ward, labor ward, postnatal ward, ICU, gynecological ward, surgery wards, pharmacy, morgue).

We developed the following campaign print materials:

One fact sheet on the burden of maternal sepsis and the new definition;

One infographic focusing on identification of maternal sepsis;

One infographic focusing on the treatment and prevention of maternal sepsis;

One poster for healthcare providers with information on the study and eligibility criteria;

One poster for women with information on dates when the study would be taking place and on the possibility of being approached by someone from the study team.

See **Deliverable 2** for copies of all the print materials developed for the campaign.

Other communication materials

In addition to the print materials we developed a press release template. Country coordinators were encouraged to collaborate with their institutions' communications departments to disseminate press releases a week before data collection began. Some countries/facilities used these templates for internal communications, others engaged the local media (newspapers and television), while others used scientific society newsletters or journals to inform about the study. According to what was communicated to me by country coordinators, about 20 different newspaper articles were published in 10 countries with information about the study and the campaign, and there were at least two television appearances by the country coordinators (in Uruguay and Egypt) presenting the study and campaign.

A logo for the campaign was also created and this was translated into all the languages available on the website. It was accessible for download from the GLOSS website and providers were encouraged to use this to identify any materials or presentations relating to the study. Templates for certificates, word documents or presentations were also created, and these were shared with all the country coordinators.

Social media

Twenty tweetable messages were created including information about the study, the Initiative, and maternal sepsis. The messages were each accompanied by an image extracted from the print materials created for the campaign. We had decided to use HRP's social media platform, using their Twitter account, to benefit from their broad number of followers using specifically designated hashtags. During the initial weeks, messages were set to be sent out three times a week, and during data collection, one message every day. Providers in the field were encouraged to follow HRP's Twitter account and propagate the messaging disseminated through that medium. Most of the

Twitter activity occurred during the campaign period and during data collection. We promoted the following hashtags to follow the campaign online: #GLOSS #maternal #sepsis #infections.

Site visits and participant observation

I visited two countries during the first week of the study data collection, during case identification week (28 November to 04 December 2017). During this trip, I visited a total of eight facilities, four in each country. The visits were organized by country coordinators; I had expressed wanting to see the sites, experience normal patient flow and case identification, and observe for campaign implementation. Visits were organized in a different way in each country. Overall, campaign materials were visible, although incomplete in one of the sites. Capacity at data collection and facility coordination was very different between both countries; in one of them, the data collectors seemed well versed in the eligibility criteria and case identification, and had obvious research experience, while in the second country there was much more confusion, and exposure to research seemed much more limited. A short description of each of the two visits follows. In order to ensure confidentiality, names of countries and facilities were omitted and any specific reference to each of the sites was eliminated, except for epidemiological data.

Country A

I visited one of the countries during days 1 and 2 of case identification week (28 and 29 November 2017). During day 1 I visited one of the largest facilities where approximately 6,300 births occur every year. This was a referral, teaching hospital. I participated in an early morning case discussion session with all the obstetrics and gynecology specialists where they presented on the cases seen in the prior 24 hours, as well as research projects under way. The data collector for GLOSS used this meeting to remind all providers about the study and requested assistance in the identification of women. I accompanied the head of the unit during rounds and potential participants for the study were pointed out.

This facility was overcrowded; women were sitting in chairs for hours (sometimes days) during labor waiting for a room or a bed to become available. Depending on the level of severity and stage of labor, women were assigned to an individual room or a shared room in the labor and delivery ward. Gynecology, ICU, antenatal, and postnatal wards consisted of large shared rooms comprised of many beds with no dividers between them. Most of the cases identified during those first days were of women with infection of postpartum surgical wound infections or post-abortion complications. Practically none of the women I saw in the wards I visited (gynecology, labor, antenatal) were mobile, but rather they all mostly stayed laying in their beds.

During day 2, I visited three additional facilities (there were a total of six facilities participating in the study in this country). These were significantly smaller (with about 3,000 births per year each). Of these, one was a private hospital that had identified several women in day 1 of the study. All the others were public hospitals in the center of town.

The first site I visited had created special stickers that they put on medical records of women identified for the study for easy retrieval during completion of study forms. The country team had also created special t-shirts for all data collectors in this site with the legend "Ask me how… to stop maternal and neonatal sepsis." According to the people involved in the study, the t-shirts helped in raising awareness among the providers on site. During my visit, many providers and other hospital staff came up to the country coordinator requesting t-shirts for themselves. With the exception of the private hospital, where we were unable to see the facility coordinator, most of the people we interacted with were aware of the study and knew it had started that week and said they were actively ensuring identification of eligible women. In the private facility, although there were campaign materials visible in the hallways, the staff we interacted with did not seem aware of the study; the facility coordinator was otherwise engaged when we arrived at the facility. In the first facility I visited, informational posters for women and providers were visibly displayed in the labor,

antenatal, and postnatal wards. No posters were seen in the ICU or gynecology wards. In the other facilities, posters were visible in hallways and some of the wards, but since the visits in those sites were briefer, I wasn't able to see whether they were displayed in all the different and pertinent wards. None of the facilities in this country had any of the infographics or the fact sheet in display. I did not see many people engage with the posters during my visits; these had been on display for several weeks before the start of the study. The posters that had been displayed were in the local language.

During the site visit to this country I was also able to help the country coordinator, data collectors, and data entry people by responding to issues and questions regarding form completion and web system data entry. Questions arose regarding eligibility and how to respond to the questions in the forms. I was able to provide support and guidance on this; this country coordinator continued to reach out to me individually during the entire study period with questions and concerns regarding eligibility criteria, completion of forms, and other technical questions. This speaks to the importance of creating personal relationships and interactions with people, especially in global research studies where the breadth of people participating is large.

Country B

I visited the other country site during days 3 and 4 of identification week (30 November and 01 December 2017). There were four participating facilities in this country, three of which were located in the capital city, and one in a nearby suburb. The country coordinator facilitated my visits to each of the sites and led all discussions with the facility teams. During my first day there, I visited the main referral hospital in the city center (with over 7,500 births/year) and met with the entire study team working in that facility. They presented me with the cases they had identified, and we reviewed questions and concerns regarding data collection. I was also taken to visit all the wards in the facility where data collectors were conducting daily visits in order to identify women:

emergency department, gynecology ward, labor and delivery, antenatal ward, ICU. Campaign materials were visible in all of these wards. During the afternoon of that same day, I visited a second facility where data collectors presented the cases they had identified, and I was taken to visit the different wards.

During day 2 of my country visit, I visited the additional two facilities, including the one located in the suburbs. The same process as in the prior day was completed and queries were clarified in the process. Most of the cases identified during these two days were postpartum surgical wound infections and post-abortion complications. Several questions in the data collection forms were aimed at understanding how facilities identified women with infection. In this country, all identification of infections relied on clinical assessments. They did not have the capacity to perform cultures, so details about the organisms causing the infection would be unavailable for this country.

In this country, there was no visible overcrowding; in fact, there were many empty rooms. Only one facility had visibly large numbers of patients (the facility that had over 9,000 deliveries/year). The facilities had very different levels of infrastructure capability. One of the hospitals had been recently renovated, while others were more run down. In some of the facilities, all women in labor were assigned a private or semi-private room. In others, women were roomed in large common spaces that had no dividers between them. In the largest facility, some women had their urine pans sitting exposed next to their beds on the floor; wall paint was peeling in many places and lighting was poor. Most of the women I saw in the wards I visited (labor, antenatal, postnatal) lay in beds, even though the majority did not look ill or unable to walk; in fact, very few of the women were mobile.

Campaign materials were visibly displayed in all four facilities. There were copies of the fact sheet, the two infographics, and informational posters for women and providers on display throughout the facilities. I did not notice anybody engage with the materials; these had been in display for

several weeks before study initiation. The materials for the campaign were the most colorful of the posters and other decals on display, and they had been printed in large poster sized paper (approximately 70x100cm). All materials were available in the local language.

Discussion of results

Given my definition of awareness the results from the qualitative and quantitative analysis provide important information from which to draw conclusions. Despite the fact that most of the people included in my sample had heard of maternal sepsis and thought it was among the top three conditions affecting women in their facilities, the majority was not able to correctly define it or identify the proper management for sepsis. Most respondents, regardless of their qualifications, gender, age, years of experience, or region of the world were unable to identify infection and organ dysfunction as the two criteria that best define maternal sepsis. It is important that I mention an important caveat here: the definition of maternal sepsis is very recent and up until this new definition, there were many different ways of referring to and defining maternal sepsis. Another interesting finding that did not arise from the responses but from the preparation of the survey upon translating the materials for the campaign, was that there is no word for sepsis in Vietnamese. This language uses an equivalent to severe infection, but not having a unique word to describe a condition is very telling of the importance that that condition has in a given environment.

Some interviewees mentioned that lack of training was one of the barriers to correct identification and management, yet when providers were specifically asked about training in the survey, this seemed to have a larger impact on having heard of maternal sepsis and management than it did on identification of maternal sepsis. Large proportions of respondents thought that blood cultures were necessary for identifying maternal sepsis when this is not an essential test needed for identification; this is extremely interesting given that in many country settings there is no capacity to routinely perform blood cultures. Perhaps part of their difficulty in being able to correctly

identify and manage sepsis is related to a perception of required resources that are unavailable to them. On the flip side, less than half of respondents identified the need for a blood pressure apparatus or urine output measurement for identifying sepsis, and changes in blood pressure as well as decreased urine output could be clear indicators of organ dysfunction. It will be interesting to know whether the materials for the campaign were able to influence on these erroneous perceptions.

