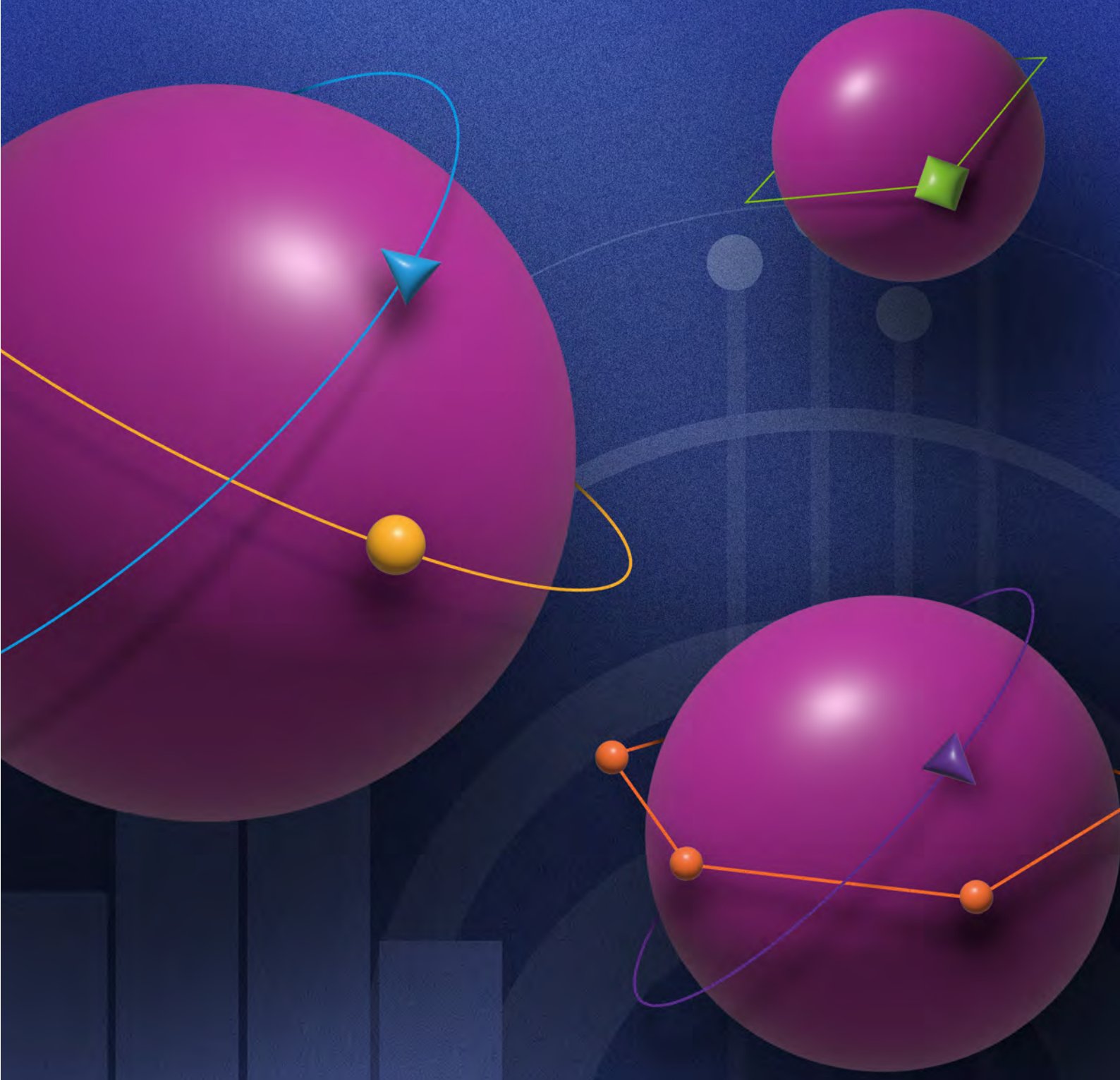
Landscape analysis of pregnancy exposure registries in low- and middle-income countries



World Health Organization

Landscape analysis of pregnancy exposure registries in low- and middle-income countries

World Health Organization

Landscape analysis of pregnancy exposure registries in low- and middle-income countries

ISBN 978-92-4-008794-1 (electronic version)
ISBN 978-92-4-008795-8 (print version)

Contents

Acknowledgments

The World Health Organization (WHO) Pharmacovigilance (PVG) Team under the supervision of Dr Shanthi Pal, would like to thank the professionals who committed their time and expertise for producing this work.

From PATH: Niranjan Bhat, Sophie Knudson, Jessica Mooney, Lauren Newhouse, Nancy Salts, Jessie Schwartz.

From University of Washington: Rahmeh Abu Shweimeh, Hilma Nakambale, Andrew Stergachis

In addition, the advice of the following experts is gratefully acknowledged: Linda Barlow-Mosha, Makerere University; Pierre Buekens, Tulane School of Public Health and Tropical Medicine; Kate Fay, Bill & Melinda Gates Foundation; Deshayne Fell, University of Ottawa; Smaragda Lamprianou, Pharmacovigilance Team, WHO HQ; Ushma Mehta, University of Cape Town; Anna Seale, Bill & Melinda Gates Foundation; Esperança Sevene, Eduardo Mondlane University.

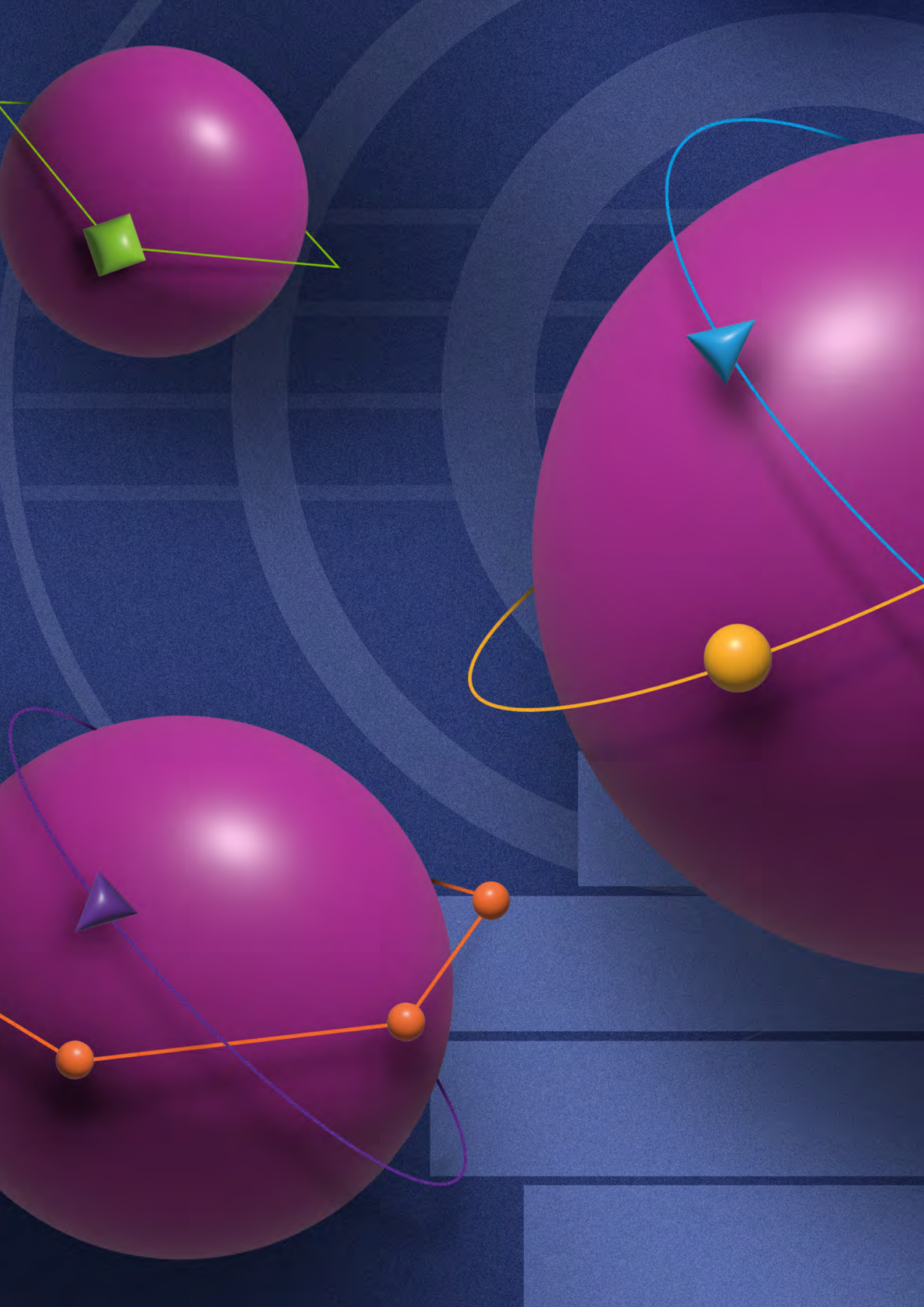
Abbreviations

APR	Antiretroviral Pregnancy Registry
BART	Baobab Health Antiretroviral Therapy
CHAMPS	Child Health and Mortality Prevention Surveillance Network
CHERISH	Children HIV Exposed Uninfected Research to Inform Survival and Health
CLAP/WR	Latin American Center for Perinatology/Women's Health and Reproductive Health
EMA	European Medicines Agency
EMBRACE	Microbicide Pregnancy Registry of the Microbicide Trials Network
ESC	Expert Steering Committee
FDA	US Food and Drug Administration
GAIA	Global Alignment of Immunization Safety Assessment in pregnancy
HDSS	Health and Demographic Surveillance Systems
HER	Electronic health records
HICs	High income countries
IeDEA	International Epidemiology Databases to Evaluate AIDS
JBI	Joanna Briggs Institute
LMICs	Low- and middle-income countries
MAH	market authorization holder
MANGO	Measuring Adverse Pregnancy and Newborn Congenital Outcomes
MiMBa	Malaria in Mothers and Babies
MNCH	Maternal, newborn, and child health
MNHR	Maternal Newborn Health Registry
NGOs	Non-governmental organizations
NICHD	US National Institute of Child Health and Human Development
NIH	US National Institute of Health
PAHO	Pan American Health Organization
PERs	Pregnancy exposure registries
PHDC	Provincial Health Data Centre
PIDM	WHO Programme for International Drug Monitoring

PRISMA-ScR	Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews
RMNCAH	Reproductive, Maternal, Newborn, Child and Adolescent Health
RSV	Respiratory syncytial virus
SIP	Sistema Informatico Perinatal
sSCAN	sub-Saharan African Congenital Anomalies Network
UBOMI BUHLE	Understanding Birth Outcomes from Mothers and Infants, Building Healthcare by Linking Exposures

Section

1 Executive summary



1.1. Background

Many vaccines and drugs hold the promise of reducing mortality and morbidity among pregnant women and infants living in low- and middle-income countries (LMICs). However, sufficient information on the safety of drugs and vaccines in pregnant women is rarely available at the time of product licensure or approval. To account for this, active safety surveillance efforts are needed during the post-licensure and post-approval phase to assess the safety of drugs and vaccines in pregnant women and their offspring. Pregnancy exposure registries (PER) are used to monitor the safety of vaccines and drugs. PERs are observational studies that systematically collect health information on exposure to medical products such as drugs and vaccines during pregnancy.

While frequently conducted in high income countries (HICs), PERs are much less commonly instituted in LMICs. When they are used in LMIC settings, PERs most often focus on the use of antiretrovirals and antimalarial drugs. Pregnant women in LMICs have unique considerations, including different underlying conditions such as malaria and HIV,[1,2] background rates of clinical outcomes, and access to care, which emphasizes the importance of generating drug and vaccine safety evidence specific to their regions.

New vaccines developed specifically for use by pregnant women, such as those for respiratory syncytial virus (RSV) and Group B *Streptococcus*, are expected to be approved and available for introduction in LMICs in the near future but prelicensure data on these vaccines will primarily come from HICs. To prepare for new drugs and vaccines and strengthen pharmacovigilance in pregnant populations more generally, better understanding of the presence and characteristics of PERs in LMICs will be important.

1.2. Objectives and methodology

This report summarizes a landscape analysis of PERs and related health data collection platforms and activities in LMICs that systematically record pregnancy exposures to medical products and pregnancy outcomes. This analysis was conducted to better inform how future efforts, such as new vaccine introductions and treatment programs, can support maternal populations in LMICs. The scoping review consisted of a systematic search of the scientific and grey literature published between 2000 and 2022, supplemented by an online survey and interviews with selected key informants. The scoping review protocol follows the Joanna Briggs Institute (JBI) manual for scoping reviews and the search strategy is reported using the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist.

1.3. Results

A total of 45 PERs and other systematic data collection resources in LMICs were identified, of whom 36 are currently in operation, organized into six major categories:

Table 1.1. Registry identification by resource category.

Resource Category	Number identified (number currently active)
Pregnancy exposure registries	11 (7)
Health and demographic surveillance systems and other observational cohorts	7 (7)
Outcomes-based registries	7 (7)
Maternal condition-based registries	6 (3)
Manufacturer registries	8 (6)
Electronic medical record databases and clinical software platforms	6 (6)

These resources cover a wide range of methodologic approaches and areas of focus, ranging from standalone research studies to analyses derived from electronic clinical systems. Pregnancy registries, also known as pregnancy exposure registries, are an essential tool for monitoring the safety of vaccines and other medical products used during pregnancy because they employ rigorous methods purposely designed to analyze the potential relationship between a given drug or vaccine exposure and subsequent clinical outcomes. However, PERs are resource intensive by comparison with other approaches to maternal and infant safety surveillance. Six of the eleven PERs identified in LMICs were designed to study the use of antiretroviral medications in pregnant women. Other resources, including other types of prospective cohorts and outcomes-based registries established in LMICs were also designed around HIV surveillance and treatment more generally, but include embedded studies focused on their pregnant population that capture antenatal exposures and subsequent outcomes.

Several resources exist that are designed primarily to systematically detect and record specified health outcomes, such as birth defects. These surveillance systems are typically structured to conduct broad screening of infants at birth, thus capturing a large number of participants and collecting exposure information retrospectively. These registries are able to evaluate questions regarding rare outcomes more efficiently but may be subject to limitations, such as incomplete recall of exposures or inability to capture early outcomes, including spontaneous abortions or stillbirths.

Other resources in LMICs include Health and Demographic Surveillance Systems (HDSS) and electronic medical record platforms, which are designed to collect a wider set of clinical and epidemiologic data on entire populations in a geographic area or health care system. HDSS's are located throughout LMICs and are operated by researchers experienced in epidemiologic analyses. These sites usually conduct active surveillance through regular visits to each household within a defined geographic area. This enables populations to be followed longitudinally and typically capture events occurring in both medical facilities as well as the community. This full cohort approach allows the HDSS to estimate population-based incidence rates and relative risks among subgroups compared to the general population. Many HDSS are members of INDEPTH, a collaborative network of sites located throughout Africa, Asia, and Latin America. Participation in this network allows sites to standardize methods and combine data across different regions or countries. Pregnancy exposure studies conducted within the overall operation of the HDSS may require additional data elements (e.g., drug doses and timing, gestational dating), procedural adaptations and additional investment into a system that is often already quite resource intensive. It may be for that reason that only a subset of HDSS sites have published research focused on this issue. However, most of these sites are adaptable by design, and can add maternal pharmacovigilance to their surveillance, given adequate support.

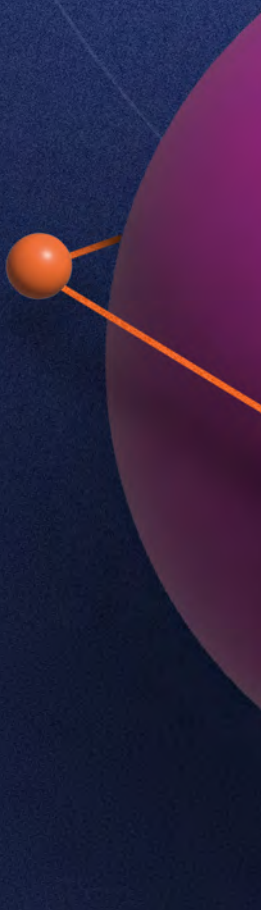
This review identified a number of electronic medical record systems and associated clinical software platforms that have been used for safety surveillance in pregnant populations. In these systems, data collection is performed as part of clinical care and thus pregnancy exposure studies can be accomplished through programming packages that include the extraction and analysis of relevant data. Additional training may be required to ensure that clinical terminology is standardized, and algorithms may need to be developed to fully capture imprecisely defined diagnoses, treatments, and conditions. However, such systems are under expansion in many LMICs, and the addition of maternal pharmacovigilance capabilities would conceivably require only a small incremental investment.

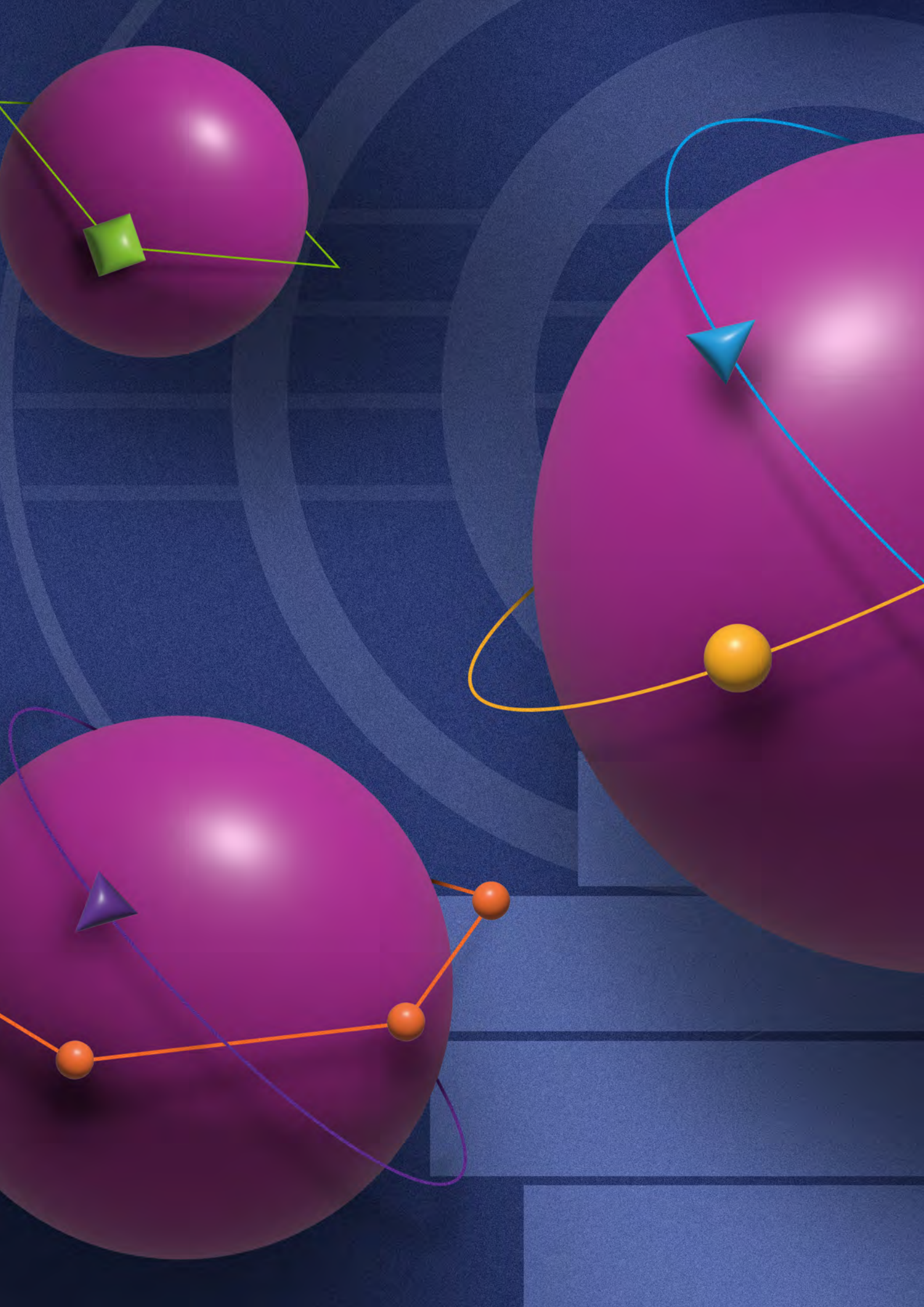
1.4. Conclusions

This review demonstrates that a number of resources presently exist in LMICs that perform active safety surveillance in pregnant populations. These results indicate such systems employ a wide variety of approaches, each with their own set of strengths and challenges, as summarized in the final section of the report. In many cases, successful examples of these resources might be expanded, replicated, or adapted to incorporate new vaccines and medications, particularly if these systems recruit from the general population of pregnant women and use prospective data collection. Comparing results, or even pooling data across multiple studies would be valuable to better evaluate rare events and assess outcome rates across populations. Such efforts would be more feasible with the adoption of harmonized definitions, tools, and protocols, and may be more easily implemented in systems that are supported through public or donor funds. An improved understanding of the current status of maternal pharmacovigilance in LMICs, can help policymakers and researchers better identify and pursue opportunities for ensuring the safety of pregnant women worldwide, including leveraging currently active systems for studies as new interventions are introduced. No or limited information on the safety of medicines during pregnancy can hinder the informed benefit-risk assessment required for clinical and policy decisions about life-saving medicines in women of childbearing age.

Section

2 Introduction





New vaccines and drugs hold the promise of reducing morbidity and mortality among pregnant women and infants living in low- and middle-income countries. However, since pregnant women are actively excluded from most pre-registration clinical trials, safety information for this group is rarely available at the time of a medical product's licensure or approval.[3,4] Consequently, the safety of drugs and vaccines administered during pregnancy must be evaluated throughout the product's life cycle, including through active surveillance approaches during the post-licensure or post-authorization phase. Understanding the landscape of critical safety monitoring methods, including pregnancy exposure registries, is therefore important to identify additional safety monitoring preparations that may be needed for product introduction readiness and use. This report provides the results of a scoping review that we conducted to identify and describe PERs and other similar resources operating in LMICs. The information is intended to support global and country decision-making around needs for monitoring the safety of new and existing drug or vaccine products used during pregnancy.

A commonly used method to assess post-approval safety of drugs and vaccines in pregnant women and their offspring is through a pregnancy exposure registry. A PER is an observational study that systematically collects health information on exposure to medical products such as drugs and vaccines during pregnancy.[5] PERs, particularly in high-income countries, are commonly used throughout the post-marketing phase of drugs and vaccines.[6,7] PERs have been less frequently used in LMICs, due to a number of unique challenges, including limited access to the interventions under evaluation, insufficient data collection resources and infrastructure, and the capacity to link these data sources together.[4] Nevertheless, pregnancy exposure registries have been established in LMICs, and include those set up to evaluate drugs or vaccines of particular relevance for their populations, such as for malaria and HIV treatment and COVID-19 prevention.[8–10]

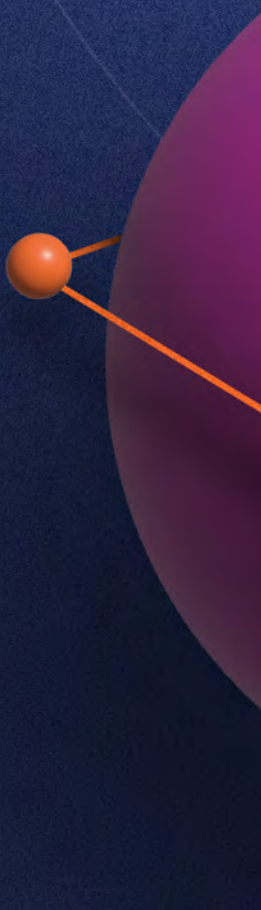
An improved understanding of the presence and nature of PERs in LMICs can better inform how future public health efforts in their maternal populations, such as new vaccine introductions and treatment programs, can be supported. While most research assessing the global status of drug and vaccine safety monitoring in pregnancy has focused on HICs,[6] one recent study focused on identifying existing maternal, newborn, and child health (MNCH) data collection systems in LMICs that could be used for active safety surveillance of vaccines used during pregnancy.[11] In contrast to these broader surveillance systems, PERs focus on active data collection specifically related to medical product exposures during pregnancy and pregnancy safety outcomes, and may be conducted by private as well as public agencies. Leveraging existing resources for the collection and use of data should better inform maternal immunization and maternal and neonatal in LMICs.