With regards to enabling environments, the majority of survey respondents were able to identify availability of protocols for maternal sepsis; in contrast, most of the people interviewed mentioned that there were no specific protocols for maternal sepsis. Given the recent definition and the difficulty among survey respondents to identify the two main criteria necessary to define maternal sepsis, I think respondents to the survey were probably alluding to general infection control protocols, or even guidelines in the prevention of life-threatening conditions among women, but not specifically maternal sepsis. Further, levels of self-confidence, feeling of institutional support, and availability of resources together with the perception of whether their facilities lets them handle maternal sepsis cases were on average low but largely affected by having received training in maternal sepsis. The group that, for the most part, fared better in these variables were nurses, yet these results were not encouraging and for the most part, not significant. Physicians fared better with regards to feeling confidence and being allowed to handle sepsis cases, something expected among this cadre of healthcare providers. Region plays a role also, but not always in the same direction. On the other hand, feelings of support, availability of resources, and exposure to training have an impact on whether respondents had heard of maternal sepsis and whether they were able to correctly state what is the best management of women with this condition. What these results lead me to believe is that contextual factors are crucial to provider awareness on maternal sepsis. In addition, given that people who respond to online surveys are typically those engaged with the topic, this poses the question of how providers that did not respond to the survey, or even

providers in non-participating facilities, perceive their work environments regarding maternal sepsis identification and management.

Lastly, providers' perception of burden of maternal sepsis did not show any specific trends. While most respondents were able to identify sepsis among the top three main conditions affecting maternal health, the vast majority expressed seeing sepsis in less than 11% of deliveries that occurred in their facilities each year. This finding was further confounded by the fact that self-confidence and feeling supported were not associated with higher or lower estimates for maternal sepsis. Asking providers to offer estimates, while potentially interesting when considering their perception of burden of disease, does not necessarily provide easily interpretable results.

To the best of my knowledge, there are no other health awareness campaigns that have been directly linked to other large multi-country studies, where an assessment of baseline qualitative and quantitative data was conducted. While there is some evidence of campaigns for healthcare workers, and campaigns evaluated through mixed methods, the evidence of using campaigns to accompany epidemiological research studies is scant (Dillip et al., 2017; Islam, Sanin, & Ahmed, 2017; Rossi, Assaad, Rebeschini, & Hamadeh, 2016). Unlike other health communication campaigns, this one targeted a very specific community and had a very targeted goal; therefore, many of the weaknesses that are commonly found in campaigns typically aimed at a lay general public were not applicable in the GLOSS campaign (Naugle & Hornik, 2014). Likewise, many health awareness initiatives have been implemented with insufficient baseline evidence (i.e., without the exercise that my DELTA project focused on) and little theoretical background to support the initiatives, while also ignoring contextual and environmental factors that are critical to individual behavior (Purtle & Roman, 2015).

Other campaigns, similar to the one being designed for this project, aimed primarily towards providers in healthcare facilities, offered positive findings in both primary and secondary

outcomes; for example, in improving hand hygiene and reducing healthcare-acquired infections (Pittet et al., 2000). Further, other targeted campaigns have proved effective in creating behavior change, especially when awareness levels at baseline were considered low (Karimi-Sari, Tajik, Bayatpoor, Sharafi, & Alavian, 2017; Rossi et al., 2016). There is also some evidence that awareness campaigns using a multi-cultural, multi-language audience through simple targeted messaging can be effective to get people to recognize the main messages from the campaign (Bazzo et al., 2017).

Therefore, a campaign aimed at increasing awareness among a target population of providers participating in a multi-country study has the potential of improving data collection while also setting the groundwork needed to build on how to best identify and manage maternal sepsis. The materials developed for this campaign will continue to be available to providers and facilities from a much wider audience, on demand to download from the website and distribute among their facilities. Hopefully, the momentum gathered and engagement built through this study and the campaign will encourage others to keep maternal sepsis on the spotlight.

It is important to acknowledge that a study and campaign like this one would have been difficult to undertake by any other organization than WHO. This study required convening power to bring together researchers and providers from over 50 countries around the world, something that stands at the core of what WHO is able to do. Even with WHO's global leadership, ensuring that all study components were delivered and implemented required frequent communication with regional and country coordinators, and individual assistance in data collection and campaign implementations. This function would have been hard for another organization to fulfill.

Limitations

Despite many of the strengths shown throughout the document, this study has several limitations. First, interviews were held only in English or Spanish, which made it difficult to interview some of

our colleagues from Central Asia and Eastern Europe that speak primarily Russian. This was a difficulty throughout the study as communication with them was often stymied and required the intervention of the regional coordinator who spoke Russian and/or WHO country staff that could act as interlocutors. Interestingly, shortly into the project we established a communication system that proved basic but sufficient for most messaging which involved emailing each other in our language of ease, and using Google translate to translate from English to Russian and vice-versa.

Second, focusing only on online surveys excluded the voices of providers in countries/environments that one could argue are the more limited (because of poor internet penetration). Although paper-based copies were enabled for the full evaluation of the WHO GLOSS campaign, the time limitation imposed by my DELTA required that I focus on the data that would be quicker to obtain.

Third, despite having had an exercise in piloting the survey, this again was done only in English. Potential issues with validity of the tool, comprehension, and flow of the questions in other languages could not be identified. This was particularly problematic for the surveys in languages for which I relied entirely on professional translations and where the alphabets used were unbeknownst to me (e.g., Russian, Arabic, Vietnamese).

Fourth, there was no control group to compare with which may limit my ability to extrapolate or generalize these findings to other settings. It will also impede knowing whether the campaign had an impact on the quality of the data collected during the study or the potential increase in providers' awareness in identifying cases of maternal infection or sepsis. Similarly, because the implementation of the campaign was decentralized and left in hands of country coordinators, it is impossible to know whether it was implemented as planned or intended. I only count with two examples, from my two site visits. However, I do have photographic evidence of materials in display from 27 countries.

Fifth, although this campaign was multi-modal it lacked a component of true participant engagement. This was primarily due to the limitations that come with a global campaign being implemented simultaneously in many settings with different languages. Engagement was, once again, left to the country coordinators to decide and define.

"No woman, child or adolescent should face a greater risk of preventable death because of where they live or who they are"

Ban ki-Moon (2010)

Section IV: Conclusion statements

The goal of this project was to explore the factors that affected provider awareness on maternal sepsis. The data obtained from this study can help further inform future campaigns, the design of interventions aimed at reducing the burden of maternal sepsis, and improving identification and management of maternal sepsis, as well as the design of future multi-country research projects.

Sepsis knows no boundaries. It affects women in rich and poor countries and facilities alike. Sepsis is now facing a critical global health moment given the current antimicrobial resistance epidemic. It is crucial to have data from a wide array of settings to be able to make substantial strides in improving maternal health outcomes, in obtaining SDG targets, and in reducing unnecessary deaths.

Challenges and opportunities to provider awareness

I set out to answer an overarching question regarding factors that influence healthcare provider awareness in identifying and managing maternal sepsis, with a subsequent quest to identify the challenges and opportunities presented to increase awareness. What became clear from the interviews and the survey, including my observations during the site visits, was that providers have very heterogeneous levels of awareness with regards to maternal sepsis. Identification and management of maternal sepsis is deficient and the environments in which providers work are not optimal for them to have a more accurate understanding of maternal sepsis. Providers' flawed perception of the burden of disease can also dismiss the issue from their attention.

It is prime time to offer providers with the information necessary to identify and manage maternal sepsis. Training and exposure to other educational experiences, such as the one provided through the online congress, have the potential to significantly influence providers' knowledge on maternal sepsis. We need to also ensure that providers are not only equipped with the knowledge for accurate and timely identification and management of sepsis, we also need to offer work environments where fear of punishment and lack of confidence are dispelled. There is a clear opportunity to build on the enthusiasm created through this campaign and study to foster working environments that enable and empower providers to feel secure enough to act and fast, in whatever capacity is applicable according to their qualifications and experience, and availability of resources. Providers seem to be motivated, both at the core of their work in improving women's lives, but also through their involvement in the activities for this study. There is a solid platform upon which to implement prevention, identification, and management actions able to reduce the impact of maternal sepsis.

Implications for women's global health

The new definition for maternal sepsis is set to provide a better understanding of how many women are affected by infections and sepsis. Collecting data on how providers identify and manage infections will have the potential to develop interventions that can prevent infections, improve management of these infections, and hence reduce the impact of sepsis on women during pregnancy, labor, postpartum, and post-abortion. Getting at the accurate estimation of the burden of maternal sepsis, including the ways in which women with suspected infections/sepsis are typically identified and managed, can have enormous implications for research, policy, guidelines, interventions, and prevention. Further, including an awareness campaign prior to data collection during a study can be a good way in which to improve the quality of said data. These two efforts combined can have an impact on global maternal health.

Evidence of low levels of knowledge, confidence and support, and a flawed perception of disease, can be useful to use in reference to other women's health issues. The findings that contextual factors affect provider awareness is important in developing interventions aimed at improving provider ability to deal with maternal sepsis. If providers are not offered the necessary tools and do not feel supported or confident in doing the right thing, they may not be able to act any differently than at present. Similarly, if the resources and protocols are not available, and people are not trained little will change in the quest to reducing maternal mortality and morbidity.

The momentum created by this campaign and study can bring the necessary attention to maternal sepsis, to increase knowledge on this condition, to foster more supportive and enabling contexts in which providers are expected to act, and to understand the true burden of the disease. Anecdotally, we have knowledge of some changes that certain countries, facilities, providers have brought about as a result of their participation in GLOSS (such as implementing protocols, establishing infection prevention and control units).

There is a current policy window as exemplified by the conflation of different global actions that can have a positive impact on maternal sepsis. First, the WHO resolution from 2017 provides the political will to ensure that, from a global health perspective, sepsis is front and center of the discussion. Second, WHO's yearly global handwashing campaign will focus on sepsis in 2018, with a special emphasis on healthcare providers. Third, the creation of a technical working group with representatives of different areas involved in prevention and management of sepsis, such as infection prevention and control, water, sanitation and hygiene (WASH), health systems strengthening, and maternal sepsis, that put together a report set to launch in early 2018 will offer recommendations for future actions. Last, the data obtained from this study and campaign can better inform these recommendations, and guide future actions.

The experience and findings from this campaign can potentially help other "hidden" maternal health conditions come out of the shadows. Ensuring that all providers are aware of research studies being conducted in their facilities can help in increasing awareness on the health condition under scrutiny and influence how they engage with the topic. Awareness campaigns can aid the execution of a research project. Since awareness around a topic is critical to identifying cases and knowing how to handle them, having good communication strategies throughout the project implementation can better inform other research studies and findings, as well as other health communication activities.