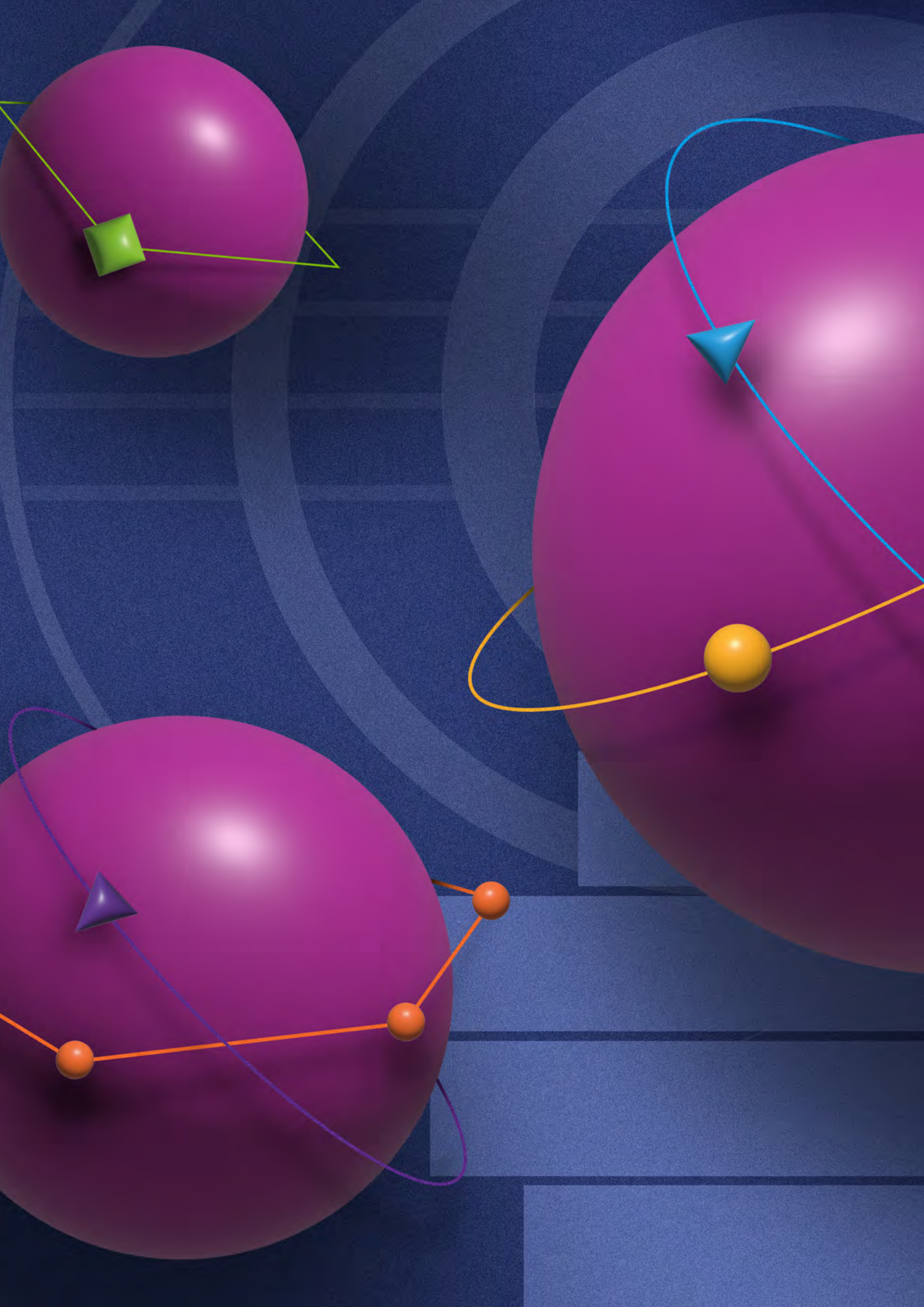
We conducted the scoping review detailed in the following sections to address this need for an improved understanding of PERs and other similar resources operating in LMICs. In this landscape report, we identify and describe our findings on existing PERs and other resources and discuss where gap exist that may need to be addressed for introduction and implementation readiness.

3

Section

Methods





The methods for this landscape analysis have been published.[12] Briefly, a scoping review was conducted to identify pregnancy exposure registries, databases and other routinely collected health data that systematically record exposures to medical products during pregnancy and maternal and infant outcomes in LMICs. This review consisted of a systematic search of the scientific and grey literature and was supplemented by an online survey and interviews with selected key informants, as needed.

This scoping review followed the Joanna Briggs Institute (JBI) manual for scoping reviews, and the search strategy is reported using the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist.[13,14] This protocol was registered with the Open Science Framework.[15] The scoping review start and end dates were July 1, 2022 and June 30, 2023, respectively.

3.1. Eligibility criteria

For the literature search, the following eligibility criteria for selection were developed:

3.1.1. Inclusion criteria

1. Publications and documents published or produced from January 2000 to the present, to ensure that identified registries possess features that are more relevant to current scientific and technological conditions; online sources were accessed.
2. Populations studied are located entirely or at least partially in LMICs.[16]
3. Reference to prospective and retrospective electronic or combined paper-electronic data collection systems including demographic national registers in LMICs.
4. Reference to prospective and retrospective cohort studies, with no restrictions regarding age range (other than women of childbearing age [i.e., 15-49 years of age]) or underlying conditions other than pregnancy, such as heart disease or epilepsy.
5. Reference to systems that collect data on exposure to one or more drugs or vaccines during pregnancy.
6. Reference to systems that collect data on pregnancy outcomes, including delivery, post-partum, and neonatal (may include an extended time frame to include birth defects detected later).

3.1.2. Exclusion criteria

1. Editorials, opinion pieces, promotional literature.
2. Guidelines or guidance documents.
3. Reference to non-allopathic (e.g., traditional, homeopathic, or naturopathic) interventions.

3.2. Search strategy and information sources

Using an iterative process, a strategy was developed for a search in PubMed incorporating controlled vocabulary/ Medical Subject Headings and free text (Appendix 6.1). A LMIC filter was applied to focus results to the geographic regions of interest. An independent information specialist peer reviewed the strategy using the PRESS Checklist. [17] After finalizing in PubMed, the strategy was translated to Embase, CINAHL, and WHO's Global Index Medicus. Reference lists of potentially relevant records and articles were also reviewed.

Additionally, a grey literature search was conducted, including Google Scholar search and relevant websites, such as industry and professional organizations, associations and alliances; selected Ministries of Health (including regulatory agencies and pharmacovigilance centers) in LMICs; and selected HIC organizations, academic and other non-governmental groups. The final search strategies are provided in Section 6.1.

3.3. Study selection and data extraction

Records retrieved by the search strategy were downloaded to EndNote Version 9.3.3 (Clarivate) for de-duplication and then uploaded to review management software (Covidence) for screening. Each title and abstract was screened by two independent reviewer authors to determine eligibility and categorized into categories (Yes, Maybe, No). Disagreements between reviewers, including uncertainties regarding eligible titles and abstracts, were resolved by a third reviewer. After screening, full-text reviews by two reviewers were then conducted to select records for data extraction. An adapted version of the PRISMA flow diagram was constructed to summarize record disposition.[14] Key information regarding the registries from the selected full-text articles and grey literature was recorded using a pilot-tested data extraction form (Section 6.2) and entered into an electronic database (Smartsheet).

3.4. Informant Survey and Interviews

An online survey was sent to experts and key informants to identify additional resources in LMICs that may not have been captured, or to provide additional detail for resources that were already identified. Key informants were identified for semi-structured interviews when additional information about the registries was needed. Responses were recorded in an electronic database for analysis. The survey instrument was developed (Section 6.3) and initially shared by members of the WHO Pharmacovigilance Team with counterparts at the WHO regional offices. The survey was delivered on July 7, 2022, to all members of the WHO Programme for International Drug Monitoring (PIDM),[18] which included over 350 contacts from Pharmacovigilance Center and National Regulatory Authorities from over 155 countries. The survey was also sent to members of the WHO Expert Steering Committee (ESC) on Safety Surveillance in Pregnancy in LMICs.

3.5. Data analysis

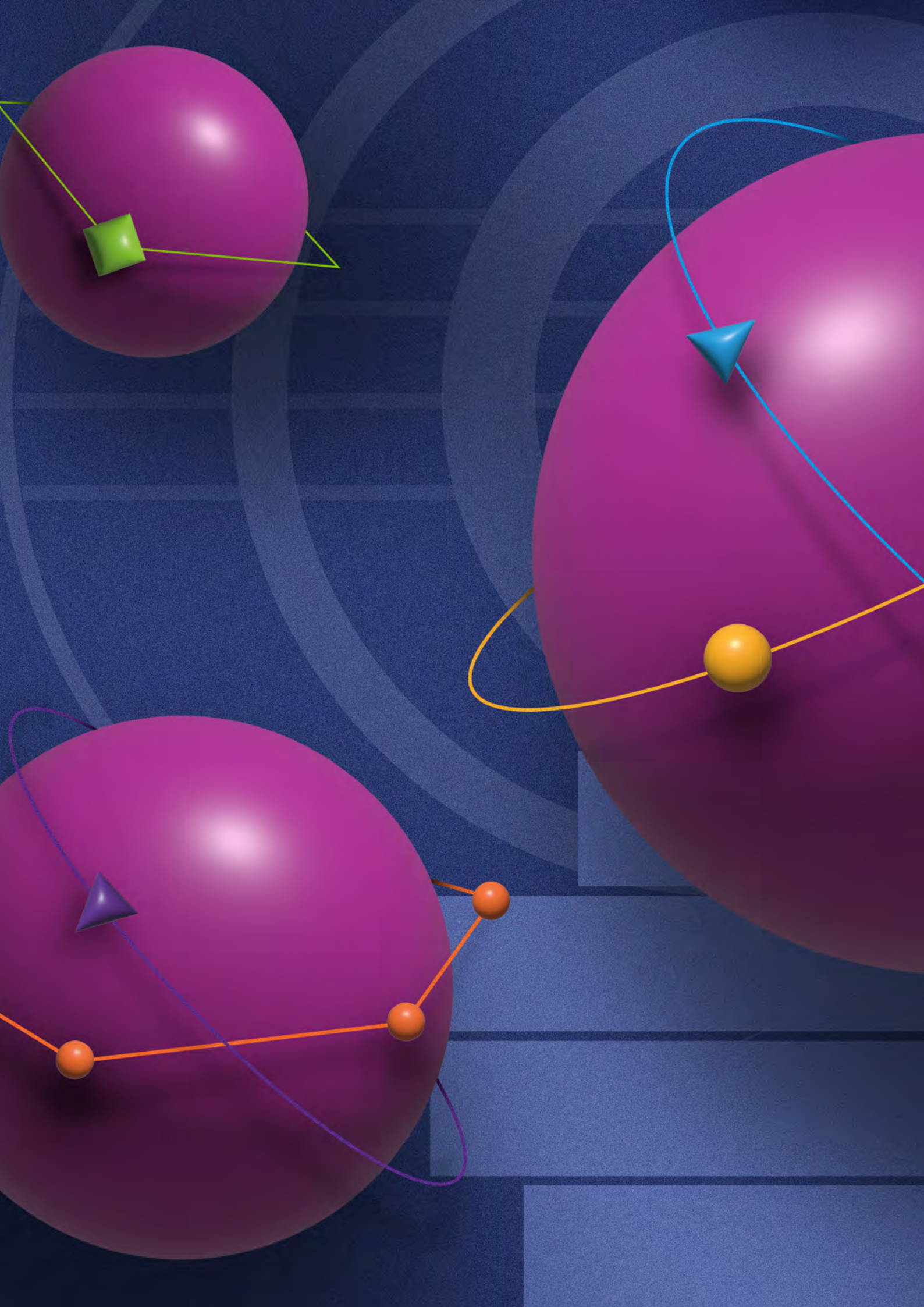
Identified resources were summarized in tables according to relevant characteristics, including methodology, geographic coverage, exposures and outcomes captured, and citations. The selected PERs were further evaluated based on additional questions (strengths, weaknesses, ability to add new interventions, and ability to combine data with other systems), and the quality of the existing registries. Geographic coverage was assessed using maps.

3.6. Consultation

A multi-disciplinary technical working group was established to provide assistance and guidance throughout the course of this review, and the protocol and results were reviewed by an Expert Steering Committee on Safety Surveillance in Pregnancy in LMICs, established by WHO. Feedback from both groups were incorporated to produce this final document.

Section

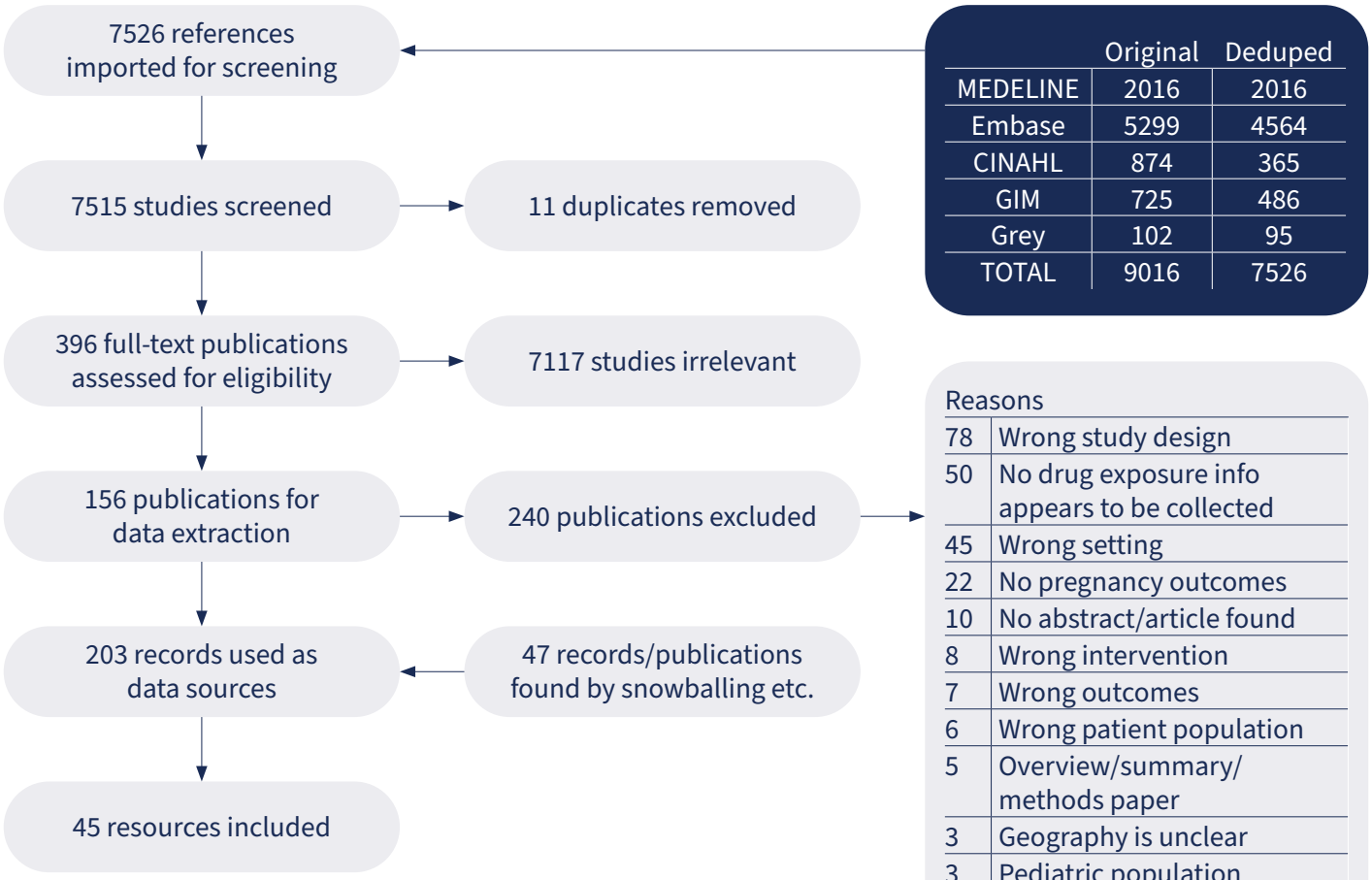
4 Results



4.1. Search Results

A total of 9,016 records were identified in our search, with 7,526 records remaining after de-duplication. These 7,526 records were imported for title and abstract screening (Figure 4.1). Through screening, an additional 11 duplicates were identified. Of the remaining 7,515 records, 396 were selected for full-text review, and 156 of those met eligibility criteria for data extraction. The reasons for exclusion during full-text review, listed in Section 3, included 78 publications with the wrong study design, 50 records where information on drug or vaccine exposures was not collected, and 45 records where studies were conducted in the wrong setting (e.g., did not include a substantial number of participants from a LMIC). An additional 47 records, publications, and other sources were identified through review of reference lists, websites, the online survey, and informant interviews, resulting in a total of 203 records with relevant information. Given that multiple records could contribute to describing a single "resource" (PER or similar data collection system), the selected 203 records yielded 45 resources that met our criteria for inclusion in the analysis.

Figure 4.1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram of records screened and included.[14]



	Original	Deduped
MEDELINE	2016	2016
Embase	5299	4564
CINAHL	874	365
GIM	725	486
Grey	102	95
TOTAL	9016	7526

Reasons	
78	Wrong study design
50	No drug exposure info appears to be collected
45	Wrong setting
22	No pregnancy outcomes
10	No abstract/article found
8	Wrong intervention
7	Wrong outcomes
6	Wrong patient population
5	Overview/summary/ methods paper
3	Geography is unclear
3	Pediatric population
2	Overview/summary paper
1	Wrong comparator

These 203 records also included descriptions of 45 research studies that were conducted as stand-alone analyses of retrospectively collected clinical data to evaluate the occurrence of maternal and/or infant outcomes following exposure to drugs or vaccines during pregnancy. Typically designed to be time-limited, these were generally not intended for ongoing surveillance and therefore only limited information was collected. These studies are summarized in Section 6.4.1. In addition to the searches of literature databases, grey literature, and internet resources, the survey yielded a total of 18 unique individuals submitted 21 responses, and after excluding duplicates and negative responses, and results were incorporated into the resource review above. A summary of these results is provided in Section 6.4.2.

4.2. Resource Location and Categorization

The resources selected for further analysis were distributed across several LMICs, as demonstrated in Figure 4.2. More than one resource was identified in some countries; conversely, some resources were found to operate in multiple countries.

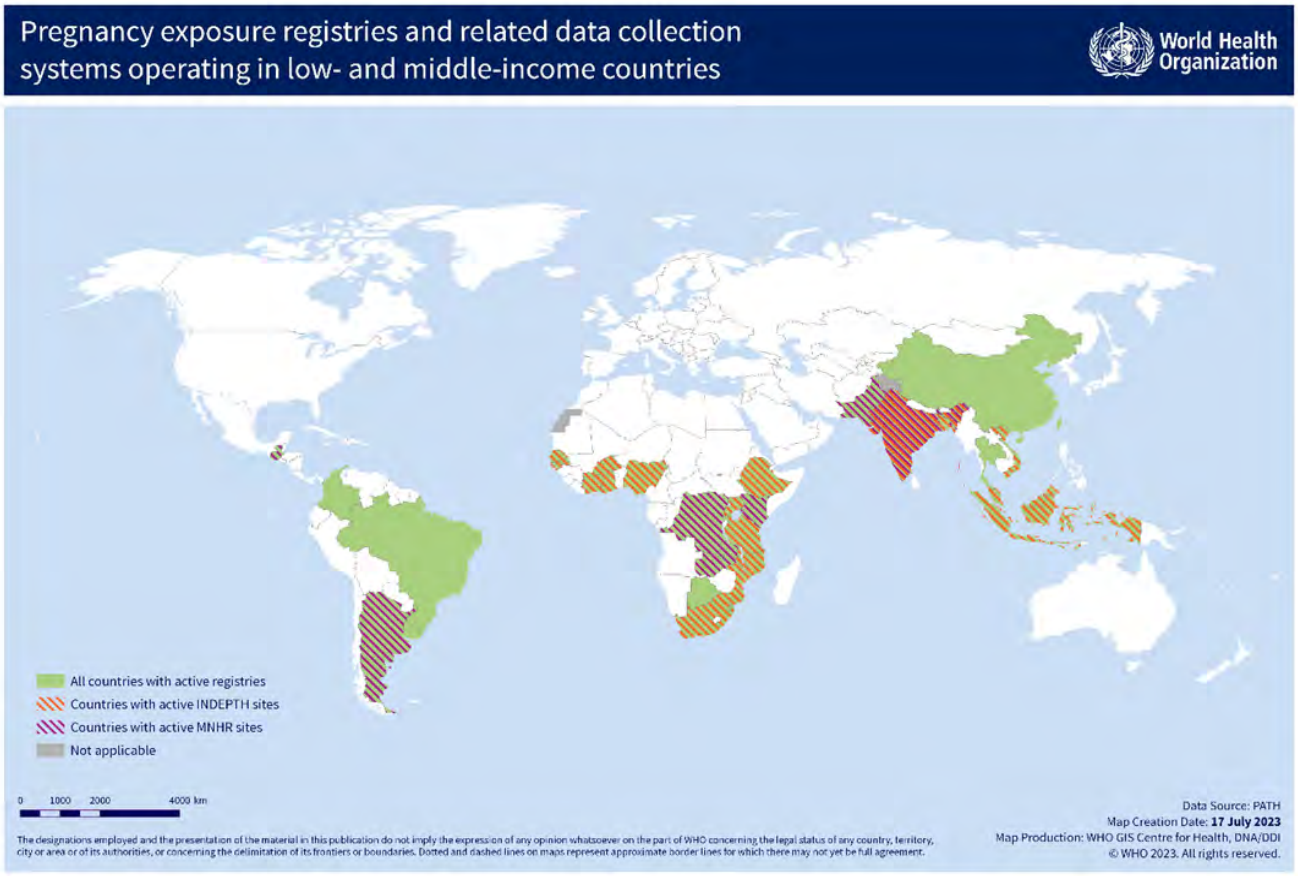
As resources were examined, they were grouped into categories based on broad characteristics, as summarized in Table 4.1.

Each of these resource categories are described in further detail below.

Table 4.1. Categorization of the pregnancy exposure registries and other resources identified through study methods.

Resource Category	Brief Description	Number of Resources (Number currently active)
Pregnancy exposure registries	Self-designated PERs with prospective enrollment and a stated aim to record exposures and outcomes	11 (7)
Health and demographic surveillance systems and other observational cohorts	Population-based cohorts with prospective collection of clinical and epidemiologic data	7 (7)
Outcomes-based registries	Registries that focus on outcomes, such as birth defects	7 (7)
Maternal condition-based registries	Registries that enroll pregnant women with specific underlying health conditions	6 (3)
Manufacturer registries	Registries established by a drug or vaccine manufacturer, often for regulatory purposes	8 (6)
Electronic medical record databases and clinical software platforms	Electronic platforms that prospectively record clinical information within a health care institution or system	6 (6)
Total		**45 (36)**

Figure 4.2. LMICs with active pregnancy exposure registries and related data collection systems.



For the literature search, the following eligibility criteria for selection were developed:

4.2.1. Pregnancy exposure registries

Resources included in this category are typically referred to as "pregnancy exposure registries," defined as prospective observational cohorts focused on the enrollment and follow-up of pregnant women who receive one or more specific drug(s) or vaccine(s) of interest.[5] Enrollment of pregnant women typically occurs before exposure to the drug or vaccine of interest. If recruitment into a PER occurs after exposure to the medical product, entry into the cohort must at least occur before any pregnancy outcomes are known, and an unexposed or non-pregnant population may be enrolled for comparison. In these systems, women are followed to the end of their pregnancy or longer in order to collect health outcome information on the mothers and their infants. Data are systematically collected on maternal exposures to medical product(s) of interest, maternal sociodemographic and health characteristics, and health events from pregnancy to outcomes for the woman and child. These resources can be used to calculate the rate of specific health events and may or may not include a reference population to provide comparison rates of health events.

4.2.2. Health and Demographic Surveillance Systems and other Observational cohorts

A number of population-based cohorts identified in this analysis did not meet all criteria to be considered as PERs but are capable of conducting maternal pharmacovigilance evaluations. Many resources in this category are designated as health and demographic surveillance systems (HDSS), and a majority of HDSS's are members of the INDEPTH, a network of research sites that maintains a common set of standards for data collection. [19] These sites and the other cohorts in this group are conducted in geographically-defined area(s) in which residents are followed longitudinally and clinical and epidemiologic data are collected prospectively at regular intervals. They monitor a defined population, of which pregnant women are a subset, and usually record aspects of overall health care rather than focus on exposure to specific drugs or vaccines.

Observational cohorts are included in this group if the resource published analyses examining drug or vaccine exposures during pregnancy and reported obstetric and neonatal outcomes.

4.2.3. Outcomes-based registries

Outcomes-based registries focus on the detection and recording of specific outcomes, such as congenital malformations. They may be focused on a particular geography or a specific population. In most cases, enrollment in an outcomes-based registry occurs at the time of delivery or birth. Therefore, exposure information is collected retrospectively. Some registries may assess infants in a single visit while others follow infants to monitor outcomes for up to six weeks. In addition, some registries may enroll unaffected infants to serve as a comparison group.

4.2.4. Maternal condition-based registries

Resources in this category are based on enrolling pregnant women who have specific health conditions such as epilepsy, HIV infection, cardiac disease, or coagulopathy. These registries focus on exposure to medications associated with these disorders and usually assess outcomes in the infants such as congenital malformations over a limited period of time. Maternal outcomes related to the health condition of interest can also be included.

4.2.5. Manufacturer-initiated registries

Resources included in this category are registries funded and owned by the manufacturer or market authorization holder (MAH) of a drug or vaccine used in pregnant women. Such registries can be operated by a contract research organization, an academic group, or the manufacturer themselves. The US Food and Drug Administration (FDA) and the European Medicines Agency (EMA) recommend that manufacturers establish surveillance efforts, such as pregnancy registries, for medical products on the market that are likely to be used during pregnancy or by women of childbearing age.[20,21] These registries are often established to meet a regulatory commitment or requirement for post-licensure safety monitoring, contribute to benefit-risk assessments, support product labeling, and inform guidance for regulators, health care providers, and the public throughout a medical product's life-cycle. Pregnant women exposed intentionally or unintentionally to the medical product of interest are typically identified passively through sporadic reporting from recipients or care providers, although there may be outreach to potential participants. Once identified, there is usually active follow-up of participants to record information about health outcomes in the mother and infants. These registries are typically based in HICs but accept reports from other regions. While these data are generally not made available to the public, the US FDA maintains a list providing contact information for manufacturer registries that operate in the United States.[22]

4.2.6. Electronic health records databases and clinical software platforms

Electronic health records (EHR) databases and clinical software platforms typically collect and record clinical information prospectively on patients within a health care system. Using records linkage across time and various health and administrative databases comes with the advantage of identifying large numbers of pregnant women exposed to particular vaccines and other medicines, as well as their pregnancy outcomes. In these situations, pregnant women and their infants are usually a subset of the population, although some EHR's may be specifically deployed in targeted maternal and newborn clinics. EHR systems are included in this report if a LMIC site has published a study or report on drug or vaccine exposures during pregnancy and their subsequent outcomes. For the purposes of this report, other resources, such as insurance claims databases have been included in this category.

The following sections report on findings, organized into the identified six categories.

4.3. Pregnancy exposure registries

Among the resources identified in this report, twelve self-identified as PERs or otherwise possessed typical characteristics of PERs (Table 4.2). While such classically designed PERs focusing on LMIC populations were found in multiple continents, the majority were located in sub-Saharan Africa (Figure 4.2), and most are currently active. Many PERs have been in operation for fewer than five years with some notable exceptions. Specifically, the Antiretroviral Pregnancy Registry (APR) and the Microbicide Pregnancy Registry of the Microbicide Trials Network (EMBRACE), have operated for over 10 years. Most PERs are funded through public or donor sources and are run by academic or non-governmental organizations (NGOs).

The majority of registries focus on antiretroviral drug exposures, but also include systems created to evaluate exposures to antimalarials. More recently, COVID-19 therapeutics and vaccines are the focus of PERs. Geographic coverage ranged from single hospitals to multi-national, with a similarly broad range in sample size from less than 500 to more than 25,000 participants accumulated over time. Some registries, such as the Measuring Adverse Pregnancy and Newborn Congenital Outcomes (MANGO) registry and the Malaria in Mothers and Babies (MiMBa) Pregnancy Registry, enroll a comparison group such as non-pregnant women of childbearing age. Others, such as the Understanding Birth Outcomes from Mothers and Infants, Building Healthcare by Linking Exposures (UBOMI BUHLE) registry and the Children HIV Exposed Uninfected Research to Inform Survival and Health (CHERISH) registry, enroll only pregnant women, but follow participants both exposed and unexposed to the interventions of interest.

The amount of detail provided in the available publications and other reports varied, but most registries were sufficiently described as encompassing a full range of obstetric and neonatal outcomes. A significant proportion follow the infants through the neonatal period only, with a focus on major congenital anomalies that can be detected in that timeframe. Infants are followed through one year (or potentially even more) in a few studies, however, to follow growth and development, as well as detect late-appearing birth defects.

Table 4.2. Pregnancy exposure registries.

Resource Name	Countries	Focus	Time period	Funding source and Implementing organization	Coverage and sample size	Design and Eligibility and duration of follow-up	Maternal Outcomes	Neonatal and Infant/child outcomes	References
Currently active									
CHERISH (Children HIV Exposed Uninfected Research to Inform Survival and Health)	South Africa	Antiretrovirals	2020-present	*Funding source*: US NIH *Implementing organization*: Stellenbosch University, Cape Town	Provincial 1,800 total	Prospective Pregnant women with known HIV status at 24–36 weeks estimated gestational age Follow-up of children to 3-5 years		Infant and under 3-year survival; infant and under 3-year all-cause and infectious-cause hospitalization; growth and neurodevelopmental outcomes at 3–5 years of age	[23]
C-VIPER (COVID-19 Vaccines International Pregnancy Exposure Registry) and PIPER (Pregistry International Pregnancy Exposure Registry)	Global, based in the United States	COVID-19 vaccines	2020-present (C-VIPER) 2022-present (PIPER)	*Funding source*: Manufacturer *Implementing organization*: Commercial organization	Global C-VIPER: 8,172 (target 6,000) PIPER: 1,230 (target 10,000)	Pregnant women exposed (C-VIPER) and not exposed (PIPER) to COVID-19 vaccines Comparison group Infants followed through 1 year of age	Spontaneous abortion, antenatal bleeding, gestational diabetes, gestational hypertension, intrauterine growth restriction, postpartum hemorrhage, fetal distress, uterine rupture, placenta previa, chorioamnionitis, Caesarean delivery, or COVID-19	Major congenital malformations, low birth weight, neonatal death, neonatal encephalopathy, neonatal infections, neonatal acute kidney injury, preterm birth, respiratory distress in the newborn, small for gestational age, stillbirth, or COVID-19; infant weight, length, developmental milestones through 1 year of age	[10,24–26]
COVID-PR (COVID-19 International Drug Pregnancy Registry)	Global, based in the United States	COVID-19 drugs (antivirals and monoclonal antibodies)	2021-present	*Funding source*: Manufacturer *Implementing organization*: Commercial	Global 368 (target 2000)	Pregnant women exposed to COVID-19 drugs Comparison groups: 1. Pregnant women treated with another therapy for COVID-19 2. Pregnant women hospitalized but not treated for COVID-19 Infants followed through 1 year of age	Spontaneous abortion, intrauterine growth restriction, gestational diabetes, gestational hypertension, postpartum hemorrhage, Caesarean delivery	Major congenital malformations, low birth weight, small for gestational age, neonatal infections, stillbirth, neonatal death, preterm birth; infant weight, length, developmental milestones through 1 year of age.	[26–28]
MANGO (Measuring Adverse Pregnancy and Newborn Congenital Outcomes)	Kenya (western)	Antiretrovirals	2020-present	*Funding source*: US NIH *Implementing organization*: Indiana University, AMPATH	Hospital 1600-2400	Prospective and retrospective Comparison group Pregnant women with known HIV status, 1:1 ratio of HIV positive to negative	Live birth, still birth, miscarriage, termination of pregnancy, ectopic pregnancy, molar pregnancy Also includes pre-term delivery (<37 weeks gestational age) or very pre-term delivery (<32 weeks gestational age)	Congenital abnormalities on newborn surface exam (e.g., extra digit, hydrocephalus, skull defects, eyes, face, mouth/lip/palate, chest, abdomen, anus, limbs, spine (including neural tube defects), hips, genitalia, skin, etc.) Also includes low birth weight, small for gestational age (<10th percentile), or very small for gestational age (<3rd percentile)	[29,30]
MiMba (Malaria in Mothers and Babies) Pregnancy Registry	Kenya, Burkina Faso	Antimalarials	2020-present	*Funding source*: Public *Implementing organization*: Liverpool School of Tropical Medicine	Multi-district 15,000	Prospective Comparison group Pregnant women exposed/unexposed to antimalarials during pregnancy Mothers followed through delivery Infants followed through two years of age	Miscarriage, stillbirth, maternal mortality	Major congenital anomalies, neonatal mortality, low birthweight, prematurity	[31,32]
REPRESENT (Xiamen Registry of Pregnant Women and Offspring)	China (Xiamen)	None specified	2008-present	*Funding source*: Public *Implementing organization*: Xiamen Health Commission, Xiamen Health and Medical Big Data Center, Chinese Evidence-based Medicine Center, Sichuan University	Provincial 766,000 as of 2020	Retrospective Mothers followed to 42 days after delivery Infants followed through childhood	Preeclampsia/eclampsia, gestational diabetes, uterine rupture, postpartum hemorrhage, stillbirth, maternal death	Birth defects, preterm birth, low birth weight, neonatal death	[33–35]
UBOMI BUHLE (Understanding Birth Outcomes from Mothers and Infants, Building Healthcare by Linking Exposures) National Pregnancy Exposure Registry	South Africa (3 provinces)	Antiretrovirals	2020-present 2013-2017 (KwaZulu Natal site) 2016-present (Western Cape site)	*Funding source*: Bill & Melinda Gates Foundation CDC (PEPFAR) Public *Implementing organization*: Wits Reproductive Health and HIV Institute (WRHI) and University of Cape Town	Multi-provincial 16,000 per year; 55,000 cumulative to date	Prospective All pregnant women attending antenatal care Mothers followed through delivery Infants followed through neonatal period	Gestational diabetes, gestational hypertension, maternal death, post-partum hemorrhage, preeclampsia / eclampsia, preterm labor, spontaneous abortion / miscarriage / pregnancy loss	Congenital anomalies / birth defects, death, preterm birth, small size for gestational age / restricted fetal growth, stillbirth	[36–40]

Resource Name	Countries	Focus	Time period	Funding source and Implementing organization	References
No longer active					
Efavirenz in Pregnancy Registry	South Africa	Antiretrovirals	2006-2008	*Funding source*: N/A *Implementing organization*: Frere Hospital, East London, South Africa	[41]
EMBRACE Microbicide Pregnancy Registry (Microbicide Trials Network (MTN-016))	Malawi, South Africa, Uganda, Zimbabwe	Microbicides and antiretrovirals	2008–2020	*Funding source*: Public *Implementing organization*: HIV Prevention Trials Network	[42–45]
POISE (Pregnancy Outcomes in the Era of Universal Antiretroviral Treatment in sub-Saharan Africa) associated registry	Malawi	Antiretrovirals	2016-2017	*Funding source*: US NIH *Implementing organization*: Johns Hopkins University	[46]
WHO Pregnancy Registry	Multinational (Kenya, Uganda, Tanzania, Ghana, Brazil [Rondonia])	None specified	2010-2012	*Funding source*: WHO *Implementing organization*: WHO	[9,47]

Pregnancy exposure registries are among the stronger study designs identified in this scoping review. Key features include systematic, prospective data collection; a focus on pregnant populations; and an emphasis on particular exposures of interest. Pregnancy registries have numerous advantages (Table 4.3). By enrolling women before outcomes are known, the prospective approach of pregnancy registries avoids recall and reporting biases of both patients and providers, allows for the systematic recording of concomitant diseases and medications, and can use standardized methods and procedures to assess outcomes, including methods for gestational dating and ensuring the collection of details regarding the dose and timing of exposures to drugs or vaccines. The availability of both numerator and denominator data allows calculations of baseline rates of events (including AEFIs), and disease incidence in vaccinated and unvaccinated populations. Enrollment of a comparator group can be a valuable feature of a PER that allows for better estimation of risk. A comparator group could be pregnant women who are not exposed to the drug or vaccine. Due to the observational nature of PERs, analytical methods must account for potential biases in comparisons between exposed and unexposed groups.

Pregnancy registries can have limitations. Because reporting for some pregnancy registries is generally voluntary, prospectively reported pregnancies may lead to reporting bias toward high-risk pregnancies. Women who consent to take part in a study may have different characteristics from those who do not consent, introducing selection bias. Moreover, abnormal outcomes are more likely to be reported than normal outcomes. Enrollment of women limited to those who attend antenatal care may bias results and diminish the generalizability of findings. Late disclosure of pregnancy and late initiation of antenatal care limit information regarding the first trimester of pregnancy, gestational age dating, and early pregnancy loss. Home births and migration increase the potential for loss to follow-up, which may bias results. Finally, few pregnancy registries follow the health of children beyond the newborn period.

Table 4.3. Strengths and limitations of selected currently active pregnancy exposure registries (PERs) with available information.

Resource	Strengths	Limitations and challenges
Category-wide attributes	• Systematic, prospective data collection • Purposely designed to capture relevant details of drug or vaccine exposures • Usually includes a comparator group and may be able to make statistical inferences	• Resource intensive • If voluntary recruitment, may bias toward high-risk • Few PER's follow children beyond newborn
C-VIPER	• Global, including LMIC; rapid enrollment; multilingual; • Not resource-intensive • Social media targets young women of child-bearing age (WOCBA) • Includes unexposed comparator cohort	• Voluntary online recruitment through social media and word of mouth requires access and resources that may limit generalizability, particularly in LMICs
MANGO	• Partnership between Kenyan and US academic groups • Second largest national referral hospital in Kenya • One of the largest HIV programs in sub-Saharan Africa (AMPATH)	• None reported
MiMBa	• Prospective, focused on antimalarials, particularly a comparison between older and newer treatments (quinine versus ACTs) • Also includes unexposed pregnant women for comparison • Good capture of first trimester exposures • Works with HDSS sites • Able to add new interventions (e.g., COVID-19 vaccine)	• Conducted in sentinel sites in two countries, limiting generalizability; however, the anticipated large size may mitigate this concern
UBOMI BUHLE	• Operating in three provinces • Linked to multiple electronic health record and other clinical databases • Merged and built from prior registries	• None reported
Xiamen REPRESENT	• Large population-based registry created by linking multiple data platforms. • Antenatal and facility-based electronic medical record databases can capture exposures and early outcomes, while a maternal and child health database can capture longer-term outcomes	• None reported

4.4. Health and Demographic Surveillance Systems and other Observational cohorts

A number of health and demographic surveillance systems (HDSS) and other population-based observational cohorts identified through this analysis did not meet all criteria for classification as PERs, such as a primary focus on pregnancy or on monitoring the safety of an intervention. Instead, these are systems that cover the population of a particular geographic area, and in which data collection encompasses a broad range of data, including vital statistics and clinical care, but which may not focus on specific drug or vaccine exposures. Participants are longitudinally followed in a prospective fashion and the entire population is monitored. In these cohorts, pregnant women are usually a subset of the monitored population, although particular attention may be paid to this group for specific studies or surveillance efforts.

Observational cohorts identified in this review are located in countries throughout sub-Saharan Africa (particularly in the eastern African region) and South and Southeast Asia, including both INDEPTH members and other sites (Figure 4.2), and all of the systems described in this section are currently active.

Classification as a HDSS indicates that the system periodically collects demographic and health event information from a geographically defined population. A majority of the HDSS resources identified in this review are members of INDEPTH (http://www.indepth-network.org/), a network created in 1998 that currently encompasses 42 independent health research centers and 49 field sites in 19 LMICs. While all INDEPTH member sites collect basic health and epidemiologic data in their populations, systems are included in this review if they have published reports describing the safety of interventions in pregnant women—indicating the presence of targeted activities related to maternal pharmacovigilance.

The Maternal Newborn Health Registry (MNHR) is another large observational cohort, which incorporates sites in 7 LMICs[48]. Begun in 2008 within the US National Institute of Child Health and Human Development (NICHD) Global Network for Women's and Children's Health Research, the MNHR is a prospective, population-based research registry that collects data to assess trends in pregnancy outcomes and inform research studies within the network, including interventional trials and other sub-studies.[29] While tailoring the surveillance to the needs of individual studies appears to be possible, the MNHR primarily monitors the outcomes of maternal mortality, neonatal mortality, and stillbirth. Specific example sites for INDEPTH and MNHR have recently been evaluated for their potential use in conducting active safety surveillance following immunization in pregnancy.[49]

The Child Health and Mortality Prevention Surveillance Network (CHAMPS) Pregnancy Surveillance is a cohort surveillance study operating at HDSS sites in several LMICs. Established in 2020 within the infrastructure of the main CHAMPS study, which focuses on determining the etiologies of stillbirth and neonatal death (see Section 4.5 Outcomes-based registries), this study is modeled after the MNHR and enrolls pregnant women prospectively and retrospectively to monitor for major maternal and infant outcomes, including mortality.

Outside of these INDEPTH and MNHR, two additional observational cohorts indicating a focus on maternal pharmacovigilance are included in this report. The Shoklo Malaria Research Unit is a field station based on the Thai-Myanmar border founded in 1986 that conducts research and clinical care provision, with an emphasis on maternal and child health and infectious diseases. Also, the PREPARE project, created in 2020, is an observational study that prospectively enrolls women at a large urban hospital in Uganda during early pregnancy and follows the mother-infant pair through nine months after birth. The intention of this study is to build and optimize a system of monitoring and surveillance in advance of anticipated candidate vaccine clinical trials against Group B *Streptococcus*.

Except for the INDEPTH network, the resources included in this section have a focus on pregnancy and, therefore, pay particular attention to the collection of maternal outcomes—following the mothers through and beyond the time of delivery. All cohorts also capture major infant outcomes through at least the early neonatal period, with some extending one to several months into the first year of life. Studies conducted by INDEPTH sites vary in terms of follow-up duration but, in all cases, evaluate infant outcomes at or near the time of birth. Major obstetric outcomes (including spontaneous abortion, stillbirth, and maternal death) are universally recorded, but some groups (such as the MNHR and PREPARE cohorts) explicitly capture a larger range of conditions like pre-eclampsia/eclampsia, post-partum hemorrhage, and gestational diabetes. The most captured infant outcomes derive from the early neonatal period, including preterm birth, low birth weight, and congenital anomalies; though later outcomes may be identified as follow-up periods allow.

Also included in this category is International Epidemiology Databases to Evaluate AIDS (IeDEA), an international research and data exchange consortium that combines observational cohort datasets representing over 2.2 million people living with and at risk for HIV, with clinical centers and research groups in 44 countries participating. Established in 2005 with US National Institute of Health (NIH) funding, this global collaboration of cohort studies collects and combines data from HIV care and treatment programs to study antiretroviral treatment in populations that include pregnant individuals and follow them for clinical outcomes. IeDEA is organized around seven regional data centers representing major world areas, who work with clinical sites to establish large datasets and conduct analyses. Publications from this network that describe clinical information tracked during pregnancy describe studies in Brazil,[50,51] Malawi,[52] South Africa,[53] and the West African region.[54]

Our search also identified several publications describing research studies conducted as stand-alone analyses of retrospectively collected clinical data to evaluate the occurrence of maternal and/or infant outcomes following exposure to drugs or vaccines during pregnancy. In most cases, these investigations involved reviewing patient medical records at the individual level, often by hand or with minimal automation. While the data analyzed range from a few months to several years, and their population may cover single facilities or larger networks, these analyses were generally time-limited in nature and aimed to answer a specific research question rather than to provide ongoing monitoring or surveillance. Publications from studies that fell into this more limited group are listed in Section 6.4.1. The activities of one research group, however, who conducted a retrospective review of medical records from a set of area hospitals in Kinshasa, DRC, is described here. Two recent publications from this group evaluated the feasibility of using Global Alignment of Immunization Safety Assessment in pregnancy (GAIA) outcome definitions in this low-resource setting, and assessed the ability of their activities to document the impact of the COVID-19 pandemic on maternal and neonatal health outcomes.[55,56] These publications indicated that their work will include a phase of prospective data collection, and therefore this group has been included in this section.

Table 4.4. Health and Demographic Surveillance Systems and other Observational cohorts.