Next steps

Further research is needed to understand how the concepts included in my definition of awareness raising interact with each other, and the impact that raising awareness can have on maternal outcomes. Understanding the systems level issues that impact provider performance when dealing with women of reproductive age can offer good guidance as to what needs to change and how.

The information obtained from GLOSS will shed light on the true burden of disease, will help validate the new definition of maternal sepsis, and provide insight into how women are typically identified and managed. Knowing whether the campaign had any impact on the data collection process as well as on maternal health outcomes will be critical in understanding whether there is a place and need for more awareness raising activities alongside research projects.

Key recommendations:

1- Offer training and exposure to learning activities to increase provider awareness on maternal sepsis.

2- Create supportive environments free of punishment for identification of maternal sepsis to help reduce some of the barriers providers face.

3- Build on the global momentum and engagement through GLOSS to bring about change in identification and management of maternal sepsis.

Section V: Bibliography

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Glossary

Antenatal ward: area in a healthcare facility designated to provide care for women during pregnancy.

Bias: a concept that explains why sometimes a statistic may be systematically different from the population parameter it is intended to estimate. There are many different types of biases (see response bias, selection bias, interview bias).

Determinants of health: includes the many factors that together can affect a population's health. According to a definition by Julio Frenk and collaborators, these determinants can be organized by types and levels of analysis: basic, structural, proximate, and health status at the systemic, societal, institutional/household, and individual levels accordingly (Frenk, Bobadilla, Stern, Frejka, & Lozano, 1991).

Developed vs. developing countries: a qualitative description of countries according to their level of economic development as well as their human development index. There are no unified criteria to define countries as developed and those that fall under the category of developing, but in broad terms they correspond to the World Bank's classification of high-income (developed), and low- and middle-income (developing) countries.

Ethics Review Committee: a committee established within WHO for assessing the safeguard of ethics during the conduction of research projects involving human subjects.

Health behavior: refers to a person's beliefs and actions that influences how they behave with regards to their own health and wellbeing.

Healthcare associated infections: infections that people get while receiving care in a healthcare facility.

Health communication: a practice commonly used in public health and health education to promote health messaging, positive health behaviors, and used in public health campaigns.

Health system: a health system includes all the activities whose primary purpose is to promote, restore, or maintain health (Murray & Frenk, 2000).

High-income countries: a classification of countries according to gross national income (GNI), or level of individual income, developed by the World Bank. According to 2018 classifications, high-income countries were those with a GNI of USD 12,236 or more per year in 2016.

Human Development Index: an index comprised of several indicators, such as life expectancy, education, and per capita income.

Infection prevention and control: an approach and solution designed to prevent harm caused by infection to patients and health workers. Healthcare facilities are encouraged to have infection prevention and control units to oversee such actions within the institution (see healthcare associated infections).

Interview bias: refers to any differences an interviewer may have with different interviewees resulting from personality, style, even preconceived notions or prejudices. These differences are usually not conscious or intended (see bias).

Institutional Review Board: the name usually assigned to ethics review boards that assess research protocols involving human subjects to ensure they are abiding by ethics standards.

Jhpiego: an international non-profit organization affiliated with Johns Hopkins University in the United States that is dedicated to improving the lives of women and families. It was formerly called the Johns Hopkins Program for International Education in Gynecology and Obstetrics.

Labor ward: area in a healthcare facility designated for providing care for women during childbirth.

Low- and middle-income countries (LMICs): a classification of countries according to gross national income (GNI), or level of individual income, developed by the World Bank. According to 2018 classifications, low-income countries were those with a GNI of up to USD 1,005 per year in 2016, while middle-income countries were those with a GNI between USD 1,006 and USD 12,235 per year in 2016. Most LMICs are located in Latin America, Africa, East and South Asia, and Central Asia/Eastern Europe.

Maternal sepsis: life-threatening condition defined as organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion, or postpartum period.

Maternal mortality: deaths occurring among women during pregnancy, childbirth, postpartum or post-abortion.

Maternal morbidity: the health problems that women endure during pregnancy, childbirth, and the postpartum period.

Merck for Mothers: a non-profit initiative by Merck pharmaceuticals intended to reduce maternal mortality through funding to partner organizations implementing projects in the field.

Post-natal ward: area in a healthcare facility designated for providing care for women after childbirth, stillbirth or abortion.

Postpartum: period of 42-days after the end of a pregnancy, usually ended by childbirth (can also be stillbirth).

Post-abortion: period of 42- days after termination of pregnancy.

Postpartum hemorrhage: is defined as a blood loss of 500 ml or more within 24 hours after birth. It is the leading cause of maternal deaths globally.

Pre-eclampsia/eclampsia: pre-eclampsia is a condition occurring during pregnancy characterized by high blood pressure. When left untreated, eclampsia can ensue, characterized by seizures. Eclampsia is a life-threatening condition.

Qualtrics: an online tool used for conducting surveys. It has the capacity to collect data and download them in a coded way for use with spreadsheets and other statistical software, and is right-to-left writing enabled.

Response bias: is the tendency of a person to answer questions on a survey that is not entirely honest, most likely out of a perceived pressure to respond in a socially acceptable way. It is also called survey bias (see bias).

Selection bias: a type of bias that impacts on the sample; it involves an increased probability that some individuals are selected to participate in a study or research activity (see bias).

Sepsis: life-threatening organ dysfunction caused by an overwhelming host response to infection.

Skype: a software that enables video and voice calls between computers, tablets, mobile devices, via the Internet and to regular telephones.

SurveyMonkey: an online tool used for conducting surveys. It has the capacity to collect data and download them in a coded way for use with spreadsheets and other statistical software.

WhatsApp: a mobile phone application that allows sending text messages and voice and video calls, and other media to other users of the same application.