Resource Name	Countries	Focus	Time period	Funding source and Implementing organization	Coverage and sample size	Design and Eligibility and duration of follow-up	Maternal Outcomes	Neonatal and Infant/child outcomes	References
Currently active									
CHAMPS (Child Health and Mortality Prevention Surveillance Network) pregnancy surveillance	Global, based in the United States	None specified	2020-present	*Funding source*: Bill & Melinda Gates Foundation *Implementing organization*: Emory University and multi-sectoral partners	Not available	Prospective and retrospective All pregnancies in catchment area Follow-up 42 days after delivery	Maternal death, post-partum hemorrhage, pre-eclampsia and eclampsia, obstructed labor, acute infections (e.g., chorioamnionitis or sepsis), Cesarean section, miscarriage	Neonatal death, neonatal resuscitation stillbirth, low/very low birthweight	Personal communication
IeDEA (International Epidemiology Databases to Evaluate AIDS)	Multinational	Antiretrovirals	2005-present	*Funding source*: US NIH *Implementing organization*: Indiana University	Various	Various study designs All populations living with or at risk for HIV Variable follow-up	Variable	Variable	[57,58,54,59,51–53,50,60,29,61]
INDEPTH	Multinational	None specified	1998-present	*Funding source*: Multiple donors *Implementing organization*: Individual HDSS sites INDEPTH Network Secretariat	District 165,820 births during 2009-2014	Prospective General population Variable follow-up	Maternal death, gestational hypertension, fetal distress, postpartum hemorrhage, spontaneous abortion, antenatal bleeding	Neonatal death, congenital anomalies, neonatal infections, preterm birth, stillbirth, low birthweight, small for gestational age	[19,62–67,8,68–78,74]
Maternal Newborn Health Registry	Multinational	None specified	2008-present	*Funding source*: US NIH *Implementing organization*: Individual sites	Global 60,000 annual enrollment >700,000 cumulative	Prospective Pregnant women Mothers followed 42 days post-partum	Maternal death, pre-eclampsia/eclampsia, gestational hypertension, fetal distress, ectopic pregnancy, postpartum hemorrhage, spontaneous abortion, antenatal bleeding, dysfunctional labor, fetal growth retardation, gestational diabetes, endometritis, chorioamnionitis, PPROM	Neonatal death, congenital anomalies, neonatal infections, preterm birth, stillbirth, low birthweight, small for gestational age, respiratory distress, neonatal seizures	[79–93,48,94–96]
PREPARE	Uganda	Antimalarials Antiretrovirals COVID-19 vaccine Td vaccine	2020-present	*Funding source*: EDCTP *Implementing organization*: St. George's University of London and Makerere University	Hospital 2,000-5,000	Prospective Pregnant women Mothers and infants followed for 9 months after delivery	Serious adverse events, medically-attended events, obstetric complications	Serious adverse events, medically attended events, major congenital anomalies, developmental delay	[97]
Shoklo Malaria Research Unit	Thailand	Antimalarials	1986-present	*Funding source*: Multiple donors *Implementing organization*: Faculty of Tropical Medicine, Mahidol University, Bangkok, Mahidol-Oxford Research Unit (MORU)	District	Prospective Pregnant women Mothers followed through delivery Infants followed through neonatal period	Miscarriage (primary)	Major congenital malformations (secondary)	[98–100]
UCLA DRC Research Program	Democratic Republic of Congo	None specified	2019-present	*Funding source*: US FDA Private charities *Implementing organization*: University of California, Los Angeles	District 14,300 (prospective) 7,697 (retrospective)	Prospective and retrospective components Pregnant women Infants followed for 28 days after delivery	Preterm birth; stillbirth	Invasive bloodstream infection; neonatal death, congenital microcephlaly, low birth weight; small for gestational age	[55,56]

Table 4.5. Strengths and limitations of selected observational cohorts with available information.

Resource	Strengths	Limitations and challenges
Category-wide attributes	• Reduced selection and recall bias due to prospective enrollment and data collection • Enrollment and monitoring occurs before outcome is known, and often before the exposure occurs • Many have been active for years, allowing assessment of trends over time	• Resource intensive • Annual enrollment population size may be limited • Outcomes of intensively monitored populations may not be generalizable • Health information may be self-reported
IeDEA (International Epidemiology Databases to Evaluate AIDS)	• Large size with substantial LMIC representation • Common methods for basic data collection and analysis practiced across sites • Shared practices and collaboration across sites • Long experience in operation	• Secondary use of data from routine clinical care • Potential heterogeneity in site capacities and practices
INDEPTH	• Large size with substantial LMIC representation • Common methods for basic data collection and analysis practiced across sites • Shared practices and collaboration across sites • Long experience in operation	• PER-specific activities conducted only in a subset of sites • Differing capacities and methods among sites for capturing PER-specific data
Maternal Newborn Health Registry	• Specifically focused on maternal and newborn populations • Unified methods and tools for data collection and analysis, resulting in a common dataset • Large combined study population • Prospective and population-based • Wide geographic coverage in LMICs • Long experience in operation	• Challenges with participant migration, or travel for delivery

4.5. Outcomes-based registries

Outcomes-based registries may be either open to the general population of pregnant women in a hospital's catchment area or geographic region, or may target enrollment for groups receiving certain interventions, such as antiretroviral medications. Registries in this category most commonly monitor for congenital malformations (used interchangeably with congenital anomalies and birth defects) in the infant and given their emphasis on the detection and evaluation of these conditions, they often enroll newborns. Information regarding maternal exposures is collected retrospectively, through access to clinical records, electronic medical databases, other data collection systems (e.g., HIV treatment programs), or less commonly, via participant recall. Depending on the registry, outcomes assessment of the infants may be conducted only once, during the neonatal period, or may occur multiple times, allowing for the detection of late-appearing congenital conditions and the observation of infant growth and development. Some registries also assist in locating or providing support to the children identified with anomalies, who may have need for special services.

The geographic distribution of outcomes-based registries identified in this report reflect their main focus (Figure 4.2). Those established to evaluate concerns for malformations related to antiretroviral therapies are mostly located in sub-Saharan Africa, while those more generically conceived birth defects registries that do not emphasize particular treatments and aim to determine incidence rates in the broader population can be found in other regions, including East Asia and South America.

Funding support for registries in this section is most commonly provided by donors and public sources, although a few derive support from manufacturers. A majority are operated by academic or non-profit organizations, at times in collaboration with the local governments.

Given their emphasis on outcomes, most of these registries enroll participants at the time of delivery and birth. Therefore, information regarding drug or vaccine exposures is collected retrospectively (Table 4.6). For the most part, registries aiming to determine the general background rate of birth defects in the population do not focus on specific interventions; however, a limited number (e.g., those listed in Uganda, Eswatini, and Botswana in Table 4.7) were established explicitly to assess the risk of antiretroviral medications such as dolutegravir and cabotegravir. In recent years, several birth defects surveillance programs in Africa have joined together to form the sub-Saharan African Congenital Anomalies Network (sSCAN).[101] sSCAN provides a forum to offer support and build technical capacity at member sites by developing and sharing resources, conducting workshops, and encouraging collaboration.

Given their design, most outcomes-based registries emphasize the detection of congenital malformations identifiable at the time of birth, typically through surface examination. Maternal outcomes (including miscarriages or other obstetric complications) might not be captured, particularly if they do not result in a live birth. While most registries focus on assessments at a single visit, some systems may follow infants for longer periods (e.g., six weeks) to capture conditions that appear later, but typically do not capture abnormalities in growth or development that may be detected in late infancy.

Outcomes-based registries generally enroll a large sample size numbering in the thousands, which may reflect the efficiencies allowed by study designs centered on a single visit at birth, allowing resources to be directed toward capturing an expanded number of infants. In many of these registries, considerable attention is given to detailed examination and classification of the detected malformations and expert adjudication on their classification. In addition, follow-up care and support of the children found to have malformations may be an important component of the registry. In most cases, no explicit comparator population is used; however, unaffected mother-infant pairs can be selected from the screened population to make comparisons with affected pairs to calculate the risk associated with exposures of interest.

The Child Health and Mortality Prevention Surveillance study is unique in focusing on identifying the causes of stillbirths and neonatal deaths. Identified through demographic and mortality surveillance at sites in multiple countries, fatal cases are evaluated through verbal autopsy, clinical records, and tissue sampling within 24 hours to determine causes of death.

Table 4.6. Outcomes-based registries.

Resource Name	Countries	Focus	Time period	Funding source and Implementing organization	Coverage and sample size	Design and Eligibility and duration of follow-up	Maternal Outcomes	Neonatal and Infant/child outcomes	References
Currently active									
BBDSFP (Bogota Birth Defects Surveillance and Follow-up Program)	Colombia	None specified	2001-present	*Funding source*: Public *Implementing organization*: National pharmacovigilance center	City 9,724 during 2006-2015	Retrospective All deliveries Neonatal period	Maternal illnesses by ICD code	Congenital anomalies	[102–104]
CHAMPS (Child Health and Mortality Prevention Surveillance)	Multinational	None specified	2016-present	*Funding source*: Bill & Melinda Gates Foundation *Implementing organization*: Emory University and multi-sectoral partners	Multinational Community surveillance 10,731 as of 2023	Retrospective Stillbirths and neonatal deaths Neonatal period	stillbirth, spontaneous abortion	Neonatal death	[77,105]
CTBC (China Teratology Birth Cohort)	China	Antiretrovirals Antimalarials Medicines related to autoimmunity, cancer, diabetes, and epilepsy	2019-present	*Funding source*: Public *Implementing organization*: National Center for Birth Defect Monitoring	Multi-provincial Sample size N/A	Prospective Comparison group All deliveries Followed for 42 days after delivery	stillbirth, spontaneous abortion	Congenital anomalies, preterm birth, post-term birth, low birth weight, macrosomia, small for gestational age, large for gestational age, low Apgar score	[106]
Eswatini Birth Defects Study	Eswatini	Antiretrovirals	2021-present	*Funding source*: Viiv Healthcare *Implementing organization*: Elizabeth Glaser Pediatric AIDS Foundation	Multi-district 18,877 during 2021-2022	Retrospective Comparison group	N/A	Major and minor surface birth defects	[107,108]
Makerere Birth Defects Surveillance Project	Uganda	Antiretrovirals Tetanus toxoid vaccine	2015-present	*Funding source*: US CDC *Implementing organization*: Makerere University	Hospital Sub-district 48,000 per year 200,000 total	Retrospective Comparison group All deliveries Neonatal period	Spontaneous abortion, stillbirth	Congenital anomalies; congenital infections	[109–111]
Malawi Birth Defects Surveillance	Malawi	None specified	2016-present	*Funding source*: US CDC *Implementing organization*: University of Washington, I-TECH Malawi (International Training and Education Center for Health)	Multi-hospital Multi-district 185,163 during 2016-2022	Retrospective All deliveries	N/A	Major external birth defects	[112,113]
Tsepamo Study	Botswana	Antiretrovirals	2014-present	*Funding source*: US NIH *Implementing organization*: Botswana Ministry of Health and Wellness and the Harvard T.H. Chan School of Public Health	Multi-hospital 250,000 target	Retrospective Comparison group All deliveries Neonatal period	Preterm delivery, stillbirth	Congenital anomalies, preterm birth, small for gestational age, or neonatal death	[114–120]

Table 4.7. Strengths and limitations of selected outcomes-based registries with available information.

Resource	Strengths	Limitations and challenges
Category-wide attributes	• Can provide detailed data regarding the incidence and characterization of uncommon infant outcomes, such as congenital anomalies • Emphasis on training HCW on newborn surface examination, expert adjudication and classification • Usually a single neonatal visit (with follow-up if needed), thus fewer resources needed per participant, and sample size can be large	• Single visit may limit amount of information collected, e.g., maternal outcomes, later infant outcomes • Information on exposures is mostly retrospective, thus subject to recall bias, misclassification, or incomplete records
BBDSFP (Bogota Birth Defects Surveillance and Follow-up Program)	• In operation since 2001 • Able to enroll control groups with no abnormalities for additional analysis	• Data on exposures are self-reported at time of delivery
CHAMPS (Child Health and Mortality Prevention Surveillance)	• Wide geographic distribution of sites • Standardized methods • Use of minimally invasive tissue sampling and placental examination to determine cause of death	• Focus on fatal infant outcomes • Focus on proximate causes of stillbirth/ neonatal death, e.g., hypoxia, infections, rather than more remote drug or vaccine exposures
CTBC (China Teratology Birth Cohort)	• Prospective cohort study • Detailed information on drug exposures is collected • High rate of facility-based deliveries in the population	• Pregnant women attending hospitals specific for infectious diseases or psychiatric conditions are not yet included • Early abortions are under-represented • Data are not publicly accessible
Makerere Birth Defects Surveillance Project	• Large sample size • High rate of hospital deliveries in the population • Active case ascertainment, including stillbirths and spontaneous abortions • Antenatal care records are all on site at delivery hospitals • Antiretroviral records maintained through national program • Able to compare women with/without HIV and with/without ARV exposure	• May miss early pregnancy losses managed at home • Does not include diagnoses after newborn discharge or data on infant follow-up and survival • Referral patterns and urban population may limit generalizability
Tsepamo Study	• Large sample size • Nationally representative • Comprehensive information on HIV infection status and ARV regimen	• Identifies only abnormalities detected by surface examination

4.6. Maternal conditions-based registries

Registries included in this section are those developed to monitor the safety of treatments given to pregnant women with specific underlying health conditions such as epilepsy, HIV, or cardiac disease (Table 4.8). Pregnancy registries centered around the presence of a selected health condition typically enroll women who receive medicines in an associated product class, such as anti-epileptic drugs, antiretrovirals, anti-coagulants, or cardiac medicines. Vaccination is rarely a focus in these efforts. These registries are often established due to a known or suspected safety signal associated with these medicines such as a particular congenital malformation or neonatal complication. These registries, therefore, emphasize detection of infant outcomes. Some of them, however, will also monitor maternal outcomes associated with the underlying health condition such as seizure frequency or worsening heart failure.

Other than those focused on HIV, the registries identified in this category are more commonly located in middle-income countries such as India, Brazil, and Argentina. This pattern may reflect that physicians specializing in fields such as neurology or cardiology may have a greater capacity to gather together larger patient cohorts in countries with higher economic levels.

As with outcomes-based registries, funding support for registries based on maternal conditions is mostly provided by donors and public sources, and these registries are operated by academic groups, clinical departments, or non-profit organizations, at times registries are managed in collaboration with the local governments.

Registries based on maternal underlying conditions are more likely to be prospective in design because the participants are often already identified and followed by the clinics providing the relevant specialty care (Table 4.9). Registries operated by individual clinics or academic centers involve a smaller study population. Even those with national or multi-national coverage generally do not reach the sample sizes achieved by the outcomes-based registries. Since exposures are often documented prospectively, comparator groups of unexposed pregnant women may be enrolled. In other cases, comparisons of non-pregnancy-related maternal health outcomes may be made with non-pregnant women that receive the intervention of interest.

Table 4.8. Maternal conditions-based registries.

Resource Name	Countries	Focus	Time period	Funding source and Implementing organization	Coverage and sample size	Design and Eligibility and duration of follow-up	References
Currently active							
Kerala registry of Epilepsy and Pregnancy (KREP)	India	Anti-epileptics	1998-present	*Funding source*: Public *Implementing organization*: KREP Study Group, Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST)	Hospital 1998-2017: 1,962 exposed 340 unexposed	Prospective, enrolled in the preconception period or first trimester Exposed and unexposed (comparator) Pregnant women with epilepsy	[121–128]
REBECGA Brazilian Registry of Pregnancy and Heart Disease	Brazil	Cardiac medications	Retrospective analysis 2017–2020 Prospective analysis 2021–26	*Funding source*: Donor *Implementing organization*: Women's Cardiology Department of University of Sao Paulo and the Brazilian Society of Cardiology	Multi-hospital Prospective phase: 300-350/year	Prospective (longitudinal) and Retrospective (cross-sectional) stages Pregnant women with heart disease	[129]
Tamil Nadu Pregnancy and Heart Disease Registry (TNPHDR)	India	Heart disease	2020–2023	*Funding source*: Public *Implementing organization*: Madras Medical College and Research Institute	State/provincial 2,461	Prospective Pregnant women with cardiac disease	[130]
No longer active							
Epilepsy Pregnancy Registry in Argentina	Argentina	Anti-epileptics	1995-2002	*Funding source*: Funding N/A *Implementing organization*: Instituto de Investigaciones Neurologicas Raul Carrea-FLENI, Buenos Aires	Multi-hospital 114	Prospective Pregnant women with epilepsy taking anti-epileptic drugs	[131]
European Collaborative Study (ECS) in Ukraine	Ukraine	Antiretrovirals	2000-2012	*Funding source*: European Union *Implementing organization*: University College of London	Multi-hospital 8,863	Prospective HIV-positive pregnant women	[132–134]
Shifa International Hospital Registry of Antiepileptic Drugs in Pregnancy	Pakistan	Anti-epileptics	2018-2020	*Funding source*: Funding N/A *Implementing organization*: Shifa International Hospital, Islamabad	Hospital 65	Prospective Pregnant women with epilepsy at the time of conception	[135]

Table 4.9. Strengths and limitations of maternal conditions-based registries.

Resource	Strengths	Limitations and challenges
Category-wide attributes	• Typically study a specific product class of drugs, thus can be focused on specific safety signals or issues, e.g., certain birth defects • Most are conducted prospectively, often with enrollment prior to conception	• Typically smaller, focused on a specific subset of the maternal population • Limited ability to include comparator participants, depending on how commonly the drug is used • May be less able to incorporate new drugs or vaccines, unless there is particular interest in their safety in the population

4.7. Manufacturer registries

Registries in this group are distinguished from others by being funded, and usually operated, by the manufacturer of a specific product (Table 4.10). The registry can focus on an individual drug or vaccine, or can monitor all products (e.g., all vaccines) in the same class made by the manufacturer. These systems are often established due to a regulatory commitment for post-licensure safety monitoring, which can be based on prior detection of a safety signal or due to a more general concern about the use of the product in pregnancy. Regardless, these systems are intended to add to the product's post-licensure safety database, with the potential inclusion of resulting data in the product's label. Most manufacturer registries are run by multinational corporations based in HICs that have well-resourced pharmacovigilance departments, and a large proportion of their data come from these markets. The registries may accept reports from other areas of the world, however, and can therefore be considered global in coverage, although these participants may only represent a small fraction of the populations analyzed. Some registries created to comply with a post-licensure commitment are designed to answer a specific scientific question and, therefore, may have a pre-defined timeframe or sample size limit. In other cases, the registries may be continued indefinitely in order to continue monitoring the use of the products during pregnancy.

Manufacturer-based registries typically use a passive surveillance design in which the operators sporadically receive voluntary reports of exposures originating from patients or providers (Table 4.11). At times, outreach to potential physicians, individual patients, or patient groups can occur, particularly if the product is to be used in specific patient populations such as those with autoimmune disorders. In most cases, however, contact information and instructions on how to enroll are simply provided in the product's package insert, product literature, or the company website. Given the global reach of coverage of these registries and their operation by a dedicated pharmacovigilance unit with substantial expertise, manufacturers are often able to conduct epidemiological analyses that can potentially detect risks.

Not included in this report are other types of observational clinical studies conducted by manufacturers that employ active surveillance or other more resource-intensive methods to recruit and monitor recipients to answer specific scientific questions, since they are usually classified as Phase 4 studies rather than registries.

In general, outcomes monitoring within these registries will encompass maternal as well as infant outcomes. The completeness of these registries can be limited by the voluntary nature of reporting by participants. In many cases, however, once a person has been enrolled, registry staff will contact them subsequently to solicit information on outcomes.

Table 4.10. Manufacturer registries.

Resource Name	Countries	Focus	Time period	Funding source and Implementing organization	Coverage and sample size	Design and Eligibility and duration of follow-up	Maternal Outcomes	Neonatal and Infant/child outcomes	References
Currently active									
APR (Antiretroviral Pregnancy Registry)	Multinational (70-80% US)	Antiretrovirals (HIV and HBV)	1989-present	*Funding source*: Manufacturer *Implementing organization*: Contract research organization	Multinational 1,300–1,700 per year, >25,000 total	Prospective No comparison group Voluntary; pregnant women exposed to antiretrovirals Mothers followed through delivery Infants followed through 28 days	Spontaneous abortion, miscarriage, pregnancy loss	Congenital anomalies / birth defects, death, live birth, preterm birth, small size for gestational age / restricted fetal growth, stillbirth	[57,136–139,114,140]
Bayer pharmacovigilance (PV) database	International, with select middle-income countries (Russia, South Africa)	Interferon beta-1b (Betaferon(R), Betaseron(R), Extavia(R))	1995-present	*Funding source*: Manufacturer	Multi-national Through 2018: 2581 prospective and 1303 retrospective	Prospectiv Retrospective (for comparison) Cases reported to Bayer's global PV database and entered prospectively (before outcome is known)	Spontaneous abortions, stillbirth/fetal death, ectopic pregnancies	Congenital anomalies	[141]
EURAP: International Registry of Antiepileptic Drugs and Pregnancy	Mainly high-income countries, but also India, Philippines	Anti-epileptics	1999-present	*Funding source*: Manufacturer *Implementing organization*: The EURAP Study Group	Multinational 29,953 worldwide	Prospective (cases that are enrolled after 16wks, after prenatal dx, or after birth are reported descriptively) Women exposed to antiepileptic drugs at the time of conception	Seizure frequency	Stillbirths, elective terminations due to fetal abnormalities Major congenital malformations up to 12 months after birth	[142–147]
GlaxoSmithKline (GSK) Pregnancy Registries	Global	Vaccines (influenza, tetanus, pertussis, varicella, measles-mumps-rubella [MMR]) Antimalarials Antiretrovirals Medications related to autoimmune diseases, epilepsy, and asthma		*Funding source*: Manufacturer *Implementing organization*: PPD Inc., OTIS	Multi-national >20,000	Prospective Retrospective Comparison group Pregnant women	Varies by product; includes spontaneous abortion	Varies by product; includes stillbirth, congenital anomalies, neonatal death, developmental and genetic outcomes	[148–153]
Novartis Multi-National Gilenya Pregnancy Exposure Registry in Multiple Sclerosis	Global, including select middle-income countries (Brazil, Russia, Argentina)	Medicines for multiple sclerosis (fingolimod)	2011-2031	*Funding source*: Manufacturer *Implementing organization*: Contract research organization (Quintiles, IQVIA)	Multi-national 500 (target)	Prospective Retrospective Pregnant women with multiple sclerosis exposed to fingolimod Followed up to 23 months	Spontaneous abortions, stillbirths and elective terminations	Major congenital malformations, minor congenital malformations, physical developmental delays as well as adverse effects on immune system development in infants around one year of age	[154–156]
Sanofi Pasteur Pregnancy Surveillance Program	Global	Vaccines (Menactra, Adacel, Fluzone, MenQuadfi (US only), Dengvaxia, Flublok (US only))	2005- (Menactra) 2005- (Adacel) 2015-19 (Fluzone intradermal) 2013-2019 (quadrivalent influenza vaccine) 2021-2028 (MenQuadfi) 2022-2024 (Dengvaxia)	*Funding source*: Manufacturer	Multi-national 158 (Menactra 2005-2012) 577 (Adacel 2005-2011) 1 (Fluzone intradermal 2011-2012) 239 (Fluzone Quadrivalent 2013-2019) 214 (Dengvaxia)	Prospective Retrospective Pregnant women exposed to vaccine	Includes gestational diabetes, spontaneous abortion	Preterm birth, stillbirth, congenital anomalies Developmental (physical and social) outcomes	[157–162]
No longer active									
GARFIELD-VTE registry	Multi-national	Anticoagulants	2014-2020	*Funding source*: Manufacturer (unrestricted grant from Bayer AG) *Implementing organization*: Thrombosis Research Institute	Multi-national 159 pregnant patients (of 10,870 enrolled)	Prospective Patients with venous thromboembotic embolism, pregnant women as a subset	Not available	Not available	[163,164]
Tysabri® (natalizumab) pregnancy exposure registry	Focus on United States and Canada, with a "rest of the world" component	Natalizumab (Tysabri)	2007-2012	*Funding source*: Manufacturer *Implementing organization*: Biogen	Multi-national 376	Prospective Women with multiple sclerosis or Crohn's disease exposed to Tysabri within 90 days of last menstrual period or during pregnancy Followed through four weeks after delivery	Spontaneous abortions, elective or therapeutic abortions, fetal losses including stillbirths, and ectopic pregnancies	Live births, birth defects	[165,166]

Table 4.11. Strengths and limitations of manufacturer registries.