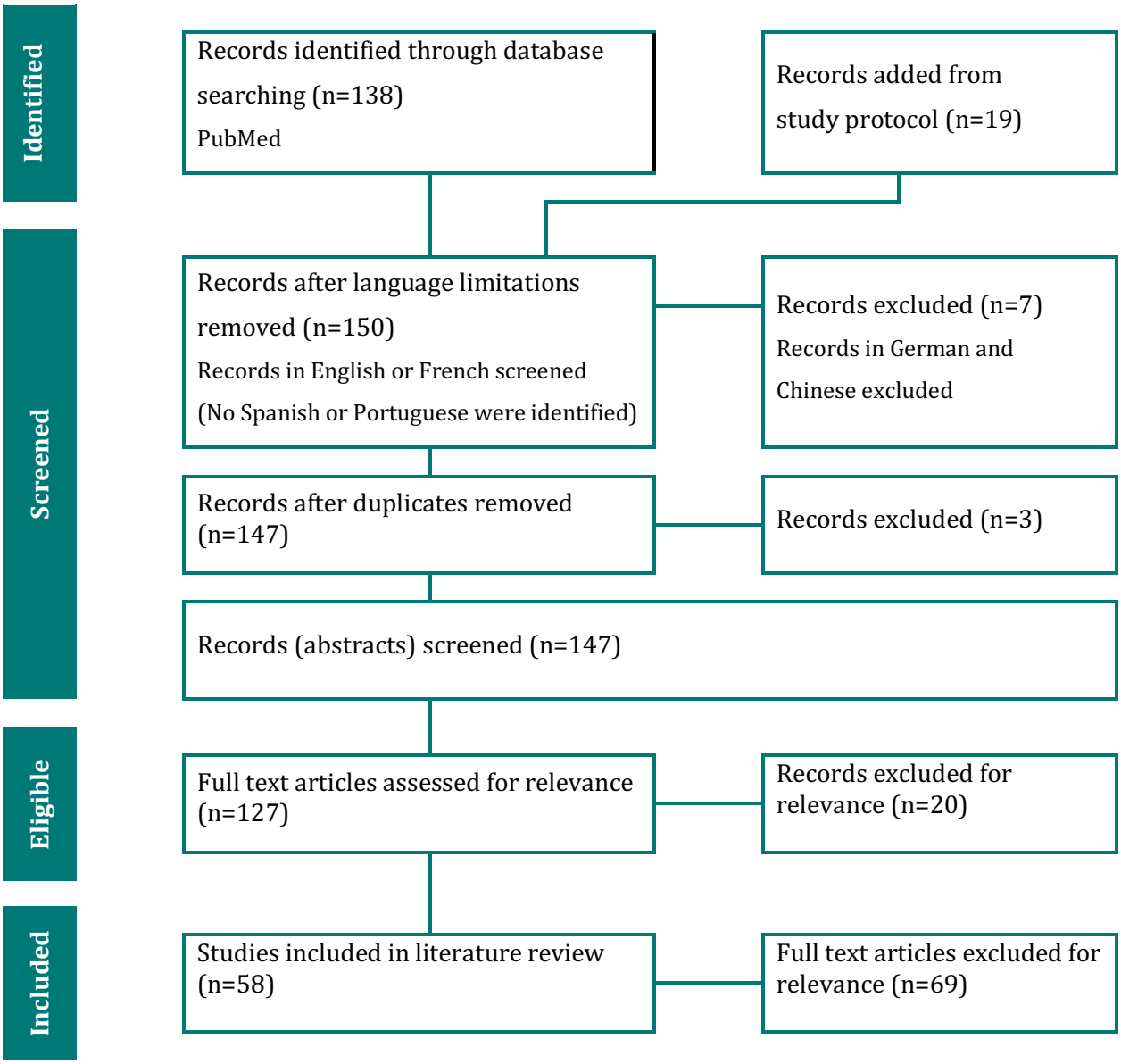
Section VI: Appendices

Appendix A – Literature Review Strategy

MeSH terms searched in PubMed

campaign[tiab] AND ("Health Personnel"[Mesh] OR "Internship and Residency"[Mesh] OR "Education, Medical"[Mesh] OR "Practice Patterns, Physicians'"[Mesh] OR "Practice Patterns, Nurses'"[Mesh] OR "Clinical Competence"[Mesh] OR "Quality of Health Care"[Mesh:NoExp] OR "Quality Improvement"[Mesh] OR "Diagnostic Techniques, Obstetrical and Gynecological"[Mesh:NoExp] OR "Early Diagnosis"[Mesh:NoExp] OR physician*[tiab] OR nurses[tiab] OR midwi*[tiab] OR practitioner*[tiab] OR clinician*[tiab] OR health care professional*[tiab] OR healthcare professional*[tiab] OR care provider*[tiab] OR quality improvement[tiab] OR quality of care[tiab]) AND ("Reproductive Health Services"[Mesh] OR "Reproductive Health"[Mesh] OR "Obstetrics and Gynecology Department, Hospital"[Mesh] OR "Obstetric Nursing"[Mesh] OR "Maternal-Child Nursing"[Mesh:NoExp] OR "Obstetrics"[Mesh] OR "Labor, Obstetric"[Mesh] OR "Obstetric Surgical Procedures"[Mesh] OR "Diagnostic Techniques, Obstetrical and Gynecological"[Mesh:NoExp] OR "Pregnancy Complications"[Mesh] OR "Pregnancy, High-Risk"[Mesh] OR "Primary Health Care"[Mesh:NoExp] OR "Physicians, Primary Care"[Mesh] OR "Emergency Medical Services"[Mesh:NoExp] OR "Emergency Medical Services"[Mesh:NoExp] OR "Intensive Care Units"[Mesh:NoExp] OR "Critical Care Nursing"[Mesh] OR "Emergency Nursing"[Mesh] maternal[tiab] OR obstetric*[tiab] OR midwi*[tiab] OR postpartum[tiab] OR childbirth[tiab] OR perinatal[tiab] OR antenatal[tiab] OR pregnancy[tiab] OR pregnant[tiab] OR reproductive health*[tiab] OR primary care[tiab] OR emergency department*[tiab] OR emergency medic*[tiab] emergency care[tiab] OR intensive care[tiab] OR critical care[tiab]).

Selection of publications



Appendix B – Interview guide and information sheets

Interview guide

Global Maternal Sepsis Study Awareness Campaign

This interview is part of the activities set forth for the Global Maternal Sepsis Study (GLOSS) that is being conducted in approximately 50 countries across the globe.

This study is being coordinated by the World Health Organization and (INSERT COORDINATING INSTITUTION IN COUNTRY) in your country. The goal of this global study is to assess the burden and management of complicated infections during pregnancy, childbirth, postpartum, or the post-abortion period. An important component of this study is a campaign to be deployed in participating healthcare facilities to increase provider awareness around this issue.

This interview is confidential, and its purpose is to gather your thoughts and opinions about maternal and neonatal sepsis identification and management. This interview should not take longer than 45 minutes. There are no right or wrong answers, but rather this is an opportunity to hear your thoughts about the topic as a (REGIONAL COORDINATOR/COUNTRY COORDINATOR) participating in this study. If you agree to this, I will record the conversation so that I can later remember what we talked about. I will likely be taking notes as well while we speak. I will also ask you to complete and sign an informed consent form. You will keep a signed copy with you.

Thanks in advance for agreeing to participate in this activity.

To start off, a few questions about yourself …

1. Sex: (OBSERVE)

    - ☐ Female
    - ☐ Male

2. What country are you from? (KNOWN AHEAD OF TIME)

3. What is your professional background? How long have you been working in this field?
4. What is your job title?
5. What is your experience with multi-country studies?
6. What is your experience participating in awareness campaigns?

I WILL NOW ASK YOU ABOUT SOME MATERNAL AND NEONATAL HEALTH CONDITIONS IN THE GEOGRAPHICAL AREA WHERE YOU WORK…

7. What are the main health conditions affecting women during pregnancy and childbirth in your workplace? (PROBE: in your REGION/COUNTRY/HOSPITAL)
8. What about neonates?
9. What do you think are the main factors that influence these conditions?
10. What, if anything, is being done to address these issues?
11. (IF THEY HAVE MENTIONED INFECTIONS): Let's focus on infections/sepsis.
    a. What are the main infections affecting women in your area? In your hospital?
    b. How does your area (PROBE GEOGRAPHICAL AREA) deal with women presenting with this condition? And your hospital?

(IF THEY HAVE NOT MENTIONED INFECTIONS):

    a. Could you tell me about infections/sepsis affecting women in your area (PROBE: GEOGRAPHICAL)? And in your hospital?
    b. What are the main infections affecting women in your area? In your hospital?
    c. How does hospital deal with women presenting with this condition?
12. What are the main barriers, if any, that providers face when encountered with cases of maternal sepsis?
13. What about any facilitators? (PROBE: WHAT TYPE OF SUPPORT, IF ANY, DO THEY RECEIVE FROM THEIR HOSPITALS/MANAGEMENT?)
14. What about barriers and/or facilitators faced by healthcare facilities?

15. How does your (REGION/COUNTRY/HOSPITAL) respond to cases of maternal and neonatal sepsis?
16. What, if any, are the guidelines or procedures to record cases of sepsis?
17. Could you tell me about any initiatives that you might know of for dealing with maternal sepsis in your (GEOGRAPHICAL AREA/HOSPITAL)?
18. Lastly, as part of this study, we are planning on sending out a survey to providers working in participating hospitals. The plan is to make this an online survey. If you agree, I would be sending you a copy of this survey for your feedback and input. (WAIT FOR ANSWER ON WHETHER THEY AGREE TO THIS OR NOT).
    a. What is the feasibility of asking providers in your area or hospital to complete a survey that requires access to the internet on a computer or smartphone?
    b. What are your thoughts on developing a campaign for increasing awareness on maternal sepsis (PROBE: WILL THIS BE EFFECTIVE IN PROVIDING INFORMATION? WHERE DO PROVIDERS GET MOST OF THEIR MEDICAL INFORMATION/TRAINING?)
19. Is there anything else you would like to add?

Thanks for participating!

Information sheet – Ethical considerations

Global Maternal and Neonatal Sepsis Campaign

This interview is part of the Global Maternal Sepsis Study (GLOSS) that is being conducted in approximately 50 countries across the globe. This study is part of the "Global Maternal and Neonatal Sepsis Initiative" which has the overall goal of accelerating reduction of preventable maternal and newborn deaths related to sepsis. It is being coordinated by the World Health Organization (WHO) and ministries of health and/or research institutions in your country. The goal of this global study is to assess the burden and management of complicated infections during pregnancy, childbirth, postpartum, or the post-abortion period. An important objective of this study is a campaign to be deployed in participating healthcare facilities to increase provider awareness around this issue. This awareness campaign is being coordinated by the Maternal and Perinatal Health and Safe Abortion team (MPA), in the Department of Reproductive Health and Research (RHR) at WHO, and developed by a communications company with extensive experience in global health campaigns.

The specific objectives of the campaign are to improve providers' awareness of maternal and neonatal sepsis and identification of those cases during the study period in participating facilities, and to foster increased awareness of this condition pre- and post-study period. In order to better develop this campaign, semi-structured interviews are being conducted with regional and country study coordinators.

Proceedings. Prior to the interview, you will be provided a copy of this informed consent form to sign. You will be provided with a signed copy of the consent form; we will keep the original signed copy on file.

Ethical considerations. The goal of this interview is to better understand existing barriers and facilitators that influence healthcare provider awareness on maternal and neonatal sepsis. For this, you will be asked for your personal opinions and thoughts on this topic. Participation in this interview is voluntary and you can request to end the interview at any time or choose not to answer any specific question. The research team guarantees confidentiality of all the information you share with us during this interview. Results from these interviews may be included in a published peer-reviewed journal without attributing responses to any specific person or institution.

Benefits of participating in this study. There are no direct benefits to you for agreeing to be interviewed. However, your thoughts on this will not only help shape the development of a better campaign that can positively influence provider awareness on the topic, but also have the potential to improve maternal and neonatal health.

If you have any questions about this interview or the study please contact Ms Vanessa Brizuela (brizuelav@who.int) or Dr Mercedes Bonet (bonetm@who.int).

Consent form

Interviews for the Development of the

Global Maternal Sepsis Study Awareness Campaign

Participant ID: _____

Name of Researcher: _____

Please initial box

1. I confirm that I have read and understand the information sheet dated July 2017 (version 1) for the above study. I have had the opportunity to consider the information, ask questions, and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. ☐

3. I give my permission for the interview to be audio recorded. I understand that my interview will first be typed up word-for-word so the discussion can be analysed by members of the research team. ☐

4. I understand that the audio recordings will be destroyed after they have been analysed and published. ☐

5. I understand that although a number will replace my name on any subsequent reports, my anonymity cannot be guaranteed. ☐

6. I agree to take part in the interview, and to be contacted again in case the research team deems it necessary to clarify any information in my interview ☐

7. I agree for my data that is collected for the above study to be used in future research studies, which have been approved by a Research Ethics Committee. ☐

Name of Participant	Date	Signature

Name of Person taking consent	Date	Signature

When completed, 1 for interviewee; 1 for researcher site file.

Appendix C – Codebook for qualitative analysis

The color scheme allowed for better identification during the analysis.

I.	**Awareness campaigns** i. Experience with campaigns ii. Value of campaign
II.	**Perinatal health conditions** i. Direct causes of maternal mortality i. Infections and sepsis ii. Indirect causes of maternal mortality iii. Maternal morbidity iv. Health conditions newborns
III.	**Determinants of women's health** i. Health status ii. Proximate (i.e., lifestyle) iii. Structural (i.e., inequality) iv. Basic (i.e., biology incl. antimicrobial resistance)
IV.	**Health system barriers** i. Inefficient referral systems ii. Lack of resources (including HR) iii. Poor quality of care iv. Lack of protocols v. Health system management vi. Private v public
V.	**Health system facilitators** i. Good referral systems ii. Existence of sepsis initiatives iii. Systems for recording cases of sepsis iv. Availability of protocols v. Provider motivation and training vi. Health system financing & governance vii. Other maternal health programs

Appendix D – Baseline campaign survey

Paper-based version

World Health Organization	**GLOBAL MATERNAL HEALTH STUDY** **GLOSS Campaign Survey**	Global Maternal Sepsis Study

This online survey is part of the activities set forth for a global study on maternal morbidity and mortality. This study is being conducted in approximately 50 countries across the globe, including your own, and it is coordinated by the World Health Organization and the healthcare facility where you work.

As part of this study, we want to learn more from healthcare providers about how you identify and manage women with complications during pregnancy, childbirth, postpartum, or post- abortion. The survey includes a number of questions on your knowledge, attitudes, and practices around maternal and neonatal health. This is not a test; this is an opportunity to let us know your thoughts and experience on the topic as a healthcare provider in one of the hospitals participating in the study.

This survey is voluntary and your answers will be kept confidential, and you can choose whether to leave some questions unanswered. General information about you, your position, and geographical location will be collected to help us categorize respondents only, but will not be used to identify you in particular. You are free to provide this information at the end of the survey.

After the study, and only if you agree, a second online survey will be sent to you via email. For this reason, we will ask you to provide an email address so that we can ensure delivery of the second survey. You will be free to decide to participate in this second survey too. Results of these surveys will be published in a peer-reviewed journal without attributing responses to any specific person or institution.

The completion of this survey implies your consent to participate.
If you have any question about the survey please contact Ms Vanessa Brizuela (brizuelav@who.int)

Date

d	d	m	m	y	y	y	y

World Health Organization

GLOBAL MATERNAL HEALTH STUDY

GLOSS Campaign Survey
page 1

Global Maternal Sepsis Study

I) Knowledge and attitudes

The following questions will ask that you respond according to your current role, competences, and skills depending on your training and background. That is, according to these, you may be the person triaging, prescribing, diagnosing, treating. Bear this in mind when responding.

1- What are the **main** conditions causing death and disability among women during pregnancy and/or childbirth in your hospital? Check all that apply

- a) abortion-related complications ☐
- b) chronic/pre-existing disease ☐
- c) embolism ☐
- d) haemorrhage ☐
- e) infection/sepsis ☐
- f) pre-eclampsia/eclampsia ☐
- g) other: please specify: ☐

_____

2- Case vignettes

Case A: A 25-year-old 32- week pregnant woman comes to your facility brought by a family member saying she is feeling unwell. Her companion reports that she seems a bit disoriented and feverish. Without any further diagnostic testing or triaging:

a) What would you **first** think could be causing her to feel this way? Choose from the following list

- i- abortion-related complications ☐
- ii- embolism ☐
- iii- haemorrhage ☐
- iv- infection/sepsis ☐
- v- pre-eclampsia/eclampsia ☐
- vi- other ☐

b) What would be **the first two things** this woman should receive?

- i- antibiotics ☐
- ii- blood transfusion ☐
- iii- body fluid culture ☐
- iv- fetal monitoring ☐
- v- fluids ☐
- vi- haematology/biochemistry laboratory ☐
- vii- other antimicrobials (i.e. antimalarias, ART) ☐
- viii- other laboratory test ☐
- ix- other medication ☐
- x- oxygen ☐
- xi- physical exam ☐
- xii- urine output measurement ☐
- xiii- other ☐

3- Case vignettes

Case B: A recently pregnant woman comes to your facility complaining that she has abdominal pain and shortness of breath. Without any further diagnostic testing or triaging:

a) What would you **first** think could be causing her to feel this way? Choose from the following list

- i- abortion-related complications ☐
- ii- embolism ☐
- iii- haemorrhage ☐
- iv- infection/sepsis ☐
- v- pre-eclampsia/eclampsia ☐
- vi- other ☐

b) What would be **the first two things** this woman should receive?

- i- antibiotics ☐
- ii- blood transfusion ☐
- iii- body fluid culture ☐
- iv- fetal monitoring ☐
- v- fluids ☐
- vi- haematology/biochemistry laboratory ☐
- vii- other antimicrobials (i.e. antimalarias, ART) ☐
- viii- other laboratory test ☐
- ix- other medication ☐
- x- oxygen ☐
- xi- physical exam ☐
- xii- urine output measurement ☐
- xiii- other ☐

World Health Organization

GLOBAL MATERNAL HEALTH STUDY

GLOSS Campaign Survey
page 2

4- How confident do you feel that you are capable of making the right decision in a case like the one above?

a) very confident ☐
b) somewhat confident ☐
c) neutral ☐
d) not too confident ☐
e) not confident at all ☐
f) N/A ☐

5- How would you qualify the availability of resources in the facility where you work to help you make the right decisions?

a) always available ☐
b) somewhat available ☐
c) neutral ☐
d) not always available ☐
e) not available at all ☐
f) N/A ☐

6- How supported do you feel by the facility in which you work to make the right decision in a case like the one above?

a) very supported ☐
b) somewhat supported ☐
c) neutral ☐
d) not very supported ☐
e) unsupported ☐
f) N/A ☐

7- How well does this statement describe your facility: "The facility where I work doesn't let me handle cases like the one described above."

a) very well ☐
b) somewhat well ☐
c) indifferent ☐
d) somewhat incorrectly ☐
e) completely incorrectly ☐
f) N/A ☐

8- Of the following, which do you think are the greatest barriers in making a right, and timely decision in your facility? Check **up to two options.**

a) I'm afraid of making a mistake ☐
b) I've never seen cases like these ☐
c) my supervisor doesn't let me make them ☐
d) I'm not sure I know the correct signs ☐
e) we don't have a way to triage/treat/ manage cases like these in my hospital ☐
f) other ☐

9- Does the hospital you work in have protocols in place for dealing with cases like the one described above?

a) yes ☐
b) no ☐
c) don't know ☐

DO NOT GO BACK AND CHANGE ANY

ANSWERS AFTER THIS QUESTION

(PURPOSELY LEFT BLANK)

10- Have you ever heard of the term "maternal sepsis"?
a) yes ☐
b) no ☐

i- If yes, how did you hear about this? Check all that apply

1) pre-service training ☐
2) in-service training ☐
3) public health campaign ☐
4) colleagues ☐
5) media (TV/radio/newspaper) ☐
6) other: please specify ☐

11- What two criteria best describe maternal sepsis? Check **two options**

a) abnormal white cell count ☐
b) altered mental status ☐
c) elevated heart rate ☐
d) excessively rapid respiration ☐
e) fever ☐
f) infection ☐
g) low blood pressure ☐
h) organ dysfunction ☐
i) other ☐

12- What supplies/commodities are essential to effectively **identify** sepsis among women during pregnancy, childbirth, postpartum or post-abortion? Check all that apply

a) blood culture ☐
b) blood pressure apparatus ☐
c) diagnostic imaging ☐
d) laboratory (haematology/ biochemistry) ☐
e) rapid test for infectious disease ☐
f) serum lactate measurement ☐
g) thermometer ☐
h) urine output measurement ☐
i) other ☐

13- What supplies/commodities are essential to effectively **manage** sepsis in women during pregnancy, childbirth, postpartum or post-abortion? Check all that apply

a) antibiotics ☐
b) blood transfusions ☐
c) fluids ☐
d) intensive care/high-dependency unit ☐
e) other antimicrobials (e.g. antimalarials, ART) ☐
f) oxygen ☐
g) urine output measurement ☐
h) other ☐

II) CONTEXT

14- How many women are affected by maternal sepsis in your facility every year? Give your best estimate (a whole number), given your experience in the facility ☐☐☐☐☐

15- How many neonates are affected by neonatal sepsis in the first week of life in your facility? Give your best estimate (a whole number), given your experience in the facility. ☐☐☐

16- How many deliveries occur every year, on average, in your facility? Give your best estimate ☐☐☐☐☐

17- Have you ever received specific training in how to manage women who present with signs of infection while pregnant, during childbirth, postpartum or post-abortion?

a) yes ☐
b) no ☐
c) can't remember ☐

World Health Organization

GLOBAL MATERNAL HEALTH STUDY

GLOSS Campaign Survey

page 4

III) PERSONAL INFORMATION

Remember! These data are collected for categorisation purposes only. Your information is confidential and you will not be identified in any future publications on this study

18- Age range

- a) 18-25 ☐
- b) 26-30 ☐
- c) 31-40 ☐
- d) 41-50 ☐
- e) 51-60 ☐
- f) 61+ ☐

19- Gender

- a) male ☐
- b) female ☐
- c) other ☐

20- Qualification

- a) nurse ☐
- b) midwife ☐
- c) physician/medical doctor ☐
- d) resident/physician in training ☐
- e) community health worker ☐
- f) social worker ☐
- g) other: please specify ☐

_____

21- Years of work experience in current setting

years ☐☐

months ☐☐

22- Total years of work experience (since completing your training): ☐☐

23- Place of work (country):

_____

24- Location (of current or main place of work)

- a) urban ☐
- b) rural ☐

25- Name of facility and address:

_____

26- Facility type (of current or main place of work)

- a) clinic ☐
- b) health centre ☐
- c) maternity hospital ☐
- d) regional/provincial hospital ☐
- e) district hospital ☐
- f) other hospital ☐
- g) other ☐

27- Facility management (of current or main place of work)

- a) private ☐
- b) public ☐
- c) social insurance ☐
- d) NGO ☐
- e) other ☐

28- Did you participae in this year's World Sepsis Congress Spotlight on Maternal and Neonatal Sepsis (held on 12 September 2017)?

- a) yes ☐
- b) no ☐

IV) FUTURE CONTACTS

29- *The global maternal study and awareness campaign would like to contact you at a future date for a follow-up on this survey. If you agree to being contacted again, please provide us with your email address*

- a) I agree ☐
- b) I do not agree ☐

Your contact details will be securely stored by the WHO staff person working on the study for one year. You can contact us to modify or suppress your information at any time. To do so, please contact: Mr Vanessa Britsuelo (britsuelov@who.int).

Your email address:

_____ @ _____

Thank you very much for participating in this survey! Your responses are extremely valuable to us in our efforts to improve the health of women and newborns

Additional Instructions and Questions for Survey Pilot

GLOSS Awareness Campaign Survey. Pilot testing from providers

This is a pilot test of an online survey which is part of the activities set forth for the Global Maternal Sepsis Study (GLOSS) being conducted in approximately 50 countries across the globe, including your own. This study is being coordinated by the World Health Organization, in conjunction with the ministry of health of your country. Although you will not be participating in the study, your opinions on whether this tool is appropriate and valid are key.