Resource	Strengths	Limitations and challenges
Category-wide attributes	• Global coverage and centralized, therefore can enroll larger numbers • Manufacturer is knowledgeable about the product • Prospective enrollment is usually encouraged • Data may be used for regulatory purposes, and thus may have a more direct impact on use • Safety monitoring can be better resourced by the manufacturer if considered a priority (e.g., due to a regulatory commitment or a known safety signal) • Monitoring of multiple products from the same manufacturer can be harmonized, or even combined • The APR in particular has a long experience in operation, monitors a large number of antiretrovirals, and has multinational representation	• Passive surveillance, voluntary and sporadic enrollment • Timing of enrollment cannot always be controlled; participants may enroll after outcomes are known • Data are not verified, particularly if self-reported; medical records for verification might be requested, but consent may be required, which is resource-intensive • Data and analyses are not always made publicly available • Often not operated by independent researchers; manufacturer staff may be considered to have a conflict of interest • Less likely to incorporate additional interventions that are not from the same manufacturer • Developing country vaccine manufacturers (DCVMs) typically do not have mature pharmacovigilance departments with the expertise needed to manage registries and analyze results

4.8. Electronic health records and other clinical software platforms

Electronic medical record (EHR) systems are computerized databases that collect and record clinical information prospectively on all patients within a healthcare system. EHR platforms may be implemented nationally, within certain health systems or sectors, or by individual facilities. Pregnant women and their infants may make up only a subset of an EHR's patient population but, by collecting and storing the clinical data electronically, the resulting databases can be searched for specific information and analyzed using structured, reproducible methods.

This report includes initiatives that have published studies or reports (either in the scientific literature or in the gray literature) that tracked drug or vaccine exposures during pregnancy and subsequent outcomes using an EHR database. In these cases, investigators may have developed programming and/or algorithms to identify pregnancies in their database, extract the data needed, and classify outcomes appropriately. Identified EHR databases include SmartCare in Zambia, the Baobab Health Antiretroviral Therapy (BART) system in Malawi, and the Provincial Health Data Centre (PHDC) system in the Western Cape province of South Africa.

Another set of systems within this category are software platforms such as DHIS2. DHIS2 is an open-source web-based software platform designed for collecting and analyzing data at the population and individual patient levels, and can be designed for facilities, health systems, or national programs. Data are entered into the system as part of medical care, rather than collected by study staff during dedicated visits, as would be done in surveillance system such as a HDSS. By the end of 2022, DHIS2 is being used in more than 75 LMICs, with 69 countries using DHIS2 at a national scale.[167,168] DHIS2 has the ability to provide for individual patient clinical care and to conduct epidemiological analyses for surveillance and research.[169] DHIS2 is comprehensive and encompassing data capture for multiple aspects of healthcare provision, including analytics and data management, individual case management, surveillance, and even logistics and supplies. Health care providers and researchers can address data collection and analysis for specific health topics such as HIV, tuberculosis, or immunizations through pre-configured installable metadata packages. These modules include a Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCAH) package, which provides a structure to track exposures and outcomes during pregnancy.

While use of the RMNCAH package is likely active in multiple settings, this review only identified one clear example in which DHIS2 was used to track maternal exposures and outcomes in Palestine. In this instance, deployment of the DHIS2 platform was initiated specifically in MNCH clinics, with the expansion of the system to other sectors afterwards. Though this one example occurred in Palestine, the potential for such data collection within the DHIS2 system could be considered for other countries.[49]

Other open-source clinical software platforms, such as OpenMRS and OpenEMR, have been promoted in LMICs worldwide and could theoretically provide similar functionality to conduct pharmacovigilance in pregnant women.[11] However, no publications or online sources describing their use for monitoring drug safety during pregnancy were found in our search.

The Perinatal Information System (Sistema Informatico Perinatal [SIP]) is a free standardized perinatal clinical record developed by the Pan American Health Organization (PAHO) and run by PAHO's Latin American Center for Perinatology/Women's Health and Reproductive Health (CLAP/WR) in Montevideo, Uruguay.[170,171] First publicized in 1983, facilities have used this database throughout Latin America and the Caribbean. Using this program, facilities can produce reports and combine their data with other facilities' using the same platform, allowing studies to be conducted at the regional or national level.[171–173] While no publications related specifically to pregnancy exposure pharmacovigilance using SIP were identified as part of this review, the capability appears to be possible, at least at the facility level.

Finally, our review found one study in which researchers in China analyzed data from a national insurance claims database to assess the safety of medication use in pregnancy. The use of administrative insurance databases to perform epidemiological studies, including those associated with drug or vaccine safety, is common in HICs where methods are well developed and coverage is relatively high. While national health insurance is generally expanding in LMICs[174] (particularly in MICs),[175] the expansion has been particularly slow in the lower-resource areas of Africa and Southeast Asia. Research involving claims databases have been even fewer,[176–179] but may increase if health insurance becomes more common. This review, however, found no studies in additional LMICs relating to the use of insurance databases to conduct maternal pharmacovigilance.

Table 4.12. Electronic health records and other clinical software platforms.

Resource Name	Countries	Focus	Time period	Funding source and Implementing organization	Coverage and sample size	Design and Eligibility and duration of follow-up	Maternal Outcomes	Neonatal and Infant/child outcomes	References
Currently active									
Baobab Health Trust	Malawi	None specified	2001-present	*Funding source*: Donor *Implementing organization*: Baobab Health Trust	Multi-district	Prospective All patients	None specified	None specified	[180,181]
CHIRA (China Health Insurance Association) database	China	None specified	2007-present	*Funding source*: Public *Implementing organization*: Chinese government via basic medical insurance (BMI)	National	Prospective Systematic sampling from public insurance databases, representing about 2% of total population	Thrombosis, gestational diabetes, gestational hypertension, PROM, preterm labor, pre-eclampsia/eclampsia, post-partum hemorrhage, corporeal infection, spontaneous abortion/ miscarriage; maternal death, placenta previa	Preterm birth, stillbirth, small for gestational age, congenital anomalies	[182]
DHIS2	Palestine, Rwanda, Tanzania	None specified	2011 in Tanzania 2016 in Palestine	*Funding source*: Public *Implementing organization*: Palestinian Ministry of Health Palestinian National Institute of Public Health Norwegian Institute of Public Health, Tanzanian MOHSW	National	Prospective All patients	Hospitalization, gestational diabetes, gestational hypertension, PROM, spontaneous abortion, preterm labor, pre-eclampsia/eclampsia, post-partum hemorrhage, dysfunctional labor, fetal growth retardation, maternal death	Neonatal death, congenital anomalies, neonatal infections, preterm birth, stillbirth, low birthweight, small for gestational age, respiratory distress. Later infancy: Infections, respiratory illness	[167,168,183–188]
SIP (Perinatal Informatic System)	Latin America (multiple countries)	None specified	1983-present	*Funding source*: Donor (PAHO) *Implementing organization*: PAHO	Hospital Multi-national	Prospective All pregnant patients	Thrombosis, gestational diabetes, gestational hypertension, PROM, preterm labor, pre-eclampsia/eclampsia, post-partum hemorrhage, corporeal infection, spontaneous abortion/ miscarriage; maternal death, placenta previa	Preterm birth, stillbirth, small for gestational age, congenital anomalies	[170–173,189]
SmartCare	Zambia	None specified	2017-present	*Funding source*: US CDC Global Fund Differentiated Service Delivery Strategic Initiative (DSD SI *Implementing organization*: Zambian Ministry of Health Centre for Infectious Disease Research in Zambia (CIDRZ)	National	Prospective All patients	None specified	None specified	[190–192]
Western Cape Provincial Health Data Centre (PHDC)	South Africa	None specified	2015-present	*Funding source*: Public *Implementing organization*: Western Cape Provincial Department of Health	Multi-district (single province)	Prospective All patients	None specified	None specified	[40,53,169, 193,194]

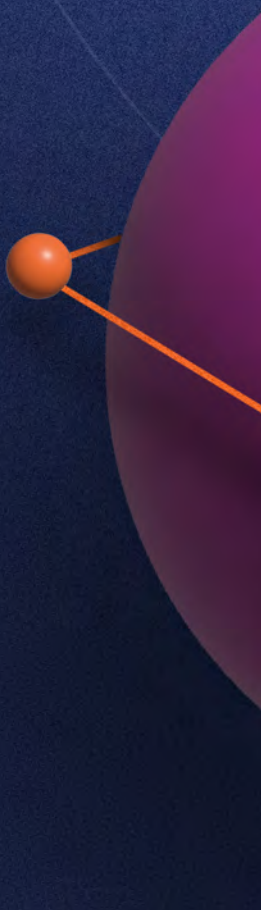
Table 4.13. Strengths and limitations of electronic medical record and clinical software platforms.

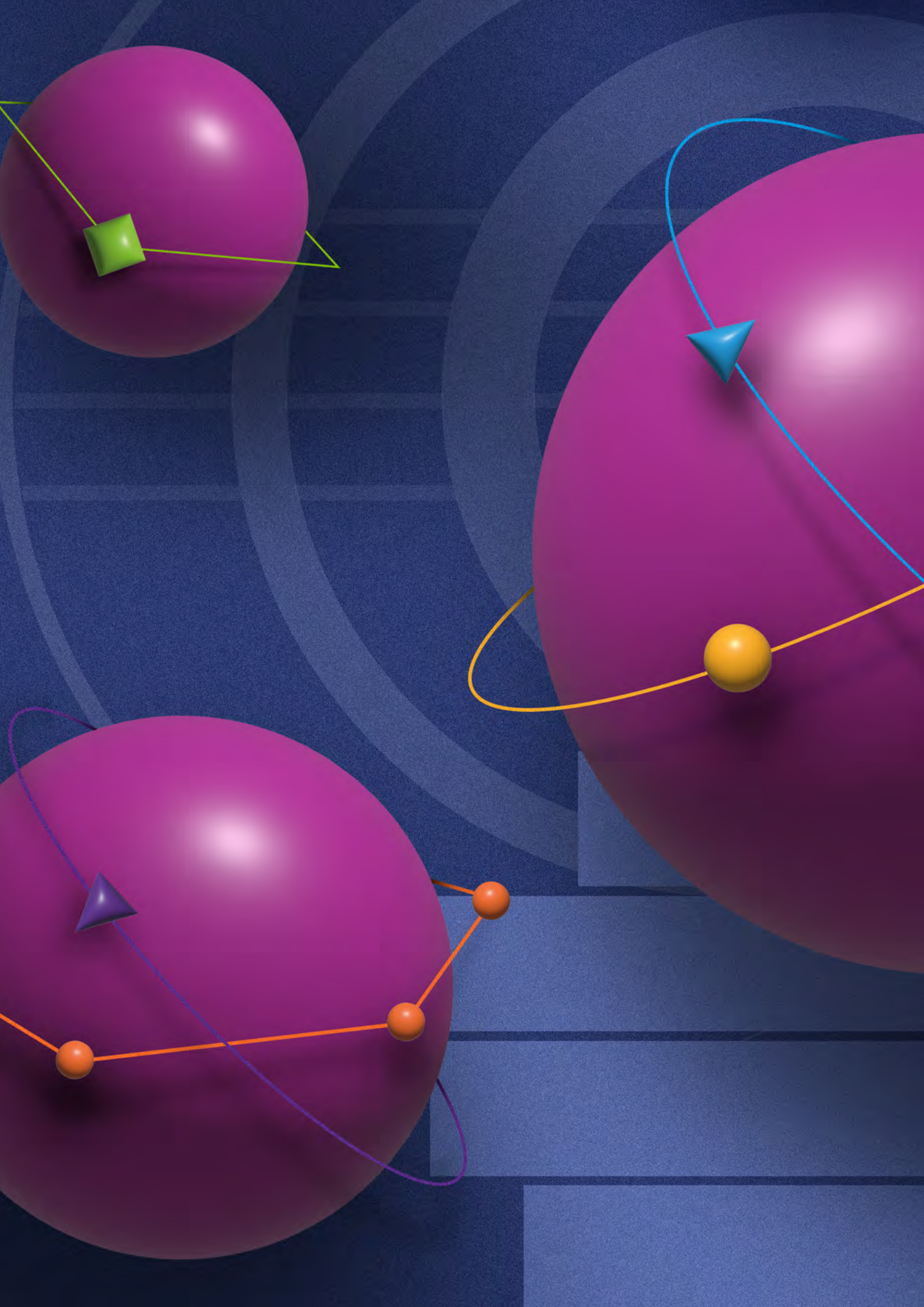
Resource	Strengths	Limitations and challenges
Category-wide attributes	• Costs of adding maternal pharmacovigilance capabilities to a system are incremental, without requiring large new investments in infrastructure or human resources • Able to link records between mother and child, over time, and across different health and administrative databases (e.g., pharmacy) • Able to capture larger numbers of pregnant women and relevant exposures across a healthcare system • Uses automated methods for searching and extracting data	• Requires investment to create specific algorithms, work procedures, and programming • Medical terminology and clinical coding may not be used widely or accurately in low-resource settings • Gestational dates may not be captured in the database. Algorithmic methods to calculate gestational timing may be imprecise. • Will only capture facility-based pregnancies

5

Section

Discussion





This landscape analysis, consisting of a scoping review that screened over 200 records, publications, and additional sources, yielded 45 PERs and related systems pertinent to maternal pharmacovigilance in LMICs. Of these, 36 were presently in operation as of the date of this review. The identified resources cover a wide range of methodologic approaches and areas of focus ranging from standalone pregnancy exposure registries and other forms of active surveillance to analyses based on electronic health care records systems. Table 5.1 lists key features of each resource type, highlighting the relative advantages and disadvantages of specific designs.

Among the resource types described in this report, classically designed PERs remain an essential tool for monitoring the safety of vaccines and drugs used during pregnancy. PERs employ rigorous methods, including prospective design whereby women are enrolled before outcomes are known, thereby avoiding recall and reporting biases of both patients and providers. Moreover, PERs can use standardized methods to assess multiple pregnancy outcomes, gestational dating, and may also include a comparison group. However, these features make these studies more expensive and resource intensive. Therefore, they can be time-limited, require significant staffing, and involve smaller populations and/or limited geographic coverage. Few PERs are designed specifically for monitoring immunization safety that are operating to a significant extent in LMICs. The majority of PERs identified in this review focus on ARV pharmacovigilance, reflecting the high HIV disease burden relevance to many LMIC populations. This work is valuable for the sustained monitoring of ARVs, which continue to expand in use and new potential safety issues arise, particularly among pregnant women, (e.g., the concerns over the safety of dolutegravir, necessitating the need for continuous operation and support of PERs for ARVs). Ongoing PERs can also be adapted to include new drug or vaccine exposures of interest. For example, while the focus of the MiMBa registry is antimalarial drugs, the project has also been systematically recording exposures to COVID-19 vaccines during pregnancy.

Observational cohorts that don't meet the formal definition of a PER but are embedded within larger surveillance research studies or networks such as MNHR, IeDEA, or an HDSS, or embedded within a set of clinical trials, such as the Microbicides Trial Network, represent another important approach to maternal safety surveillance. Additional resources may be required to adapt observational cohort studies to include monitoring the safety of medicines used by pregnant women to ensure appropriate details of the exposures and relevant outcomes are recorded. Nevertheless, HIV-focused cohorts in particular are generally comprehensive in terms of clinical data collection, and designed to follow participants longitudinally, and can include comparison groups.

Observational cohorts conducted within the context of HDSS are widespread throughout LMICs and have a long history of operation by researchers, expert in epidemiologic approaches. HDSS sites are well suited to address questions around the safety of medicines used during pregnancy. While most HDSS's include some reporting of baseline indicators, including monitoring of births, maternal deaths, etc., maternal pharmacovigilance requires some adaptation and investment of resources, including methods for identifying women early in their pregnancies, perform gestational dating, ensure accurate reporting of exposures (date, dosing, lot number, etc.), and ensure complete capture of a comprehensive list of adverse events in both the mother and infant over time. Depending on their design, some HDSS's have significant community surveillance components, thus allowing monitoring and capture of pregnancies and deliveries that occur outside health facilities. By embedding their analyses within a larger set of surveillance activities, HDSS's can sometimes establish comparator populations, determine background rates (e.g., in non-pregnant populations, or in unexposed pregnant populations) and calculate relative risk estimates. Ultimately, these are operated as research studies of significant intensity, and require substantial investment in terms of funding, human resources, and community engagement. HDSS and other sentinel population cohorts provide a platform for adding information relevant for monitoring MNCH health and disease and standard reporting for AEFIs. HDSS sites have been used for pharmacovigilance projects in pregnancy, coordinated by the INDEPTH MNCH Working Group.

Electronic medical record systems and associated clinical software platforms, such as DHIS2 or Smartcare, represent another potential avenue for maternal safety surveillance that involves embedding a circumscribed set of activities within a broader data collection structure. Much of the data collection is performed as part of clinical care, and thus additional training of staff is not needed. However, data quality is subject to the level of training and quality of the data input by health care workers. Data analysis requires standardized terminologies or algorithms to detect diagnoses, treatments, and conditions. Once designed, relevant data extractions and analyses can be reproduced at periodic intervals. If such a system is available in a country, or being adopted or expanded, maternal PV would be a relatively small incremental investment to incorporate the added capabilities.

Birth defects surveillance and other outcomes-based registries can be adapted to assess the safety of medicines used during pregnancy if the interest is in specific birth defects that may be uncommon in the general population and if information on pregnancy exposures can be collected in a valid and reliable manner. These registries usually involve few interactions with the vast majority of participants to identify and document outcomes, with follow-up needed only when potential outcomes of interest are detected. The trade-off is that the focus is on specific outcomes, often limited to those that can be detected in the neonatal period, and information regarding exposures is collected retrospectively. Thus, these studies are potentially subject to bias or incomplete verification, or the information collected may be imprecise (in terms of dose, timing, etc.). All obstetric events would be similarly collected via subject recall, and overall, there is generally less emphasis on the mother's health. In addition, these systems are designed to identify adverse events that do not result in a live birth, such as spontaneous abortion or stillbirth.

Table 5.1. Key features of pregnancy exposure registries and related data collection systems, by resource type.

Type of Resource	Prospective enrollment of pregnant women[1]	Exposure ascertainment[2]	Maternal characteristics ascertainment[3]	Maternal and infant outcomes ascertainment	Ability to include a comparison group[4]	Ability to calculate rates and relative risk	Ability to assess new drugs or vaccines of interest	Complexity and resources requirements
Pregnancy exposure registries	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High
HDSS & other observational cohorts	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High
Outcomes-based registries	No[5]	No	Yes	Yes	Yes	Sometimes[6]	Yes	Low
Maternal conditions-based registries	Yes	Yes	Yes	Yes	Yes	No	Yes	Low
Manufacturer registries	Sometimes	Yes	Yes	Yes	Sometimes	Sometimes[7]	Sometimes	High
EMR databases and clinical software platform with pregnancy exposure module	Yes[8]	Yes	Yes[9]	Yes	Yes	Yes[10]	Yes	Low

1. Enrollment of the pregnant woman before the outcome of pregnancy is known. Can be before or after the exposure has occurred.
2. Vaccine and drug type, dose, frequency, duration, timing in relation to gestation.
3. Can include relevant demographic information, concomitant illnesses and medications, and reproductive history.
4. Comparison group may be unexposed pregnant participants, exposed non-pregnant participants, or unexposed non-pregnant participants.
5. May be mitigated if routine clinical data can be accessed and are detailed and prospectively entered into medical records and if standardized terminology is used.
6. Yes, if surveillance captures all deliveries or other relevant denominator in a population. Typically does not include spontaneous abortions.
7. Can calculate an incidence rate among a population of exposed; cannot calculate a relative risk unless a comparison group is enrolled.
8. Yes, if routine clinical data are detailed and prospectively entered into medical records and if standardized terminology is used.
9. Can be done through record linkage.
10. If health system covers an entire population.

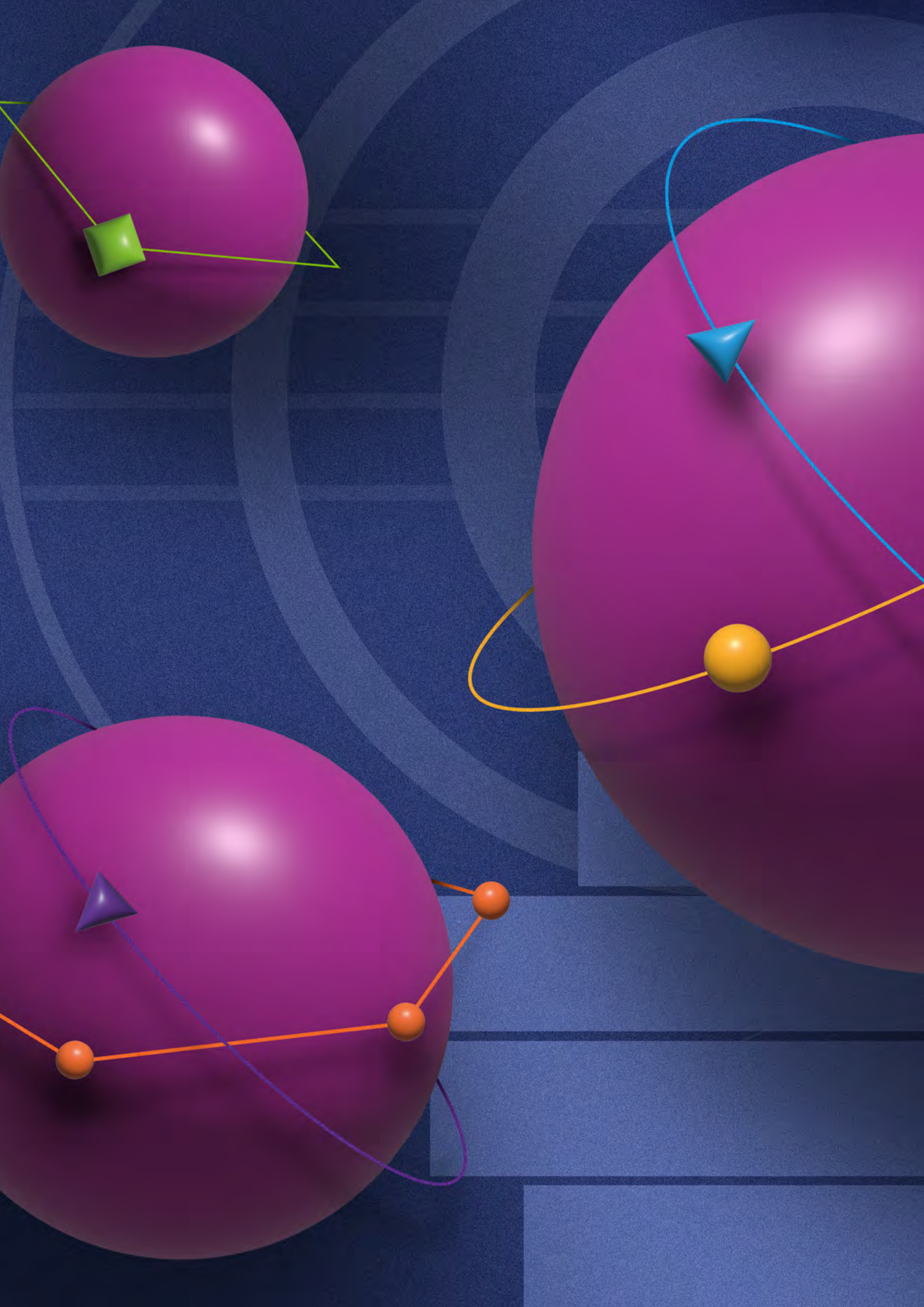
This landscape analysis has identified that a substantial level of resources has been dedicated to maternal PV in LMICs, but it is clear that more safety surveillance is needed. It is important to note that not all countries will need their own systems, but the selection of resource type must be matched to the context, such as the questions to be answered, funding available, and infrastructure that exists, to make it suitable for purpose. Strengths of this analysis include a structured and standardized scoping review approach that included a comprehensive literature search strategy supplemented by grey literature and expert consultation. The online survey and interviews helped to fill in gaps, particularly for resources that do not have any publications. With the exception of those studies that are tightly focused on specific populations, most registries and other resources identified can likely be modified to incorporate capture of vaccinations, including new maternal vaccines that are projected to be launched in the coming years, if adequate resources are provided. Relevant factors that are more desirable, such as early enrollment and prospective data collection, focus on maternal/obstetric experiences, enumerated populations for denominator-based rates, etc. should be included when considering which systems to support.