For this study, we are launching a campaign to raise awareness among healthcare providers participating in the study. Through this survey we want to learn from healthcare providers about how women with infection during pregnancy, childbirth or postpartum, or post- abortion are identified and treated in participating hospitals. The aim of piloting this survey is to assess whether this tool is appropriate at gathering provider knowledge, attitudes, and behaviours with regards to sepsis identification and management. Your responses to this pilot test are crucial to finalising the survey and translating it to the different languages of participating countries.

After completing the online survey, there will be some additional questions that are extremely important that you complete, as these give us important information on the validity and clarity of the tool.

1. Were you able to complete the entire survey?
2. Where there any questions you left unanswered?
    a. If yes, why?
3. Where there any questions you had trouble answering?
    a. If yes, which one(s)?
    b. If yes, why did you have trouble answering it/them?

4. Where there any questions that were unclear?
    a. If yes, which one(s)?
    b. If yes, why was it/were they unclear?
5. Did any of the questions make you uncomfortable?
    a. If yes, which ones?
    b. If yes, what made you uncomfortable?
6. Were there things you wanted to explain but weren't allowed to through the tool?
    a. If yes, what exactly?
7. Did the flow of questions work for you?
    a. If no, what would you change?
8. Would you eliminate any questions?
    a. If yes, which one(s)?
    b. Why?
9. How long did it take you to complete the entire survey, from start to finish?
10. Anything else?
11. Please provide us with your email address so that we can contact you in case we have any further questions.

Appendix E – Codebook for quantitative analysis

Name of variable	Code	Label of variable
Q1: **What are the main conditions causing death and disability among women during pregnancy and/or childbirth in your hospital? Check all that apply**		
Q1abortion	1	Abortion
Q1chronic	1	Chronic/pre-existing
Q1embolism	1	Embolism
Q1haemorrhage	1	Haemorrhage
Q1sepsis	1	Infection/sepsis
Q1PEE	1	Pre-eclampsia/Eclampsia
Q1other	1	Other
Other	text	
Q2a. Case A. What would you first think could be causing her to feel this way? Choose from the following list		
Q2a	1	Abortion-related complications
	2	Embolism
	3	Hemorrhage
	4	Infection/sepsis
	5	Pre-eclampsia/Eclampsia
	6	Other
Q2b. Case A. What would be the first two things this should receive?		
Q2ATB	1	Antibiotics
Q2blood	1	Blood transfusion
Q2culture	1	Body fluid culture
Q2fetal	1	Fetal monitoring
Q2fluids	1	Fluids
Q2lab	1	Haematology/biochemistry
Q2AM	1	Other antimicrobial
Q2otherlab	1	Other lab
Q2meds	1	Other medication
Q2oxygen	1	Oxygen
Q2physical	1	Physical exam

Q2urine	1	Urine output measurement
Q2other	1	Other
Q3a. Case A. What would you first think could be causing her to feel this way? Choose from the following list		
Q3a	1	Abortion-related complications
	2	Embolism
	3	Hemorrhage
	4	Infection/sepsis
	5	Pre-eclampsia/Eclampsia
	6	Other
Q3b. Case A. What would be the first two things this should receive?		
Q3ATB	1	Antibiotics
Q3blood	1	Blood transfusion
Q3culture	1	Body fluid culture
Q3fetal	1	Fetal monitoring
Q3fluids	1	Fluids
Q3lab	1	Haematology/biochemistry
Q3AM	1	Other antimicrobial
Q3otherlab	1	Other lab
Q3meds	1	Other medication
Q3oxygen	1	Oxygen
Q3physical	1	Physical exam
Q3urine	1	Urine output measurement
Q3other	1	Other
Q4. How confident do you feel that you are capable of making the right decision in a case like the one above?		
Q4	0	NA
	1	very confident
	2	somewhat confident
	3	neutral
	4	not too confident
	5	not confident at all
Q5. How would you qualify the availability of resources in the facility where you work to help you make the right decisions?		
Q5	0	NA

	1	always available
	2	somewhat available
	3	neutral
	4	not always available
	5	not available at all
Q6. How supported do you feel by the facility in which you work to make the right decision in a case like the one above?		
Q6	0	NA
	1	very supported
	2	somewhat supported
	3	neutral
	4	not very supported
	5	unsupported
Q7. How well does this statement describe your facility: "The facility where I work doesn't let me handle cases like the one described above."		
Q7	0	NA
	1	Very well
	2	Somewhat well
	3	Indifferent
	4	Somewhat incorrectly
	5	Completely incorrectly
Q8. Of the following, which do you think are the greatest barriers in making a right, and timely decision in your facility? Check up to two options.		
Q8afraid	1	I'm afraid of making a mistake
Q8never	1	I've never seen cases like these
Q8supervisor	1	My supervisor doesn't let me make them
Q8unsure	1	I'm not sure I know the correct signs
Q8notriage	1	We don't have a way to triage/treat/manage cases like these in my hospital
Q8other	1	other
Q9. Does the hospital you work in have protocols in place for dealing with cases like the one described above?		
Q9	0	No/Don't know
	1	Yes
Q10. Have you ever heard of the term maternal sepsis?		

Q10	0	No
	1	Yes
Q10a. If yes, how did you hear about this? Check all that apply		
Q10preserv	1	Pre-service training
Q10inserv	1	In-service training
Q10colleague	1	Public health campaign
Q10campaign	1	Colleagues
Q10media	1	Media
Q10self	1	Self-learning (including courses, readings, internet, conferences)
Q10work	1	At work (including protocols, and experiences)
Q10other	1	Other
Other	text	
Q11. What two criteria best describe maternal sepsis? Check two options.		
Q11WBC	1	Abnormal white cell count
Q11mental	1	Altered mental status
Q11HR	1	Elevated heart rate
Q11RR	1	Excessively rapid respiration
Q11fever	1	Fever
Q11infect	1	Infection
Q11BP	1	Low blood pressure
Q11OD	1	Organ dysfunction
Q11other	1	Other
Q12. What supplies/commodities are essential to effectively identify sepsis among women during pregnancy, childbirth, postpartum or post-abortion? Check all that apply		
Q12culture	1	Blood culture
Q12BP	1	Blood pressure apparatus
Q12imag	1	Diagnostic imaging
Q12lab	1	Laboratory (haematology/biochemistry)
Q12raptest	1	Rapid test for infectious disease
Q12lact	1	Serum lactate measurement
Q12therm	1	Thermometer
Q12urine	1	Urine output measurement
Q12other	1	Other
Q13. What supplies/commodities are essential to effectively manage sepsis among women		

during pregnancy, childbirth, postpartum or post-abortion? Check all that apply		
Q13ATB	1	Antibiotics
Q13blood	1	Blood transfusion
Q13fluids	1	Fluids
Q13ICU	1	Intensive care/high-dependency unit
Q13AM	1	Other antimicrobial
Q13oxygen	1	Oxygen
Q13urine	1	Urine output measurement
Q13other	1	Other
Q14. How many women are affected by maternal sepsis in your facility every year?		
Q14	Number	
Q15. How many neonates are affected by neonatal sepsis in the first week of life in your facility?		
Q15	Number	
Q16. How many deliveries occur every year, on average in your facility? Give your best estimate		
Q16	Number	
Q17. Have you ever received specific training in how to manage women who present with signs of infection while pregnant, during childbirth, postpartum or post-abortion?		
Q17	0	No/Can't remember
	1	Yes
Q18. Age range		
Q18	1	18-25
	2	26-30
	3	31-40
	4	41-50
	5	51-60
	6	61+
Q19. Gender		
Q19	0	Male
	1	Female
	2	Other
Q20. Qualification		
Q20	1	Nurse

	2	Midwife
	3	Physician/medical doctor
	4	Resident/physician in training
	5	Community health worker
	6	Social worker
	7	Student
	8	Physical therapist
	9	Auxiliary nurse
	10	Other
Q20other	Text	Other
Q21. Years of work experience in current setting		
Q21y	Number	
Q21. Months of work experience in current setting		
Q21mo	Number	
Q22. Total years of work experience		
Q22	Number	
Q23. Country* (see list)		
Q24. Location (of current or main place of work)		
Q24	0	Rural
	1	Urban
Q25. Name of facility and address		
Q25	Text	
Q26. Facility type		
Q26	1	Clinic
	2	Health centre
	3	Maternity hospital
	4	Regional/provincial hospital
	5	District hospital
	6	Other hospital
	7	Other
Q27. Facility management		
Q27	1	Private
	2	Public

	3	Social insurance
	4	NGO
	5	Other
Q28. Did you participate in this year's World Sepsis Congress Spotlight on Maternal and Neonatal Sepsis (held on 12 September 2017)?		
Q28	0	No
	1	Yes
Q29. (Agree to getting contact)		
Q29	0	No
	1	Yes
Q30. Email address		
Q30	text	
Q31. Do you work in a participating facility?		
Q31	0	No
	1	Yes
Q32. Language		
Q32	1	English
	2	Spanish
	3	Russian
	4	French
	5	Portuguese
	6	Vietnamese
	7	Italian
	8	Arabic
Region		
AFRO	1	Africa
ASIA	2	Asia
EMRO	3	Eastern Mediterranean
EURO	4	Europe (Central Asia + Eastern Europe)
PAHO	5	Latin America
HIC	6	High-income countries
Age range into 3		
agerange	1	<31
	2	31-40

	3	>40
New classification of qualifications		
qual	1	Nurse/auxiliary nurse
	2	Midwife
	3	Physician
	4	Resident
	5	Other
Total years of experience by range		
exp_range	1	<10
	2	10-20
	3	>20
Years of experience in current location by range		
currentexp_range	1	<10
	2	10-20
	3	>20
Q11. Correctly identified the two criteria for maternal sepsis (infection + organ dysfunction)		
Q11gold	0	Incorrect
	1	Correct
Q11. Identified infection + marker for organ dysfunction		
Q11silver_inf	0	Incorrect
	1	Correct
Q11. Identified organ dysfunction + marker for infection		
Q11silver_OD	0	Incorrect
	1	Correct
Q11. Identified marker for organ dysfunction + marker for infection		
Q11bronze	0	Incorrect
	1	Correct
Q2. Correctly identified antibiotics and fluids if selected sepsis/infection		
Q2correct	0	Incorrect
	1	Correct
Q8. Checked *other* plus another option under barriers		
Q8other_b	0	No
	1	Yes

Q8. Checked only *other* under barriers		
Q8other_only	0	No
	1	Yes
Enabling environment dichotomous variables		
Confidence	0	No
	1	Yes
Resources	0	No
	1	Yes
Support	0	No
	1	Yes
Empower	O	No
	1	Yes
Protocols	0	No
	1	Yes
Cases of maternal sepsis as a proportion of deliveries per year per facility		
mspercent	Number	

Country codes	
3	Afghanistan
10	Argentina
19	Belgium
20	Burkina Faso
24	Benin
28	Bolivia
29	Brazil
45	Cameroon
47	Colombia
57	Denmark
61	Ecuador
63	Egypt
66	Spain
67	Ethiopia
76	United Kingdom
81	Ghana

90	Guatemala
96	Honduras
104	India
109	Italy
114	Kenya
115	Kyrgyzstan
116	Cambodia
124	Kazakhstan
126	Lebanon
129	Sri Lanka
132	Lithuania
136	Morocco
138	Moldova
144	Mali
145	Myanmar
146	Mongolia
155	Malawi
156	Mexico
158	Mozambique
163	Nigeria
164	Nicaragua
165	Netherlands
167	Nepal
173	Peru
176	Philippines
177	Pakistan
189	Romania
196	Sudan
202	Slovakia
205	Senegal
215	Chad
218	Thailand
219	Tajikistan
234	Uruguay

241	Vietnam
248	South Africa
250	Zimbabwe

Appendix F – Participant observation checklist

Before Participant Observation

1. Decide upon countries to be visited during study week (28 November to 04 December 2017).
2. Select the site(s), time(s) of day, and date(s), and anticipate for how long participant observation data will be collected on each date (i.e., how many hours).
3. Within each site, determine ahead of time, what wards will be observed.
4. Consider having access to common areas where campaign materials may have been displayed in addition to specific wards.
5. Consider how observer will present themselves to the facility staff, both in terms of appearance and purpose if necessary. This will be determined with study research team in collaboration with site focal point and country coordinator.
6. Plan for note taking during the participant observation activity.
7. Remember to take field notebook and a pen.

During Participant Observation

1. Observe for visibility and location of campaign materials.
2. Observe for competition of campaign materials with other posted materials (e.g., specific to the hospital, referring to other campaigns, other materials).
3. Observe for provider engagement with campaign materials.
4. Observe for patient flow and provider interaction in the designated wards.
5. Observe for interactions between providers and women.
6. Take note of comments, conversations, interactions that are relevant to campaign and study (i.e., observations about the materials, interaction with data collection forms).

After Participant Observation

1. Schedule time soon after participant observation to expand notes.
2. Review observation notes in conjunction with notes from interviews for consistencies, contradictions, novelties.

Appendix G - Harvard IRB approval letter

HARVARD
Human Research Protection Program

Harvard T.H. Chan School of Public Health
Office of Human Research Administration
90 Smith Street, 3rd Floor
Boston, MA 02120
Federalwide Assurance FWA00002642

Notification of Initial Study Approval

December 18, 2017

Ana Langer
alanger@hsph.harvard.edu

Protocol Title:	Why don't providers identify and manage maternal sepsis? A mixed-methods approach to developing an awareness campaign to accompany a WHO-led multi-country study
Principal Investigator:	Ana Langer
Protocol #:	IRB17-1857
Funding Source:	None
Review Date:	12/18/2017
STUDY Effective Date:	12/18/2017
Expiration Date:	12/17/2018
IRB Review Type:	Expedited
IRB Review Action:	Approved

The Institutional Review Board (IRB) of the Harvard T.H. Chan School of Public Health approved this Initial Study. **Please note that the approval for this protocol will lapse on 12/17/2018.**

This approval includes the following:
- Initial Application, IRB17-1857
- IRB Protocol: Factors influencing provider awareness on maternal sepsis (0.01)

Additionally, the IRB has reviewed the following documents:
- Ancillary Approvals/Permissions: WHO Ethics Review Committee of parent study where primary data was collected (5.1)
- Ancillary Approvals/Permissions: WHO Ethics Review Committee Approval (4)
- Data Use Agreement or Other Agreements: Access to data (1)

The IRB made the following determinations:
- Waivers:
  - A waiver of the requirement to obtain consent is appropriate as set forth at 45 CFR 46.116(d).
- Risk Determination: No greater than minimal risk

- Research Information Security Level: The research is classified, using Harvard's Data Security Policy, as Level 2 Data.

Please contact me at 617-432-3071 or gbullock@hsph.harvard.edu with any questions.

Sincerely,

Grace Bullock
IRB Review Specialist

Appendix H – Knowledge about sepsis by respondent country of origin

Country*	Had heard about maternal sepsis (N=1,057)			Correctly identified the two criteria to define maternal sepsis (N=671)			Correctly identified management of sepsis when maternal sepsis was suspected (N=276)		
	n	*N*	*(%)*	*n*	*N*	*(%)*	*n*	*N*	*(%)*
AFRO									
Benin	2	6	33	0	4	0	0	1	0
Burkina Faso	23	25	92	1	13	8	0	3	0
Cameroon	1	1	100	0	1	0	1	1	100
Chad	1	1	100		†	n/a		†	n/a
Ethiopia	5	6	83	0	4	0	1	1	100
Ghana	4	5	80	2	3	67	0	1	0
Kenya	20	21	95	3	12	25	4	6	67
Malawi	5	5	100	0	2	0	1	1	100
Mali	5	5	100	0	2	0		†	n/a
Mozambique	15	15	100	1	12	8	0	6	0
Nigeria	9	9	100	0	6	0	1	3	33
South Africa	7	7	100	2	3	67	1	1	100
Zimbabwe	1	1	100		†	n/a	1	1	100
EMRO									
Egypt	7	7	100	0	5	0	1	3	33
Lebanon	10	10	100	0	9	0		†	n/a
Morocco	3	6	50	0	3	0		†	n/a
Pakistan	2	2	100	1	1	100		†	n/a
Sudan	5	5	100	0	4	0	1	1	100
EURO									
Kazakhstan	19	21	90	0	12	0	0	2	0
Kyrgyzstan	17	17	100	1	5	20	0	5	0
Lithuania	95	99	96	20	47	43	4	16	25
Republic of Moldova	11	11	100	4	6	67	1	3	33
Romania	21	22	95	8	15	53	1	5	20
Slovakia	14	15	93	2	5	40	0	1	0

PAHO									
Argentina	59	59	100	9	27	33	2	9	22
Bolivia	20	20	100	2	12	17	1	4	25
Brazil	43	43	100	9	30	30	15	19	79
Colombia	133	133	100	11	89	12	40	47	85
Ecuador	39	39	100	1	31	3	4	5	80
Guatemala	163	175	93	22	106	21	19	55	35
Honduras	7	7	100	1	4	25		†	n/a
Mexico	32	34	94	1	24	4	4	9	44
Nicaragua	2	2	100	1	2	50		†	n/a
Peru	9	10	90	1	5	20		†	n/a
Uruguay	18	18	100	6	8	75	0	1	0
ASIA									
India	4	5	80	1	4	25	1	2	50
Mongolia	1	1	100					†	n/a
Myanmar	4	4	100	1	2	50		†	n/a
Nepal	9	9	100	4	7	57	1	1	100
Philippines	4	4	100	0	2	0	0	1	0
Thailand	3	5	60	0	4	0		†	n/a
Viet Nam	21	24	88	0	15	0	0	8	0
HIC									
Italy	14	14	100	2	10	20		5	0
Spain	2	2	100	0	1	0		†	n/a
UK	10	10	100	7	8	88		†	n/a

**Not all countries are listed. Those countries for which there was no response to any of these three questions were excluded from this table*

†*Means that there were no responses from this country*

Appendix I – Logistic regression models for the component *knowledge*

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Full model
Had heard of maternal sepsis						
	cOR [CI]	cOR [CI]	cOR [CI]	cOR [CI]	cOR [CI]	aOR [CI]
Qualification						
Nurse			1.28 [0.37-4.44]			0.67 [0.17-2.59]
Midwife			0.25** [0.11-0.58]			0.23** [0.09-0.60]
Resident			1 [omitted]			1 [omitted]
Other			0.18** [0.07-.043]			0.21 [0.06-0.71]
Region						
ASIA				0.66 [0.20-2.18]		0.69 [0.18-2.67]
EMRO				0.64 [0.16-2.65]		1.74 [0.36-8.50]
EURO				1.58 [0.56-4.49]		2.66 0.84-8.40]
PAHO				2.68 [1.05-6.81]		5.23 [1.60-17.11]
HIC				1 [omitted]		1 [omitted]
Age						
<31					0.43 [0.18-1.12]	0.42 [0.14-1.22]
>40					0.61 [0.24-1.53]	0.76 [0.28-2.06]
WSC	2.62 [0.79-8.63]					1.45 [0.39-5.41]
Training		9.85** [3.80-25.51]				10.53** [3.57-31.07]

*** denotes statistical significance at p<0.005*
All full models had a p-value <0.0001.
cOR: crude odds ratio
aOD: adjusted odds ratio
CI: confidence interval
For the variable qualifications *physicians were used as the comparison; for* region *AFRO was used as the comparison; for* age *the range 31-40 was used as the comparison.*

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Full model
Correctly identified the two criteria to define maternal sepsis						
	cOR [CI]	cOR [CI]	cOR [CI]	cOR [CI]	cOR [CI]	aOR [CI]
Qualification						
Nurse			0.19** [0.08-0.49]			0.18** [0.07-0.49]
Midwife			0.48 [0.19-1.17]			0.68 [0.26-1.76]
Resident			1.44 [0.83-2.49]			1.70 [0.89-3.27]
Other			0.34 [0.10-1.15]			0.66 [0.18-2.46]
Region						
ASIA				1.26 [0.41-3.91]		0.76 [0.22-2.69]
EMRO				0.28 [0.03-2.35]		0.38 [0.04-3.48]
EURO				3.75** [1.64-8.54]		4.86** [2.03-11.64]
PAHO				1.38 0.65-2.93]		1.62 [0.72-3.63]
HIC				5.3** [1.69-16.65]		5.09 [1.49-17.41]
Age						
<31					0.65 [0.39-1.07]	0.56 [0.31-1.02]
>40					0.75 [0.47-1.21]	0.56 [0.32-0.97]
WSC	3.07** [1.94-4.84]					3.99** [2.34-6.79]
Training		1.30 [0.86-1.96]				1.45 [0.89-2.34]