This review does have some limitations. A number of PER's and other relevant resources, particularly in LMICs, have not yet published their data, and may have minimal online presence, such as a website. Some of these resources were identified by reference lists, expert consultations, grey literature, and other web searching, but this process may have left several uncaptured. Many publications and online resources contained minimal or incomplete information on the methods used, including the specific outcomes monitored and their definitions. In some cases, we were able to contact informants, including through the survey, to supplement our information, but some could not be reached.

This analysis identifies a number of registries that are currently active and may be similar or flexible enough to combine data or analyses. Such information could enable studies to prepare LMICs for new drugs or vaccines intended for use in pregnancy, particularly among those funded through public or charitable sources. However, true assessment of compatibility among these resources will require more granular information regarding the structure, data variables, and methodologic approaches of the registries of interest. It is also possible that registries may expand beyond their current areas and operate regionally. An improved understanding of the current status of maternal PV in LMICs will allow programmatic staff and policymakers to identify major gaps in our understanding of maternal safety and opportunities for strengthening these efforts.

Section

6 Appendices



6.1. Search strategies by database

6.1.1. PubMed

Set #	Query	Results
132	#130 NOT #131	2,016
131	address[Publication Type] OR autobiography[Publication Type] OR bibliography[Publication Type] OR biography[Publication Type] OR comment[Publication Type] OR dictionary[Publication Type] OR directory[Publication Type] OR editorial[Publication Type] OR "expression of concern"[Publication Type] OR festschrift[Publication Type] OR historical article[Publication Type] OR interactive tutorial[Publication Type] OR lecture[Publication Type] OR news[Publication Type] OR newspaper article[Publication Type] OR portrait[Publication Type] OR video-audio media[Publication Type] OR webcast[Publication Type]	2,050,653
130	#128 NOT #129	2,048
129	Animals[mesh] NOT Humans[mesh]	5,016,862
128	#126 AND #127	2,051
127	("2000"[Date - Publication] : "3000"[Date - Publication])	20,721,844
126	#61 AND #125	2,597
125	#62 OR #63 OR #64 OR #65 OR #66 OR #67 OR #68 OR #69 OR #70 OR #71 OR #72 OR #73 OR #74 OR #75 OR #76 OR #77 OR #78 OR #79 OR #80 OR #81 OR #82 OR #83 OR #84 OR #85 OR #86 OR #87 OR #88 OR #89 OR #90 OR #91 OR #92 OR #93 OR #94 OR #95 OR #96 OR #97 OR #98 OR #99 OR #100 OR #101 OR #102 OR #103 OR #104 OR #105 OR #106 OR #107 OR #108 OR #109 OR #110 OR #111 OR #112 OR #113 OR #114 OR #115 OR #116 OR #117 OR #118 OR #119 OR #120 OR #121 OR #122 OR #123 OR #124	7,704,889
124	MNCH[Other Term] AND (maternal*[Other Term] OR newborn*[Other Term] OR child*[Other Term])	11
123	MNCH[Title] AND (maternal*[Title] OR newborn*[Title] OR child*[Title])	22
122	"Maternal Health"[mesh]	2,142
121	"Child Health"[mesh]	4,447
120	"Infant Health"[mesh]	1,175
119	(birth[Other Term] OR births[Other Term]) AND defect*[Other Term]	1,029
118	(birth[Title] OR births[Title]) AND defect*[Title]	2,671
117	(birth[Other Term] OR births[Other Term] OR matern*[Other Term] OR neonat*[Other Term] OR neo-nat*[Other Term] OR perinatal*[Other Term] OR peri-natal*[Other Term] OR peripartum[Other Term] OR "peri-partum"[Other Term] OR postnatal*[Other Term] OR post-natal*[Other Term] OR postpartum[Other Term] OR "post-partum"[Other Term] OR post-birth*[Other Term] OR pregnanc*[Other Term]) AND outcome*[Other Term]	9,426

Set #	Query	Results
116	(birth[Title] OR births[Title] OR matern*[Title] OR neonat*[Title] OR neo-nat*[Title] OR perinatal*[Title] OR peri-natal*[Title] OR peripartum[Title] OR "peri-partum"[Title] OR postnatal*[Title] OR post-natal*[Title] OR postpartum[Title] OR "post-partum"[Title] OR post-birth*[Title] OR pregnanc*[Title]) AND outcome*[Title]	31,066
115	Pregnancy Outcome[mesh]	82,242
114	(fetal[OT] OR foetal[OT] OR fetus*[OT] OR foetus*[OT] OR prenatal*[OT] OR pre-natal*[OT]) AND expos*[OT]	2,033
113	(fetal[Title] OR foetal[Title] OR fetus*[Title] OR foetus*[Title] OR prenatal*[Title] OR pre-natal*[Title]) AND expos*[Title]	10,858
112	"Prenatal Exposure Delayed Effects"[mesh]	33,016
111	(fetal[Other Term] OR foetal[Other Term] OR fetus*[Other Term] OR foetus*[Other Term]) AND develop*[Other Term]	2,531
110	(fetal[Title] OR foetal[Title] OR fetus*[Title] OR foetus*[Title]) AND develop*[Title]	8,734
109	"Fetal Development"[mesh:noexp]	9,246
108	antiretroviral*[Other Term] OR anti-retroviral*[Other Term] OR "anti-HIV"[Other Term] OR "anti-AIDS"[Other Term] OR "AIDS drug"[Other Term] OR "AIDS drugs"[Other Term]	7,307
107	(antiretroviral*[Title] OR anti-retroviral*[Title] OR "anti-HIV"[Title] OR "anti-AIDS"[Title] OR "AIDS drug"[Title] OR "AIDS drugs"[Title])	29,826
106	"Anti-Retroviral Agents"[mesh]	69,532
105	"Zika Virus Infection/prevention and control"[MeSH]	1,096
104	"Streptococcal Infections/prevention and control"[MeSH:noexp]	2,944
103	"Respiratory Syncytial Virus Infections/prevention and control"[MeSH Terms]	1,832
102	"Hepatitis E/prevention and control"[MeSH Terms]	346
101	"Cytomegalovirus Infections/prevention and control"[MeSH Terms]	3,130
100	antimalarial*[Other Term] OR anti-malarial*[Other Term]	2,577
99	antimalarial*[Title] OR anti-malarial*[Title]	8,562
98	Antimalarials[mesh]	28,226
97	"Malaria/prevention and control"[MeSH Terms]	17,528
96	(maternal[Other Term] OR pregnan*[Other Term]) AND (immunisation*[Other Term] OR immunization*[Other Term])	754
95	(maternal[Title] OR pregnan*[Title]) AND (immunisation*[Title] OR immunization*[Title])	1,153
94	(antibod*[Other Term] OR anti-bod*[Other Term]) AND transfer*[Other Term]	338
93	(antibod*[Title] OR anti-bod*[Title]) AND transfer*[Title]	1,620
92	immunit*[Other Term] AND maternally-acqui*[Other Term]	8
91	immunit*[Title] AND maternally-acqui*[Title]	8
90	immunit*[Other Term] AND transfer*[Other Term]	161
89	immunit*[Title] AND transfer*[Title]	882
88	"Immunity, Maternally-Acquired"[mesh]	5,842
87	"Immunization Programs"[mesh:noexp]	12,435
86	Immunization[mesh:noexp]	144,668
85	vaccin*[ti] OR vaccin*[ot]	220,223
84	"Viral Vaccines"[mesh]	132,729

Set #	Query	Results
83	"Vaccines, Live, Unattenuated"[mesh]	82
82	"Vaccines, Synthetic"[mesh]	31,589
81	"Vaccines, Inactivated"[mesh:noexp]	6,082
80	"Vaccines, Combined"[mesh]	10,562
79	"Vaccines, Attenuated"[mesh]	12,810
78	"Protozoan Vaccines"[mesh]	6,894
77	"Bacterial Vaccines"[mesh]	72,365
76	Vaccines[mesh:noexp]	25,746
75	Vaccination[mesh]	100,718
74	GAIA[Text Word] AND (alignment[Text Word] OR immunisation[Text Word] OR immunization[Text Word] OR safety[Text Word] OR pregnan*[Text Word])	35
73	"Global Alignment of Immunization Safety Assessment in Pregnancy"[tw] - Schema: all	0
72	AEFI[Other Term] AND adverse[Other Term]	68
71	AEFI[Title] AND adverse[Title]	35
70	adverse effect[Other Term] OR adverse effects[Other Term] OR adverse reaction[Other Term] OR adverse reactions[Other Term] OR adverse event[Other Term] OR adverse events[Other Term] OR adverse outcome[Other Term] OR adverse outcomes[Other Term]	17,729
69	adverse effect[Title] OR adverse effects[Title] OR adverse reaction[Title] OR adverse reactions[Title] OR adverse event[Title] OR adverse events[Title] OR adverse outcome[Title] OR adverse outcomes[Title]	31,848
68	safe[Other Term] OR safety[Other Term] OR side effect[Other Term] OR side effects[Other Term] OR undesirable effect[Other Term] OR undesirable effects[Other Term] OR treatment emergent[Other Term] OR tolerability[Other Term] OR toxicity[Other Term] OR adrs[Other Term]	98,171
67	safe[Title] OR safety[Title] OR side effect[Title] OR side effects[Title] OR undesirable effect[Title] OR undesirable effects[Title] OR treatment emergent[Title] OR tolerability[Title] OR toxicity[Title] OR adrs[Title]	296,710
66	("adverse effects"[MeSH Subheading]) OR (Complications[MeSH Subheading]) OR ("drug effects"[MeSH Subheading])	6,963,724
65	(drug[Title] OR drugs[Title] OR medicine[Title] OR medicines[Title] OR medication*[Title] OR pharmaceutical*[Title] OR pharma-ceutical*[Title]) AND expos*[Title]	4,387
64	"Drug-Related Side Effects and Adverse Reactions"[MeSH Terms]	127,437
63	(global[Title] OR international*[Title] OR world*[Title]) AND health*[Title]	27,778
62	Global Health[mesh]	53,845
61	#56 AND #60	8,450
60	#57 OR #58 OR #59	1,104,126
59	"high burden country"[Other Term] OR "high burden countries"[Other Term] OR "high-burden country"[Other Term] OR "high-burden countries"[Other Term] OR "countdown country"[Other Term] OR "countdown countries"[Other Term]	10
58	"high burden country"[Title/Abstract] OR "high burden countries"[Title/Abstract] OR "high-burden country"[Title/Abstract] OR "high-burden countries"[Title/Abstract] OR "countdown country"[Title/Abstract] OR "countdown countries"[Title/Abstract]	633

Set #	Query	Results
57	afghanistan[Text Word] OR albania[Text Word] OR algeria[Text Word] OR "american samoa"[Text Word] OR angola[Text Word] OR antigua[Text Word] OR barbuda[Text Word] OR argentina[Text Word] OR armenia[Text Word] OR armenian[Text Word] OR aruba[Text Word] OR azerbaijan[Text Word] OR bahrain[Text Word] OR bangladesh[Text Word] OR barbados[Text Word] OR belarus[Text Word] OR byelarus[Text Word] OR belorussia[Text Word] OR byelorussian[Text Word] OR belize[Text Word] OR "british honduras"[Text Word] OR benin[Text Word] OR dahomey[Text Word] OR bhutan[Text Word] OR bolivia[Text Word] OR "bosnia herzegovina"[Text Word] OR bosnia[Text Word] OR herzegovina[Text Word] OR botswana[Text Word] OR bechuanaland[Text Word] OR brazil[Text Word] OR brasil[Text Word] OR bulgaria[Text Word] OR "burkina faso"[Text Word] OR "burkina fasso"[Text Word] OR "upper volta"[Text Word] OR burundi[Text Word] OR urundi[Text Word] OR "cabo verde"[Text Word] OR "cape verde"[Text Word] OR cambodia[Text Word] OR kampuchea[Text Word] OR "khmer republic"[Text Word] OR cameroon[Text Word] OR cameron[Text Word] OR cameroun[Text Word] OR "central african republic"[Text Word] OR "ubangi shari"[Text Word] OR chad[Text Word] OR chile[Text Word] OR china[Text Word] OR colombia[Text Word] OR comoros[Text Word] OR "comoro islands"[Text Word] OR "iles comores"[Text Word] OR mayotte[Text Word] OR "democratic republic of the congo"[Text Word] OR "democratic republic congo"[Text Word] OR congo[Text Word] OR zaire[Text Word] OR "costa rica"[Text Word] OR "cote d'ivoire"[Text Word] OR "cote d' ivoire"[Text Word] OR "cote divoire"[Text Word] OR "cote d ivoire"[Text Word] OR "ivory coast"[Text Word] OR croatia[Text Word] OR cuba[Text Word] OR cyprus[Text Word] OR "czech republic"[Text Word] OR czechoslovakia[Text Word] OR djibouti[Text Word] OR "french somaliland"[Text Word] OR dominica[Text Word] OR "dominican republic"[Text Word] OR ecuador[Text Word] OR egypt[Text Word] OR "united arab republic"[Text Word] OR "el salvador"[Text Word] OR "equatorial guinea"[Text Word] OR "spanish guinea"[Text Word] OR eritrea[Text Word] OR estonia[Text Word] OR eswatini[Text Word] OR swaziland[Text Word] OR ethiopia[Text Word] OR fiji[Text Word] OR gabon[Text Word] OR "gabonese republic"[Text Word] OR gambia[Text Word] OR "georgia (republic)"[Text Word] OR georgian[Text Word] OR ghana[Text Word] OR "gold coast"[Text Word] OR gibraltar[Text Word] OR greece[Text Word] OR grenada[Text Word] OR guam[Text Word] OR guatemala[Text Word] OR guinea[Text Word] OR "guinea bissau"[Text Word] OR guyana[Text Word] OR "british guiana"[Text Word] OR haiti[Text Word] OR hispaniola[Text Word] OR honduras[Text Word] OR hungary[Text Word] OR india[Text Word] OR indonesia[Text Word] OR timor[Text Word] OR iran[Text Word] OR iraq[Text Word] OR "isle of man"[Text Word] OR jamaica[Text Word] OR jordan[Text Word] OR kazakhstan[Text Word] OR kazakh[Text Word] OR kenya[Text Word] OR "democratic people's republic of korea"[Text Word] OR "republic of korea"[Text Word] OR "north korea"[Text Word] OR "south korea"[Text Word] OR korea[Text Word] OR kosovo[Text Word] OR kyrgyzstan[Text Word] OR kirghizia[Text Word] OR kirgizstan[Text Word] OR "kyrgyz republic"[Text Word] OR kirghiz[Text Word] OR laos[Text Word] OR "lao pdr"[Text Word] OR "lao people's democratic republic"[Text Word] OR latvia[Text Word] OR lebanon[Text Word] OR lebanese republic[Text Word] OR lesotho[Text Word] OR basutoland[Text Word] OR	1,103,822

Set #	Query	Results
	liberia[Text Word] OR libya[Text Word] OR "libyan arab jamahiriya"[Text Word] OR lithuania[Text Word] OR macau[Text Word] OR macao[Text Word] OR republic of "north macedonia"[Text Word] OR macedonia[Text Word] OR madagascar[Text Word] OR "malagasy republic"[Text Word] OR malawi[Text Word] OR nyasaland[Text Word] OR malaysia[Text Word] OR "malay federation"[Text Word] OR "malaya federation"[Text Word] OR maldives[Text Word] OR "indian ocean islands"[Text Word] OR "indian ocean"[Text Word] OR mali[Text Word] OR malta[Text Word] OR micronesia[Text Word] OR "federated states of micronesia"[Text Word] OR kiribati[Text Word] OR "marshall islands"[Text Word] OR nauru[Text Word] OR "northern mariana islands"[Text Word] OR palau[Text Word] OR tuvalu[Text Word] OR mauritania[Text Word] OR mauritius[Text Word] OR mexico[Text Word] OR moldova[Text Word] OR moldovian[Text Word] OR mongolia[Text Word] OR montenegro[Text Word] OR morocco[Text Word] OR ifni[Text Word] OR mozambique[Text Word] OR "portuguese east africa"[Text Word] OR myanmar[Text Word] OR burma[Text Word] OR namibia[Text Word] OR nepal[Text Word] OR "netherlands antilles"[Text Word] OR nicaragua[Text Word] OR niger[Text Word] OR nigeria[Text Word] OR oman[Text Word] OR muscat[Text Word] OR pakistan[Text Word] OR panama[Text Word] OR "papua new guinea"[Text Word] OR "new guinea"[Text Word] OR paraguay[Text Word] OR peru[Text Word] OR philippines[Text Word] OR philipines[Text Word] OR phillipines[Text Word] OR phillippines[Text Word] OR poland[Text Word] OR "polish people's republic"[Text Word] OR portugal[Text Word] OR "portuguese republic"[Text Word] OR "puerto rico"[Text Word] OR romania[Text Word] OR russia[Text Word] OR "russian federation"[Text Word] OR ussr[Text Word] OR "soviet union"[Text Word] OR "union of soviet socialist republics"[Text Word] OR rwanda[Text Word] OR ruanda[Text Word] OR samoa[Text Word] OR "pacific islands"[Text Word] OR polynesia[Text Word] OR "samoan islands"[Text Word] OR "navigator island"[Text Word] OR "navigator islands"[Text Word] OR "sao tome and principe"[Text Word] OR "saudi arabia"[Text Word] OR senegal[Text Word] OR serbia[Text Word] OR seychelles[Text Word] OR "sierra leone"[Text Word] OR slovakia[Text Word] OR "slovak republic"[Text Word] OR slovenia[Text Word] OR melanesia[Text Word] OR "solomon island"[Text Word] OR "solomon islands"[Text Word] OR "norfolk island"[Text Word] OR "norfolk islands"[Text Word] OR somalia[Text Word] OR "south africa"[Text Word] OR "south sudan"[Text Word] OR "sri lanka"[Text Word] OR ceylon[Text Word] OR "saint kitts and nevis"[Text Word] OR "st. kitts and nevis"[Text Word] OR "saint lucia"[Text Word] OR "st. lucia"[Text Word] OR "saint Vincent and the grenadines"[Text Word] OR "saint vincent"[Text Word] OR "st. vincent"[Text Word] OR grenadines[Text Word] OR sudan[Text Word] OR suriname[Text Word] OR surinam[Text Word] OR "dutch guiana"[Text Word] OR "netherlands guiana"[Text Word] OR syria[Text Word] OR "syrian arab republic"[Text Word] OR tajikistan[Text Word] OR tadjikistan[Text Word] OR tadzhikistan[Text Word] OR tadzhik[Text Word] OR tanzania[Text Word] OR tanganyika[Text Word] OR thailand[Text Word] OR siam[Text Word] OR "timor leste"[Text Word] OR "east timor"[Text Word] OR togo[Text Word] OR "togolese republic"[Text Word] OR tonga[Text Word] OR "Trinidad and tobago"[Text Word] OR trinidad[Text Word] OR tobago[Text Word] OR tunisia[Text Word] OR turkey[Text Word] OR turkmenistan[Text Word] OR turkmen[Text Word] OR uganda[Text Word] OR	

Set #	Query	Results
	ukraine[Text Word] OR uruguay[Text Word] OR uzbekistan[Text Word] OR uzbek[Text Word] OR vanuatu[Text Word] OR "new hebrides"[Text Word] OR venezuela[Text Word] OR vietnam[Text Word] OR "viet nam"[Text Word] OR "middle east"[Text Word] OR "west bank"[Text Word] OR gaza[Text Word] OR palestine[Text Word] OR yemen[Text Word] OR yugoslavia[Text Word] OR zambia[Text Word] OR zimbabwe[Text Word] OR "northern rhodesia"[Text Word] OR "global south"[Text Word] OR "africa south of the sahara"[Text Word] OR "sub-saharan africa"[Text Word] OR "subsaharan africa"[Text Word] OR "africa, central"[Text Word] OR "central africa"[Text Word] OR "africa, northern"[Text Word] OR "north africa"[Text Word] OR "northern africa"[Text Word] OR magreb[Text Word] OR maghrib[Text Word] OR sahara[Text Word] OR "africa, southern"[Text Word] OR "southern africa"[Text Word] OR "africa, eastern"[Text Word] OR "east africa"[Text Word] OR "eastern africa"[Text Word] OR "africa, western"[Text Word] OR "west africa"[Text Word] OR "western africa"[Text Word] OR "west indies"[Text Word] OR caribbean[Text Word] OR "central america"[Text Word] OR "latin america"[Text Word] OR "south and central america"[Text Word] OR "south america"[Text Word] OR "asia, central"[Text Word] OR "central asia"[Text Word] OR "asia, northern"[Text Word] OR "north asia"[Text Word] OR "northern asia"[Text Word] OR "asia, southeastern"[Text Word] OR "southeastern asia"[Text Word] OR "south eastern asia"[Text Word] OR "southeast asia"[Text Word] OR "south east asia"[Text Word] OR "asia, western"[Text Word] OR "western asia"[Text Word] OR "europe, eastern"[Text Word] OR "east europe"[Text Word] OR "eastern europe"[Text Word] OR "developing country"[Text Word] OR "developing countries"[Text Word] OR "developing nation"[Text Word] OR "developing nations"[Text Word] OR "developing population"[Text Word] OR "developing populations"[Text Word] OR "developing world"[Text Word] OR "less developed country"[Text Word] OR "less developed countries"[Text Word] OR "less developed nation"[Text Word] OR "less developed nations"[Text Word] OR "less developed population"[Text Word] OR "less developed populations"[Text Word] OR "less developed world"[Text Word] OR "lesser developed country"[Text Word] OR "lesser developed countries"[Text Word] OR "lesser developed nation"[Text Word] OR "lesser developed nations"[Text Word] OR "lesser developed population"[Text Word] OR "lesser developed populations"[Text Word] OR "lesser developed world"[Text Word] OR "under developed country"[Text Word] OR "under developed countries"[Text Word] OR "under developed nation"[Text Word] OR "under developed nations"[Text Word] OR "under developed population"[Text Word] OR "under developed populations"[Text Word] OR "under developed world"[Text Word] OR "underdeveloped country"[Text Word] OR "underdeveloped countries"[Text Word] OR "underdeveloped nation"[Text Word] OR "underdeveloped nations"[Text Word] OR "underdeveloped population"[Text Word] OR "underdeveloped populations"[Text Word] OR "underdeveloped world"[Text Word] OR "middle income country"[Text Word] OR "middle income countries"[Text Word] OR "middle income nation"[Text Word] OR "middle income nations"[Text Word] OR "middle income population"[Text Word] OR "middle income populations"[Text Word] OR "low income country"[Text Word] OR "low income countries"[Text Word] OR "low income nation"[Text Word] OR "low income nations"[Text Word] OR "low income population"[Text Word] OR	