*** denotes statistical significance at p<0.005*

All full models had a p-value <0.0001.

cOR: crude odds ratio

aOD: adjusted odds ratio

CI: confidence interval

For the variable qualifications *physicians were used as the comparison; for* region *AFRO was used as the comparison; for* age *the range 31-40 was used as the comparison.*

Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Full model
Correctly identified management of sepsis when maternal sepsis was suspected						
	cOR [CI]	cOR [CI]	cOR [CI]	cOR [CI]	cOR [CI]	aOR [CI]
Qualification						
Nurse			0.49 [0.23-1.03]			0.18** [0.07-0.48]
Midwife			0.87 [0.30-2.51]			0.77 [0.21-2.86]
Resident			2.24 [1.10-4.56]			2.54 [1.00-6.44]
Other			0.51 [0.17-1.57]			0.51 [0.12-2.12]
Region						
ASIA				0.3 [0.05-1.67]		0.21 [0.03-1.64]
EMRO				0.75 [0.11-4.90]		0.94 [0.07-12.51]
EURO				0.35 [0.10-1.14]		0.28 [0.07-1.14]
PAHO				1.99 [0.84-4.72]		2.61 [0.91-7.49]
HIC				2.25 [0.30-1.48]		1.41 [0.16-12.28]
Age						
<31					0.84 [0.45-1.58]	0.77 [0.33-1.81]
>40					0.82 [0.42-1.61]	1.36 [0.56-3.32]
WSC	5.68** [2.73-11.85]					8.60** [3.48-21.22]
Training		4.20** [2.34-7.53]				2.50 [1.20-5.19]

*** denotes statistical significance at p<0.005*
All full models had a p-value <0.0001.
cOR: crude odds ratio
aOD: adjusted odds ratio
CI: confidence interval
For the variable qualifications *physicians were used as the comparison; for* region *AFRO was used as the comparison; for* age *the range 31-40 was used as the comparison.*

Appendix J – Logistic regression models for the component *enabling environments*

Predictor	Confidence in making the right decision	Availability of resources	Support from the facility	Facility allows to handle	Availability of protocols	Received training
	aOR [CI]	aOR [CI]	aOR [CI]	aOR [CI]	aOR [CI]	aOR [CI]
Qualification						
Nurse	0.73 [0.46-1.14]	2.50** [1.61-3.87]	1.91** [1.70-3.09]	0.94 [0.60-1.47]	0.72 [0.33-1.59]	1.53 [0.96-2.45]
Midwife	0.71 [0.40-1.25]	1.11 [0.65-1.89]	0.73 [0.43-1.24]	0.53 [0.30-0.95]	3.00 [0.68-13.30]	1.05 [0.63-1.77]
Resident	0.91 [0.55-1.50]	1.04 [0.65-1.67]	1.02 [0.64-1.61]	0.80 [0.48-1.33]	0.82 [0.34-1.97]	1.05 [0.66-1.67]
Other	0.53 [0.23-1.22]	0.41 [0.18-0.95]	0.91 [0.46-1.80]	0.30 [0.10-0.88]	0.32 [0.12-0.81]	0.36 [0.19-0.69]
Region						
ASIA	0.17** [0.07-0.44]	3.03 [1.34-6.85]	0.94 [0.42-2.09]	0.56 [0.27-1.15]	0.63 [0.17-2.37]	0.56 [0.28-1.13]
EMRO	0.45 [0.16-1.23]	1.53 [0.50-4.74]	1.03 0.37-2.90]	0.17 [0.05-0.61]	1 [omitted]	0.54 [0.22-1.32]
EURO	0.49 [0.29-0.84]	6.49** [3.50-12.07]	3.71** [2.16-6.38]	0.70 [0.42-1.17]	1.03 [0.37-2.92]	0.44** [0.27-0.73]
PAHO	0.83 0.53-1.32]	4.49** [2.53-7.98]	2.75** [1.69-4.49]	0.56 [0.36-0.88]	0.96 [0.36-2.59]	1.39 [0.87-2.20]
HIC	0.08** [0.02-0.37]	7.82** [2.99-20.46]	2.74 [1.11-6.74]	1.05 [0.43-2.55]	0.41 [0.07-2.38]	7.24 [1.61-32.59]
Age						
<31	0.60 [0.40-0.90]	0.94 [0.64-1.38]	0.77 [0.53-1.12]	0.54** [0.36-0.82]	0.87 [0.43-1.76]	1.10 [0.75-1.60]
>40	1.17 [0.82-1.67]	1.49 [1.05-2.12]	1.16 [0.83-1.64]	1.09 [0.78-1.55]	1.13 [0.56-2.26]	1.45 [1.02-2.06]
WSC	1.21 [0.84-1.75]	1.40 [0.97-2.00]	1.27 [0.89-1.82]	1.80** [1.26-2.57]	1.35 [0.57-3.19]	2.57** [1.72-3.84]
Training	2.08** [1.51-2.86]	1.90** [1.40-2.59]	2.29** [1.70-3.09]	1.80** [1.31-2.47]	6.46** [3.51-11.88]	N/A

*** denotes statistical significance at p<0.005. All models had a p-value <0.0001*

aOD: adjusted odds ratio

CI: confidence interval

For the variable qualifications *physicians were used as the comparison; for* region *AFRO was used as the comparison; for* age *the range 31-40 was used as the comparison.*

Appendix K – Checklist for GLOSS awareness campaign implementation

1- ***Description of the campaign***: this is a campaign geared towards healthcare providers working in participating healthcare facilities that see women during pregnancy, childbirth, postpartum or post-abortion. This includes physicians (Obstetricians, Intensive Care doctors, GPs, Residents, etc.), nurses, midwives. The goal of this campaign is to raise provider awareness on maternal and neonatal sepsis in order to get at the true burden of maternal sepsis during data collection at the end of the year.

2- ***What the campaign entails***: the campaign is comprised by several materials

   a. ***Fact sheet***: one poster-sized fact-sheet should be displayed, visibly, in your facilities. These should be print in full color following the instructions provided below under PRINTING INSTRUCTIONS. Some examples of places where these can be displayed: bulletin boards in nurses' areas, in doctor lounges, at the entrance of the facility.

   b. ***Infographics***: two poster-sized infographics should be print in full color following the instructions provided below under PRINTING INSTRUCTIONS. Some examples of places where these can be displayed: at the entrance to the facility, in main waiting areas in the different wards where data collection will happen, in any areas where doctors, nurses, midwives or other providers congregate.

   c. ***Informational posters***: two regular-sized posters, one for women who might be eligible for the study, another for study data collectors. These should be print using personal printers and displayed in waiting areas where pregnant or recently pregnant women might be, as well as any wards or areas where data collectors would gather. These are available for download from http://srhr.org/sepsis/resources/.

   d. ***Website***: there is an entire website dedicated to this campaign. It is already up and functioning. It is a *living website*; more sections of it will become functional in the upcoming weeks. Notably, this website will serve as a repository for all the materials being developed for the campaign. The website address is http://srhr.org/sepsis.

      i. ***News section***: the website includes a news section that we are hoping to populate with new stories every two weeks. We encourage everyone at the country level to provide us with stories relating to maternal sepsis. Please check the following sign-up sheet to select when you would like to write: https://docs.google.com/spreadsheets/d/1g_s8RYmzUsDBMfCcQxdiJ9ZDzodJDTLtDG94e6d-F_o/edit#gid=42976540

   e. ***Press releases***: there is a template press release to use with local media alerting them of the study. The template includes sections that are highlighted in yellow for you to adapt to your local contexts. These are available for download from http://srhr.org/sepsis/resources/.

   f. ***Template fact sheets***: these are two Word/PPT documents with the header/footer identifying the campaign for you to use to communicate anything regarding the study and the campaign. Some examples of uses for these: as certificates for data

collectors, to convey news about the study in your workplace, to announce different events regarding the study. These can also be used in the future to announce some preliminary findings from the study and campaign. These are available for download from http://srhr.org/sepsis/resources/.

g. ***Survey***: there is a baseline survey that has been released on September 29 and will be closed on 05 November 2017. There will be a second survey after the study and campaign are over (after 15 January 2018). The goal of these surveys is to gather information about provider knowledge, attitudes, and practices around maternal sepsis so that we can assess the success of the campaign. The more people we have completing the survey, the more representation we'll have of the true reality of provider awareness.

3- ***What we need from you***: we need you to be our eyes on the ground. This means you need to ensure that the materials get to the participating facilities and that they are being displayed visibly. Below you'll find a timeline with dates by when the different things need to be accomplished. Please refer to this timeline on a weekly basis!

PRINTING INSTRUCTIONS:

1- **Logistics**: Contact a professional printing service and send them the GLOSS TOOLKIT zip file that includes all the files that need to be printed. We are including the professional .ai files.
2- **Sizing**: We suggest printing everything in A3 size.
3- **Color**: full color, gloss should be used for all materials
4- **Paper**: at least 130 gsm outdoor paper [190g/m^2 photo paper preferred]

Timeline of activities

Activity	**Week 1** 15-21 Oct	**Week 2** 22-28 Oct	**Week 3** 29 Oct-4 Nov	**Week 4** 5-11 Nov	**Week 5** 12-18 Nov	**Week 6** 19-25 Nov	**Week 7** 26 Nov-2 Dec
Survey	✓	✓					
Printing of materials		✓	✓				
Distribution of materials			✓				
Display of materials				✓	✓	✓	✓
Press release						✓	
Data collection 28 Nov - 04 Dec							✓

Leave campaign materials up even after data collection ends

Post-campaign survey will be distributed after data collection has ended, 15 January 2018