Set #	Query	Results
	"low income populations"[Text Word] OR "lower income country"[Text Word] OR "lower income countries"[Text Word] OR "lower income nation"[Text Word] OR "lower income nations"[Text Word] OR "lower income population"[Text Word] OR "lower income populations"[Text Word] OR "underserved country"[Text Word] OR "underserved countries"[Text Word] OR "underserved nation"[Text Word] OR "underserved nations"[Text Word] OR "underserved population"[Text Word] OR "underserved populations"[Text Word] OR "underserved world"[Text Word] OR "under served country"[Text Word] OR "under served countries"[Text Word] OR "under served nation"[Text Word] OR "under served nations"[Text Word] OR "under served population"[Text Word] OR "under served populations"[Text Word] OR "under served world"[Text Word] OR "deprived country"[Text Word] OR "deprived countries"[Text Word] OR "deprived nation"[Text Word] OR "deprived nations"[Text Word] OR "deprived population"[Text Word] OR "deprived populations"[Text Word] OR "deprived world"[Text Word] OR "poor country"[Text Word] OR "poor countries"[Text Word] OR "poor nation"[Text Word] OR "poor nations"[Text Word] OR "poor population"[Text Word] OR "poor populations"[Text Word] OR "poor world"[Text Word] OR "poorer country"[Text Word] OR "poorer countries"[Text Word] OR "poorer nation"[Text Word] OR "poorer nations"[Text Word] OR "poorer population"[Text Word] OR "poorer populations"[Text Word] OR "poorer world"[Text Word] OR "developing economy"[Text Word] OR "developing economies"[Text Word] OR "less developed economy"[Text Word] OR "less developed economics"[Text Word] OR "lesser developed economy"[Text Word] OR "lesser developed economies"[Text Word] OR "under developed economy"[Text Word] OR "under developed economies"[Text Word] OR "underdeveloped economy"[Text Word] OR "underdeveloped economies"[Text Word] OR "middle income economy"[Text Word] OR "middle income economies"[Text Word] OR "low income economy"[Text Word] OR "low income economies"[Text Word] OR "lower income economy"[Text Word] OR "lower income economies"[Text Word] OR "low gdp"[Text Word] OR "low gnp"[Text Word] OR "low gross domestic"[Text Word] OR "low gross national"[Text Word] OR "lower gdp"[Text Word] OR "lower gnp"[Text Word] OR "lower gross domestic"[Text Word] OR "lower gross national"[Text Word] OR lmic[Text Word] OR lmics[Text Word] OR "third world"[Text Word] OR "lami country"[Text Word] OR "lami countries"[Text Word] OR "transitional country"[Text Word] OR "transitional economies"[Text Word] OR "emerging economy"[Text Word] OR "emerging economies"[Text Word] OR "emerging nation"[Text Word] OR "emerging nations"[Text Word]	
56	#1 OR #55	39,866
55	#21 AND #54	39,859
54	#22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 OR #52 OR #53	850,027
53	"Product Surveillance, Postmarketing/statistics and numerical data"[MeSH Terms]	2,361
52	"Maternal Health Services/statistics and numerical data"[MeSH Terms]	7,290
51	"Maternal Exposure/statistics and numerical data"[MeSH Terms]	1,123
50	pharmacovigilan*[ti] OR pharmaco-vigilan*[ti] OR pharmacovigilan*[ot] OR pharmaco-vigilan*[ot]	3,751
49	"Product Surveillance, Postmarketing"[mesh:noexp]	7,553
48	"data system"[ti] OR "data systems"[ti] OR "information system"[ti] OR "information systems"[ti] OR "data system"[ot] OR "data systems"[ot] OR "information system"[ot] OR "information systems"[ot]	13,581

Set #	Query	Results
47	“Health Information Systems”[mesh]	1,546
46	(decision*[ti] AND support*[ti] AND clinical*[ti]) OR (decision*[ot] AND support*[ot] AND clinical*[ot])	4,467
45	“Decision Support Systems, Clinical”[mesh]	9,106
44	“Databases, Factual”[mesh]	163,862
43	“Databases as Topic”[mesh:noexp]	9,688
42	surveillance*[ti] OR surveillance*[ot]	61,304
41	“Population Surveillance”[mesh]	74,026
40	survey*[ti] OR survey*[ot]	189,840
39	“Health Surveys”[mesh:noexp]	66,266
38	“Health Care Surveys”[MeSH Major Topic]	10,167
37	“Surveys and Questionnaires”[MeSH Major Topic:noexp]	49,876
36	registry[ot] OR registries[ot] OR eregistr*[ot] OR “e-registry”[ot] OR “e-registries”[ot]	8,509
35	registry[ti] OR registries[ti] OR eregistr*[ti] OR “e-registry”[ti] OR “e-registries”[ti]	34,311
34	Registries[mesh:noexp]	104,749
33	(preliminary[ot] OR “pilot project”[ot] OR “pilot projects”[ot]) AND data[ot]	35
32	(preliminary[ti] OR “pilot project”[ti] OR “pilot projects”[ti]) AND data[ti]	2,947
31	“Preliminary Data”[mesh]	724
30	“focus group”[ti] OR “focus groups”[ti] OR “focus group”[ot] OR “focus groups”[ot]	6,048
29	“Focus Groups”[mesh]	34,384
28	databas*[ot] OR “data base”[ot] OR “data bases”[ot] OR databank*[ot] OR “data bank”[ot] OR “data banks”[ot] OR dataset*[ot] OR “data set”[ot] OR “data sets”[ot]	14,502
27	databas*[ti] OR “data base”[ti] OR “data bases”[ti] OR databank*[ti] OR “data bank”[ti] OR “data banks”[ti] OR dataset*[ti] OR “data set”[ti] OR “data sets”[ti]	55,119
26	“Datasets as Topic”[mesh]	7,252
25	data[ot] AND (accumulat*[ot] OR accura*[ot] OR assembl*[ot] OR captur*[ot] OR collect*[ot] OR compil*[ot] OR coordinat*[ot] OR co-ordinat*[ot] OR gather*[ot] OR hub[ot] OR hubs[ot])	5,205
24	data[ti] AND (accumulat*[ti] OR accura*[ti] OR assembl*[ti] OR captur*[ti] OR collect*[ti] OR compil*[ti] OR coordinat*[ti] OR co-ordinat*[ti] OR gather*[ti] OR hub[ti] OR hubs[ti])	11,365
23	“Data Accuracy”[mesh]	3,726
22	“Data Collection”[mesh:noexp]	91,761
21	#2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20	1,067,642
20	maternal[ot] AND (fetal[ot] OR fetus[ot] OR foetal[ot] OR foetus[ot])	3,848
19	(maternal*[ot] OR maternity[ot]) AND (care[ot] OR health*[ot] OR service[ot] OR services[ot])	11,210
18	(maternal*[ot] or maternity[ot]) AND (contact*[ot] or expos*[ot])	601
17	perinatal*[ot] OR “peri-natal”[ot] OR “peri-natally”[ot] OR peripartum[ot] or “peri-partum”[ot]	7,552
16	prenatal*[ot] OR antenatal*[ot] OR “ante-natal”[ot] OR “ante-natally”[ot] OR antepartum[ot] or “ante-partum”[ot]	15,862

Set #	Query	Results
15	maternal[ti] AND (fetal[ti] OR fetus[ti] OR foetal[ti] OR foetus[ti])	13,964
14	(maternal*[ti] OR maternity[ti]) AND (care[ti] OR health*[ti] OR service[ti] OR services[ti])	13,467
13	"Maternal Health Services"[mesh:noexp]	15,617
12	(maternal*[ti] or maternity[ti]) AND (contact*[ti] or expos*[ti])	3,847
11	"Maternal Exposure"[mesh]	10,689
10	perinatal*[ti] OR "peri-natal"[ti] OR "peri-natally"[ti] OR peripartum[ti] or "peri-partum"[ti]	30,982
9	"Perinatal Care"[mesh]	11,334
8	prenatal*[ti] OR antenatal*[ti] OR "ante-natal"[ti] OR "ante-natally"[ti] OR antepartum[ti] or "ante-partum"[ti]	59,414
7	"Prenatal Care"[mesh]	31,249
6	pregnan*[ti]	252,201
5	"Pregnancy Trimesters"[mesh]	43,874
4	"Pregnant Women"[mesh]	12,334
3	"Pregnancy Complications"[mesh]	460,551
2	Pregnancy[mesh]	970,546
1	"pregnancy exposure database" [tw] OR "pregnancy exposure databases" [tw] OR "pregnancy exposure data base" [tw] OR "pregnancy exposure data bases" [tw] OR "pregnancy exposure registry" [tw] OR "pregnancy exposure registries" [tw]	34

6.1.2. Embase

1	("pregnancy exposure database" or "pregnancy exposure databases" or "pregnancy exposure data base" or "pregnancy exposure data bases" or "pregnancy exposure registry" or "pregnancy exposure registries").tw,kw,kf. (113)
2	exp pregnancy/ (727815)
3	exp pregnancy complication/ (141579)
4	exp named groups by pregnancy/ (130431)
5	pregnan*.ti,kw,kf. (329712)
6	exp prenatal care/ (167165)
7	(prenatal* or antenatal* or "ante-natal" or "ante-natally" or antepartum or "ante-partum").ti,kw,kf. (87488)
8	exp perinatal care/ (65235)
9	(perinatal* or peri-natal* or peripartum or "peri-partum").ti,kw,kf. (46195)
10	maternal exposure/ (3606)
11	((maternal* or maternity) and (contact* or expos*)).ti,kw,kf. (6357)
12	maternal health service/ (2454)
13	((maternal* or maternity) and (care or health* or service or services)).ti,kw,kf. (22738)
14	(maternal and (fetal or fetus or foetal or foetus)).ti,kw,kf. (20741)
15	or/2-14 [PREGNANCY] (1035932)

16 *information processing/ (37078)
17 data aggregation/ (374)
18 data accuracy/ (1596)
19 (data and (accumulat* or accura* or assembl* or captur* or collect* or compil* or coordinat* or co-ordinat* or gather* or hub or hubs)).ti,kw,kf. (18259)
20 (databas* or “data base” or “data bases” or databank* or “data bank” or “data banks” or dataset* or “data set” or “data sets”).ti,kw,kf. (86633)
21 (focus group or focus groups).ti,kw,kf. (7608)
22 preliminary data/ (31472)
23 ((preliminary or pilot project or pilot projects) and data).ti,kw,kf. (5481)
24 exp register/ (180900)
25 (registry or registries or eregistr* or “e-registry” or “e-registries”).ti,kw,kf. (68347)
26 questionnaire/ (814172)
27 *health care survey/ (2606)
28 health survey/ (213987)
29 survey*.ti,kw,kf. (220889)
30 population surveillance/ (117)
31 surveillance*.ti,kw,kf. (82221)
32 data base/ (248533)
33 factual database/ (27912)
34 clinical decision support system/ (4716)
35 (decision* and support* and clinical*).ti,kw,kf. (5904)
36 medical information system/ (22591)
37 (“data system” or “data systems” or “information system” or “information systems”).ti,kw,kf. (18222)
38 exp postmarketing surveillance/ (37924)
39 (pharmacovigilan* or pharmaco-vigilan*).ti,kw,kf. (7417)
40 or/16-39 [DATA COLLECTION, REGISTRIES] (1815231)
41 15 and 40 [PREGNANCY - DATA COLLECTION, REGISTRIES] (71373)
42 1 or 41 [PERs, PREGNANCY - DATA COLLECTION, REGISTRIES] (71381)

43 (afghanistan or albania or algeria or american samoa or angola or “antigua and barbuda” or antigua or barbuda or argentina or armenia or armenian or aruba or azerbaijan or bahrain or bangladesh or barbados or republic of belarus or belarus or byelarus or belorussia or byelorussian or belize or british honduras or benin or dahomey or bhutan or bolivia or “bosnia and herzegovina” or bosnia or herzegovina or botswana or bechuanaland or brazil or brasil or bulgaria or burkina faso or burkina fasso or upper volta or burundi or urundi or cabo verde or cape verde or cambodia or kampuchea or khmer republic or cameroon or cameron or cameroun or central african republic or ubangi shari or chad or chile or china or colombia or comoros or comoro islands or iles comores or mayotte or democratic republic of the congo or democratic republic congo or congo or zaire or costa rica or “cote d’ivoire” or “cote d’ ivoire” or cote divoire or cote d ivoire or ivory coast or croatia or cuba or cyprus or czech republic or czechoslovakia or djibouti or french somaliland or dominica or dominican republic or ecuador or egypt or united arab republic or el salvador or equatorial guinea or spanish guinea or eritrea or estonia or eswatini or swaziland or ethiopia or fiji or gabon or gabonese republic or gambia or “georgia (republic)” or georgian or ghana or gold coast or gibraltar or greece or grenada or guam or guatemala or guinea or guinea bissau or guyana or british guiana or haiti or hispaniola or honduras or hungary or india or indonesia or timor or iran or iraq or isle of man or jamaica or jordan or kazakhstan or kazakh or kenya or “democratic people’s republic of korea” or republic of korea or north korea or south korea or korea or kosovo or kyrgyzstan or kirghizia or kirgizstan or kyrgyz republic or kirghiz or laos or lao pdr or “lao people’s democratic republic” or latvia or lebanon or lebanese republic or lesotho or basutoland or liberia or libya or libyan arab jamahiriya or lithuania or macau or macao or republic of north macedonia or macedonia or madagascar or malagasy republic or malawi or nyasaland or malaysia or malay federation or malaya federation or maldives or indian ocean islands or indian ocean or mali or malta or micronesia or federated states of micronesia or kiribati or marshall islands or nauru or northern mariana islands or palau or tuvalu or mauritania or mauritius or mexico or moldova or moldovian or mongolia or montenegro or “montenegro (republic)” or morocco or ifni or mozambique or portuguese east africa or myanmar or burma or namibia or nepal or netherlands antilles or nicaragua or niger or nigeria or oman or muscat or pakistan or panama or papua new guinea or new guinea or paraguay or peru or philippines or philipines or phillipines or phillippines or poland or “polish people’s republic” or portugal or portuguese republic or puerto rico or romania or russia or russian federation or ussr or soviet union or union of soviet socialist republics or rwanda or ruanda or samoa or pacific islands or polynesia or samoan islands or navigator island or navigator islands or “sao tome and principe” or saudi arabia or senegal or serbia or seychelles or sierra leone or slovakia or slovak republic or slovenia or melanesia or solomon island or solomon islands or norfolk island or norfolk islands or somalia or south africa or south sudan or sri lanka or ceylon or “saint kitts and nevis” or “st. kitts and nevis” or saint lucia or “st. lucia” or “saint vincent and the grenadines” or saint vincent or “st. vincent” or grenadines or sudan or suriname or surinam or dutch guiana or netherlands guiana or syria or syrian arab republic or tajikistan or tadjikistan or tadzhikistan or tadzhik or tanzania or tanganyika or thailand or siam or timor leste or east timor or togo or togolese republic or tonga or “trinidad and tobago” or trinidad or tobago or tunisia or “turkey (republic)” or turkey or turkmenistan or turkmen or uganda or ukraine or uruguay or uzbekistan or uzbek or vanuatu or new hebrides or venezuela or vietnam or viet nam or middle east or west bank or gaza or palestine or yemen or yugoslavia or zambia or zimbabwe or northern rhodesia or global south

or africa south of the sahara or "sub saharan africa" or subsaharan africa or africa, central or central africa or africa, northern or north africa or northern africa or magreb or maghrib or sahara or africa, southern or southern africa or africa, eastern or east africa or eastern africa or africa, western or west africa or western africa or west indies or indian ocean islands or caribbean region or caribbean islands or caribbean or central america or latin america or "south and central america" or south america or asia, central or central asia or asia, northern or north asia or northern asia or asia, southeastern or southeastern asia or south eastern asia or southeast asia or south east asia or asia, western or western asia or europe, eastern or east europe or eastern europe or developing country or developing countries or developing nation? or developing population? or developing world or less developed countr* or less developed nation? or less developed population? or less developed world or lesser developed countr* or lesser developed nation? or lesser developed population? or lesser developed world or under developed countr* or under developed nation? or under developed population? or under developed world or underdeveloped countr* or underdeveloped nation? or underdeveloped population? or underdeveloped world or middle income countr* or middle income nation? or middle income population? or low income countr* or low income nation? or low income population? or lower income countr* or lower income nation? or lower income population? or underserved countr* or underserved nation? or underserved population? or underserved world or under served countr* or under served nation? or under served population? or under served world or deprived countr* or deprived nation? or deprived population? or deprived world or poor countr* or poor nation? or poor population? or poor world or poorer countr* or poorer nation? or poorer population? or poorer world or developing econom* or less developed econom* or lesser developed econom* or under developed econom* or underdeveloped econom* or middle income econom* or low income econom* or lower income econom* or low gdp or low gnp or low gross domestic or low gross national or lower gdp or lower gnp or lower gross domestic or lower gross national or lmic or lmics or third world or lami countr* or transitional countr* or emerging economies or emerging nation?).ti,ab,sh,kw. (2517925)

44 ("high burden country" or "high burden countries" or "high-burden country" or "high-burden countries" or "countdown country" or "countdown countries").ti,ab,kw,kf. (808)

45 43 or 44 [LMICs] (2518149)

46 42 and 45 [PERs, PREGNANCY - DATA COLLECTION, REGISTRIES - LMICs] (18846)

47 global health/ (16219)

48 ((global or international* or world*) and health*).ti,kw,kf. (45947)

49 exp adverse drug reaction/ (586248)

50 ((drug or drugs or medicine or medicines or medication* or pharmaceutical* or pharma-ceutical*) and expos*).ti,kw,kf. (9329)

51 (ae or co).fs. (2915988)

52 (safe or safety or side effect or side effects or undesirable effect or undesirable effects or treatment emergent or tolerability or toxicity or adrs).ti,kw,kf. (514988)

53 (adverse effect or adverse effects or adverse reaction or adverse reactions or adverse event or adverse events or adverse outcome or adverse outcomes).ti,kw,kf. (70731)

54 (AEFI and adverse).ti,kw,kf. (157)

55 "Global Alignment of Immuni#ation Safety Assessment in Pregnancy".tw,kw,kf. (20)

56 (GAIA and (alignment or immuni#ation or safety or pregnan*)).tw,kw,kf. (71)

57 exp vaccination/ (205483)

58 vaccine/ (67719)

59 exp bacterial vaccine/ or exp cell-based vaccine/ or conjugate vaccine/ or edible vaccine/ or exp fungus vaccine/ or exp inactivated vaccine/ or live vaccine/ or exp meningitis vaccine/ or exp nucleic acid vaccine/ or exp parasite vaccine/ or exp peptide vaccine/ or protein vaccine/ or exp subunit vaccine/ or exp toxoid vaccine/ or exp vector vaccine/ or virosome vaccine/ or exp virus vaccine/ (304544)

60 vaccin*.ti,kw,kf. (251220)

61 immunization/ (104541)

62 passive immunization/ (12623)

63 (immunit* and transfer*).ti,kw,kf. (1262)

64 (immunit* and (maternally-acqui* or passive*)).ti,kw,kf. (766)

65 ((antibod* or anti-bod*) and transfer*).ti,kw,kf. (2375)

66 ((maternal or pregnan*) and immuni#ation*).ti,kw,kf. (1766)

67 exp malaria/pc [Prevention] (14654)

68 exp antimalarial agent/ (161880)

69 (antimalarial* or anti-malarial*).ti,kw,kf. (11586)

70 exp cytomegalovirus infection/pc [Prevention] (5146)

71 respiratory syncytial virus infection/pc [Prevention] (1057)

72 exp Streptococcus infection/pc [Prevention] (10568)

73 exp Zika fever/pc [Prevention] (780)

74 exp antiretrovirus agent/ (216196)

75 (antiretroviral* or anti-retroviral* or “anti-HIV” or “anti-AIDS” or “AIDS drug” or “AIDS drugs”).ti,kw,kf. (46286)

76 exp fetus development/ (29871)

77 ((fetal or foetal or fetus* or foetus*) and develop*).ti,kw,kf. (14926)

78 exp prenatal exposure/ (37294)

79 ((fetal or foetal or fetus* or foetus* or prenatal* or pre-natal*) and expos*).ti,kw,kf. (16619)

80 pregnancy outcome/ (72177)

81 ((birth or births or matern* or neonat* or neo-nat* or perinatal* or peri-natal*or peripartum or “peri-partum” or postnatal* or post-natal* or postpartum or “post-partum” or post-birth* or pregnanc*) and outcome*).ti,kw,kf. (55800)

82 ((birth or births) and defect*).ti,kw,kf. (4849)

83 child health/ (32206)

84 maternal welfare/ (15842)

85 (MNCH and (maternal* or newborn* or child*)).ti,kw,kf. (49)

86 or/47-85 [DRUGS, VACCINES, SAFETY, OUTCOMES] (4592324)

87 46 and 86 [PERs, PREGNANCY - DATA COLLECTION, REGISTRIES - LMICs - DRUGS, VACCINES, SAFETY, OUTCOMES] (5663)

88 exp animal/ or exp animal experimentation/ or exp animal model/ or exp animal experiment/ or nonhuman/ or exp vertebrate/ (30677570)

89 exp human/ or exp human experimentation/ or exp human experiment/ (23737031)

90 88 not 89 (6941713)

91 87 not 90 [ANIMAL-ONLY REMOVED] (5643)

92 editorial.pt. (729310)

93 91 not 92 [EDITORIALS REMOVED] (5614)

94 limit 93 to yr=”2000-current” (5299)

6.1.3. CINAHL

#	Query	Results
S92	S90 and S91	878
S91	DT 2000 - 2022	7,386,209
S90	S88 NOT S89	885
S89	PT editorial or opinion or commentary	684,750
S88	S45 AND S87	891
S87	S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55 OR S56 OR S57 OR S58 OR S59 OR S60 OR S61 OR S62 OR S63 OR S64 OR S65 OR S66 OR S67 OR S68 OR S69 OR S70 OR S71 OR S72 OR S73 OR S74 OR S75 OR S76 OR S77 OR S78 OR S79 OR S80 OR S81 OR S82 OR S83 OR S84 OR S85 OR S86	354,157
S86	TI (MNCH AND (maternal* OR newborn* OR child*))	17
S85	(MH "Maternal-Child Health")	3,727
S84	(MH "Child Health")	17,073
S83	TI (birth OR births) and defect*	969
S82	TI (birth OR births OR matern* OR neonat* OR neo-nat* OR perinatal* OR peri-natal* OR peripartum OR "peri-partum" OR postnatal* OR post-natal* OR postpartum OR "post-partum" OR post-birth* OR pregnanc*) AND outcome*	17,343
S81	(MH "Pregnancy Outcomes")	27,127
S80	TI (fetal OR foetal OR fetus* OR foetus* or prenatal* or pre-natal*) AND expos*	2,603
S79	(MH "Prenatal Exposure Delayed Effects")	6,314
S78	TI (fetal OR foetal OR fetus* OR foetus*) AND develop*	1,028
S77	(MH "Fetal Development")	7,851
S76	TI antiretroviral* OR anti-retroviral* OR "anti-HIV" OR "anti-AIDS" OR "AIDS drug" OR "AIDS drugs"	9,126
S75	(MH "Anti-Retroviral Agents+")	24,911
S74	(MH "Zika Virus Infections/PC")	168
S73	(MH "Streptococcal Infections+/PC")	2,280
S72	(MH "Respiratory Syncytial Virus Infections/PC")	583
S71	(MH "Hepatitis E/PC")	69
S70	(MH "Cytomegalovirus Infections+/PC")	509
S69	TI antimalarial* or (anti W0 malarial*)	714
S68	(MH "Antimalarials+")	8,320
S67	(MH "Malaria/PC")	3,293
S66	TI (maternal* or pregnan*) and immuni?ation*	253
S65	TI ((antibod* or (anti W0 bod*)) and transfer*)	79
S64	TI immunit* AND (passive* or "maternally-acquired")	13
S63	TI immunit* AND transfer*	16
S62	(MH "Immunity, Maternally Acquired")	232
S61	(MH "Immunization Programs")	6,426
S60	(MH "Viral Vaccines+")	36,206
S59	(MH "Vaccines, Combined+")	3,562

#	Query	Results
S58	(MH "Toxoids+")	2,372
S57	(MH "Bacterial Vaccines+")	10,296
S56	(MH "Vaccines")	9,533
S55	(MH "Immunization+")	31,914
S54	TI (GAIA AND (alignment or immuni?ation or safety or pregnan*)) OR AB (GAIA AND (alignment or immuni?ation or safety or pregnan*))	6
S53	TI ("Global Alignment of Immunisation Safety Assessment in Pregnancy" or "Global Alignment of Immunization Safety Assessment in Pregnancy") OR AB ("Global Alignment of Immunisation Safety Assessment in Pregnancy" or "Global Alignment of Immunization Safety Assessment in Pregnancy")	0
S52	TI AEFI and adverse	5
S51	TI "adverse effect" or "adverse effects" or "adverse reaction" or "adverse reactions" or "adverse event" or "adverse events" or "adverse outcome" or "adverse outcomes"	12,615
S50	TI safe or safety or "side effect" or "side effects" or "undesirable effect" or "undesirable effects" or "treatment emergent" or tolerability or toxicity or adrs	113,937
S49	TI (drug or drugs or medicine or medicines or medication* or pharmaceutical* or pharma-ceutical*) AND expos*	1,420
S48	(MH "Adverse Drug Event")	16,207
S47	TI (global or international* or world*) and health*	22,194
S46	(MH "World Health")	29,391
S45	S39 AND S44	4,402
S44	S40 OR S41 OR S42 OR S43	379,212
S43	TI ("high burden country" or "high burden countries" or "high-burden country" or "high-burden countries" or "countdown country" or "countdown countries") OR AB ("high burden country" or "high burden countries" or "high-burden country" or "high-burden countries" or "countdown country" or "countdown countries")	188

#	Query	Results
S42	TI ("developing country" or "developing countries" or "developing nation" or "developing nations" or "developing population" or "developing populations" or "developing world" or "less developed country" or "less developed countries" or "less developed nation" or "less developed nations" or "less developed population" or "less developed populations" or "less developed world" or "lesser developed country" or "lesser developed countries" or "lesser developed nation" or "lesser developed nations" or "lesser developed population" or "lesser developed populations" or "lesser developed world" or "under developed country" or "under developed countries" or "under developed nation" or "under developed nations" or "under developed population" or "under developed populations" or "under developed world" or "underdeveloped country" or "underdeveloped countries" or "underdeveloped nation" or "underdeveloped nations" or "underdeveloped population" or "underdeveloped populations" or "underdeveloped world" or "middle income country" or "middle income countries" or "middle income nation" or "middle income nations" or "middle income population" or "middle income populations" or "low income country" or "low income countries" or "low income nation" or "low income nations" or "low income population" or "low income populations" or "lower income country" or "lower income countries" or "lower income nation" or "lower income nations" or "lower income population" or "lower income populations" or "underserved country" or "underserved countries" or "underserved nation" or "underserved nations" or "underserved population" or "underserved populations" or "underserved world" or "under served country" or "under served countries" or "under served nation" or "under served nations" or "under served population" or "under served populations" or "under served world" or "deprived country" or "deprived countries" or "deprived nation" or "deprived nations" or "deprived population" or "deprived populations" or "deprived world" or "poor country" or "poor countries" or "poor nation" or "poor nations" or "poor population" or "poor populations" or "poor world" or "poorer country" or "poorer countries" or "poorer nation" or "poorer nations" or "poorer population" or "poorer populations" or "poorer world" or "developing economy" or "developing economies" or "less developed economy" or "less developed economics" or "lesser developed economy" or "lesser developed economies" or "under developed economy" or "under developed economies" or "underdeveloped economy" or "underdeveloped economies" or "middle income economy" or "middle income economies" or "low income economy" or "low income economies" or "lower income economy" or "lower income economies" or "low gdp" or "low gnp" or "low gross domestic" or "low gross national" or "lower gdp" or "lower gnp" or "lower gross domestic" or "lower gross national" or lmic or lmics or “third world” or “lami country” or “lami countries” or “transitional country” or “transitional economies” or “emerging economy” or “emerging economies” or “emerging nation” or “emerging nations”) OR AB (“developing country” or “developing countries” or “developing nation” or “developing nations” or “developing population” or “developing populations” or “developing world” or “less developed country” or “less developed countries” or “less developed nation” or “less developed nations” or “less developed population” or “less developed populations” or “less developed world”	39,219

#	Query	Results
	or “lesser developed country” or “lesser developed countries” or “lesser developed nation” or “lesser developed nations” or “lesser developed population” or “lesser developed populations” or “lesser developed world” or “under developed country” or “under developed countries” or “under developed nation” or “under developed nations” or “under developed population” or “under developed populations” or “under developed world” or “underdeveloped country” or “underdeveloped countries” or “underdeveloped nation” or “underdeveloped nations” or “underdeveloped population” or “underdeveloped populations” or “underdeveloped world” or “middle income country” or “middle income countries” or “middle income nation” or “middle income nations” or “middle income population” or “middle income populations” or “low income country” or “low income countries” or “low income nation” or “low income nations” or “low income population” or “low income populations” or “lower income country” or “lower income countries” or “lower income nation” or “lower income nations” or “lower income population” or “lower income populations” or “underserved country” or “underserved countries” or “underserved nation” or “underserved nations” or “underserved population” or “underserved populations” or “underserved world” or “under served country” or “under served countries” or “under served nation” or “under served nations” or “under served population” or “under served populations” or “under served world” or “deprived country” or “deprived countries” or “deprived nation” or “deprived nations” or “deprived population” or “deprived populations” or “deprived world” or “poor country” or “poor countries” or “poor nation” or “poor nations” or “poor population” or “poor populations” or “poor world” or “poorer country” or “poorer countries” or “poorer nation” or “poorer nations” or “poorer population” or “poorer populations” or “poorer world” or “developing economy” or “developing economies” or “less developed economy” or “less developed economics” or “lesser developed economy” or “lesser developed economies” or “under developed economy” or “under developed economies” or “underdeveloped economy” or “underdeveloped economies” or “middle income economy” or “middle income economies” or “low income economy” or “low income economies” or “lower income economy” or “lower income economies” or “low gdp” or “low gnp” or “low gross domestic” or “low gross national” or “lower gdp” or “lower gnp” or “lower gross domestic” or “lower gross national” or lmic or lmics or “third world” or “lami country” or “lami countries” or “transitional country” or “transitional economies” or “emerging economy” or “emerging economies” or “emerging nation” or “emerging nations”)	

#	Query	Results
S41	TI (mali or malta or micronesia or "federated states of micronesia" or kiribati or "marshall islands" or nauru or "northern mariana islands" or palau or tuvalu or mauritania or mauritius or mexico or moldova or moldovian or mongolia or montenegro or morocco or ifni or mozambique or "portuguese east africa" or myanmar or burma or namibia or nepal or "netherlands antilles" or nicaragua or niger or nigeria or oman or muscat or pakistan or panama or "papua new guinea" or "new guinea" or paraguay or peru or philippines or philipines or phillipines or phillippines or poland or "polish people's republic" or portugal or "portuguese republic" or "puerto rico" or romania or russia or "russian federation" or ussr or "soviet union" or "union of soviet socialist republics" or rwanda or ruanda or samoa or "pacific islands" or polynesia or "samoan islands" or "navigator island" or "navigator islands" or "sao tome and principe" or "saudi arabia" or senegal or serbia or seychelles or "sierra leone" or slovakia or "slovak republic" or slovenia or melanesia or "solomon island" or "solomon islands" or "norfolk island" or "norfolk islands" or somalia or "south africa" or "south sudan" or "sri lanka" or ceylon or "saint kitts and nevis" or "st. kitts and nevis" or "saint lucia" or "st. lucia" or "saint Vincent and the grenadines" or "saint vincent" or "st. vincent" or grenadines or sudan or suriname or surinam or "dutch guiana" or "netherlands guiana" or syria or "syrian arab republic" or tajikistan or tadjikistan or tadzhikistan or tadzhik or tanzania or tanganyika or thailand or siam or "timor leste" or "east timor" or togo or "togolese republic" or tonga or "Trinidad and tobago" or trinidad or tobago or tunisia or turkey or turkmenistan or turkmen or uganda or ukraine or uruguay or uzbekistan or uzbek or vanuatu or "new hebrides" or venezuela or vietnam or "viet nam" or "middle east" or "west bank" or gaza or palestine or yemen or yugoslavia or zambia or zimbabwe or "northern rhodesia" or "global south" or "africa south of the sahara" or "sub-saharan africa" or "subsaharan africa" or "africa, central" or "central africa" or "africa, northern" or "north africa" or "northern africa" or magreb or maghrib or sahara or "africa, southern" or "southern africa" or "africa, eastern" or "east africa" or "eastern africa" or "africa, western" or "west africa" or "western africa" or "west indies" or caribbean or "central america" or "latin america" or "south and central america" or "south america" or "asia, central" or "central asia" or "asia, northern" or "north asia" or "northern asia" or "asia, southeastern" or "southeastern asia" or "south eastern asia" or "southeast asia" or "south east asia" or "asia, western" or "western asia" or "europe, eastern" or "east europe" or "eastern europe") OR AB (mali or malta or micronesia or "federated states of micronesia" or kiribati or "marshall islands" or nauru or "northern mariana islands" or palau or tuvalu or mauritania or mauritius or mexico or moldova or moldovian or mongolia or montenegro or morocco or ifni or mozambique or "portuguese east TI (mali or malta or micronesia or “federated states of micronesia” or kiribati or “marshall islands” or nauru or “northern mariana islands” or palau or tuvalu or mauritania or mauritius or mexico or moldova or moldovian or mongolia or montenegro or morocco or ifni or mozambique or “portuguese east africa” or myanmar or burma or namibia or nepal or “netherlands antilles” or nicaragua or niger or nigeria or oman or muscat or pakistan or panama or “papua new guinea” or “new guinea” or paraguay or peru or philippines or philipines or phillipines or phillippines or	148,518

#	Query	Results
	poland or “polish people’s republic” or portugal or “portuguese republic” or “puerto rico” or romania or russia or “russian federation” or ussr or “soviet union” or “union of soviet socialist republics” or rwanda or ruanda or samoa or “pacific islands” or polynesia or “samoan islands” or “navigator island” or “navigator islands” or “sao tome and principe” or “saudi arabia” or senegal or serbia or seychelles or “sierra leone” or slovakia or “slovak republic” or slovenia or melanesia or “solomon island” or “solomon islands” or “norfolk island” or “norfolk islands” or somalia or “south africa” or “south sudan” or “sri lanka” or ceylon or “saint kitts and nevis” or “st. kitts and nevis” or “saint lucia” or “st. lucia” or “saint Vincent and the grenadines” or “saint vincent” or “st. vincent” or grenadines or sudan or suriname or surinam or “dutch guiana” or “netherlands guiana” or syria or “syrian arab republic” or tajikistan or tadjikistan or tadzhikistan or tadzhik or tanzania or tanganyika or thailand or siam or “timor leste” or “east timor” or togo or “togolese republic” or tonga or “Trinidad and tobago” or trinidad or tobago or tunisia or turkey or turkmenistan or turkmen or uganda or ukraine or uruguay or uzbekistan or uzbek or vanuatu or “new hebrides” or venezuela or vietnam or “viet nam” or “middle east” or “west bank” or gaza or palestine or yemen or yugoslavia or zambia or zimbabwe or “northern rhodesia” or “global south” or “africa south of the sahara” or “sub-saharan africa” or “subsaharan africa” or “africa, central” or “central africa” or “africa, northern” or “north africa” or “northern africa” or magreb or maghrib or sahara or “africa, southern” or “southern africa” or “africa, eastern” or “east africa” or “eastern africa” or “africa, western” or “west africa” or “western africa” or “west indies” or caribbean or “central america” or “latin america” or “south and central america” or “south america” or “asia, central” or “central asia” or “asia, northern” or “north asia” or “northern asia” or “asia, southeastern” or “southeastern asia” or “south eastern asia” or “southeast asia” or “south east asia” or “asia, western” or “western asia” or “europe, eastern” or “east europe” or “eastern europe”) OR AB (mali or malta or micronesia or “federated states of micronesia” or kiribati or “marshall islands” or nauru or “northern mariana islands” or palau or tuvalu or mauritania or mauritius or mexico or moldova or moldovian or mongolia or montenegro or morocco or ifni or mozambique or “portuguese east africa” or myanmar or burma or namibia or nepal or “netherlands antilles” or nicaragua or niger or nigeria or oman or muscat or pakistan or panama or “papua new guinea” or “new guinea” or paraguay or peru or philippines or philipines or phillipines or phillippines or poland or “polish people’s republic” or portugal or “portuguese republic” or “puerto rico” or romania or russia or “russian federation” or ussr or “soviet union” or “union of soviet socialist republics” or rwanda or ruanda or samoa or “pacific islands” or polynesia or “samoan islands” or “navigator island” or “navigator islands” or “sao tome and principe” or “saudi arabia” or senegal or serbia or seychelles or “sierra leone” or slovakia or “slovak republic” or slovenia or melanesia or “solomon island” or “solomon islands” or “norfolk island” or “norfolk islands” or somalia or “south africa” or “south sudan” or “sri lanka” or ceylon or “saint kitts and nevis” or “st. kitts and nevis” or “saint lucia” or “st. lucia” or “saint Vincent and the grenadines” or “saint vincent” or “st. vincent” or grenadines or sudan or suriname or surinam or “dutch guiana” or “netherlands guiana” or syria	

#	Query	Results
	or “syrian arab republic” or tajikistan or tadjikistan or tadzhikistan or tadzhik or tanzania or tanganyika or thailand or siam or “timor leste” or “east timor” or togo or “togolese republic” or tonga or “Trinidad and tobago” or trinidad or tobago or tunisia or turkey or turkmenistan or turkmen or uganda or ukraine or uruguay or uzbekistan or uzbek or vanuatu or “new hebrides” or venezuela or vietnam or “viet nam” or “middle east” or “west bank” or gaza or palestine or yemen or yugoslavia or zambia or zimbabwe or “northern rhodesia” or “global south” or “africa south of the sahara” or “sub-saharan africa” or “subsaharan africa” or “africa, central” or “central africa” or “africa, northern” or “north africa” or “northern africa” or magreb or maghrib or sahara or “africa, southern” or “southern africa” or “africa, eastern” or “east africa” or “eastern africa” or “africa, western” or “west africa” or “western africa” or “west indies” or caribbean or “central america” or “latin america” or “south and central america” or “south america” or “asia, central” or “central asia” or “asia, northern” or “north asia” or “northern asia” or “asia, southeastern” or “southeastern asia” or “south eastern asia” or “southeast asia” or “south east asia” or “asia, western” or “western asia” or “europe, eastern” or “east europe” or “eastern europe”)	
S40	TI (afghanistan or albania or algeria or "american samoa" or angola or antigua or barbuda or argentina or armenia or armenian or aruba or azerbaijan or bahrain or bangladesh or barbados or belarus or byelarus or belorussia or byelorussian or belize or "british honduras" or benin or dahomey or bhutan or bolivia or "bosnia herzegovina" or bosnia or herzegovina or botswana or bechuanaland or brazil or brasil or bulgaria or "burkina faso" or "burkina fasso" or "upper volta" or burundi or urundi or "cabo verde" or "cape verde" or cambodia or kampuchea or "khmer republic" or cameroon or cameron or cameroun or "central african republic" or "ubangi shari" or chad or chile or china or colombia or comoros or "comoro islands" or "iles comores" or mayotte or "democratic republic of the congo" or "democratic republic congo" or congo or zaire or "costa rica" or "cote d’ivoire" or "cote d’ ivoire" or "cote divoire" or "cote d ivoire" or "ivory coast" or croatia or cuba or cyprus or "czech republic" or czechoslovakia or djibouti or "french somaliland" or dominica or "dominican republic" or ecuador or egypt or "united arab republic" or "el salvador" or "equatorial guinea" or "spanish guinea" or eritrea or estonia or eswatini or swaziland or ethiopia or fiji or gabon or "gabonese republic" or gambia or "georgia (republic)" or georgian or ghana or "gold coast" or gibraltar or greece or grenada or guam or guatemala or guinea or "guinea bissau" or guyana or "british guiana" or haiti or hispaniola or honduras or hungary or india or indonesia or timor or iran or iraq or "isle of man" or jamaica or jordan or kazakhstan or kazakh or kenya or "democratic people’s republic of korea" or "republic of korea" or "north korea" or "south korea" or korea or kosovo or kyrgyzstan or kirghizia or kirgizstan or "kyrgyz republic" or kirghiz or laos or "lao pdr" or "lao people's democratic republic" or latvia or lebanon or lebanese republic or lesotho or basutoland or liberia or libya or "libyan arab jamahiriya" or lithuania or macau or macao or republic of "north macedonia" or macedonia or madagascar or "malagasy republic" or malawi or nyasaland or malaysia or “malay federation” or “malaya federation” or maldives or “indian ocean islands” or “indian ocean”) OR AB (afghanistan or albania or algeria or “american samoa” or angola or antigua or barbuda or argentina or armenia or armenian or aruba or azerbaijan or bahrain or bangladesh or barbados or belarus or byelarus or belorussia or byelorussian or belize or “british honduras” or benin or dahomey or bhutan or bolivia or “bosnia herzegovina” or bosnia or herzegovina or botswana or bechuanaland or brazil or brasil or bulgaria or “burkina faso” or “burkina fasso” or “upper volta” or burundi or urundi or “cabo verde” or “cape verde” or cambodia or kampuchea or “khmer republic” or cameroon or cameron	230,968

#	Query	Results
	or cameroun or “central african republic” or “ubangi shari” or chad or chile or china or colombia or comoros or “comoro islands” or “iles comores” or mayotte or “democratic republic of the congo” or “democratic republic congo” or congo or zaire or “costa rica” or “cote d’ivoire” or “cote d’ivoire” or “cote divoire” or “cote d ivoire” or “ivory coast” or croatia or cuba or cyprus or “czech republic” or czechoslovakia or djibouti or “french somaliland” or dominica or “dominican republic” or ecuador or egypt or “united arab republic” or “el salvador” or “equatorial guinea” or “spanish guinea” or eritrea or estonia or eswatini or swaziland or ethiopia or fiji or gabon or “gabonese republic” or gambia or “georgia (republic)” or georgian or ghana or “gold coast” or gibraltar or greece or grenada or guam or guatemala or guinea or “guinea bissau” or guyana or “british guiana” or haiti or hispaniola or honduras or hungary or india or indonesia or timor or iran or iraq or “isle of man” or jamaica or jordan or kazakhstan or kazakh or kenya or “democratic people’s republic of korea” or “republic of korea” or “north korea” or “south korea” or korea or kosovo or kyrgyzstan or kirghizia or kirgizstan or “kyrgyz republic” or kirghiz or laos or “lao pdr” or “lao people’s democratic republic” or latvia or lebanon or lebanese republic or lesotho or basutoland or liberia or libya or “libyan arab jamahiriya” or lithuania or macau or macao or republic of “north macedonia” or macedonia or madagascar or “malagasy republic” or malawi or nyasaland or malaysia or “malay federation” or “malaya federation” or maldives or “indian ocean islands” or “indian ocean”)	
S39	S1 OR S38	15,244
S38	S16 AND S37	15,243
S37	S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36	354,620
S36	(MH "Product Surveillance+/SN")	1
S35	(MH "Maternal Health Services+/SN")	1,245
S34	TI pharmacovigilan* or (pharmaco W0 vigilan*)	846
S33	(MH "Product Surveillance+")	2,417
S32	TI "data system" or "data systems" or "information system" or "information systems"	4,466
S31	(MH "Health Information Systems")	3,566
S30	TI (decision* AND support* AND clinical*)	1,865
S29	(MH "Decision Support Systems, Clinical")	6,139
S28	TI surveillance*	15,975
S27	(MH "Population Surveillance+")	11,277
S26	TI survey*	71,609
S25	(MH "Surveys")	157,567
S24	TI registry or registries or eregistr* or "e-registry" or "e-registries"	13,946
S23	TI (preliminary or "pilot project" or "pilot projects") AND data	682
S22	TI "focus group" or "focus groups"	2,957
S21	(MH "Focus Groups")	48,414
S20	TI databas* or "data base" or "data bases" or databank* or "data bank" or "data banks" or dataset* or "data set" or "data sets"	16,019
S19	TI data AND (accumulat* or accura* or assembl* or captur* or collect* or compil* or coordinat* or co-ordinat* or gather* or hub or hubs)	4,425
S18	(MH "Data Curation")	184
S17	(MH "Data Collection")	49,942

#	Query	Results
S16	S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15	290,175
S15	TI maternal AND (fetal or fetus or foetal or foetus)	4,004
S14	TI (maternal* or maternity) AND (care or health* or service or services)	9,718
S13	(MH "Maternal Health Services")	11,199
S12	TI (maternal* or maternity) AND (contact* or expos*)	1,028
S11	(MH "Maternal Exposure")	2,588
S10	TI perinatal* or "peri-natal" or "peri-natally" or peripartum or "peri-partum"	12,858
S9	(MH "Perinatal Care")	5,019
S8	TI prenatal* or antenatal* or "ante-natal" or "ante-natally" or antepartum or "ante-partum"	20,877
S7	(MH "Prenatal Care")	19,422
S6	TI pregnan*	80,123
S5	(MH "Pregnancy Trimesters+")	13,521
S4	(MH "Expectant Mothers")	11,382
S3	(MH "Pregnancy Complications+")	106,825
S2	(MH "Pregnancy") OR (MH "Pregnancy, Multiple+") OR (MH "Pregnancy, Unplanned") OR (MH "Pregnancy, Unwanted") OR (MH "Pregnancy, High Risk") OR (MH "Pregnancy, Prolonged")	227,240
S1	TI ("pregnancy exposure database" OR "pregnancy exposure databases" OR "pregnancy exposure data base" OR "pregnancy exposure data bases" OR "pregnancy exposure registry" OR "pregnancy exposure registries") OR AB ("pregnancy exposure database" OR "pregnancy exposure databases" OR "pregnancy exposure data base" OR "pregnancy exposure data bases" OR "pregnancy exposure registry" OR "pregnancy exposure registries")	7

6.1.4. Global Index Medicus

tw:((tw:(pregnan* exposure* database*)) OR (tw:(pregnan* exposure* “data base”)) OR (tw:(pregnan* exposure* “data bases”)) OR (tw:(pregnan* exposure* databank*)) OR (tw:(pregnan* exposure* “data bank”)) OR (tw:(pregnan* exposure* “data banks”)) OR (tw:(pregnan* exposure* register)) OR (tw:(pregnan* exposure* registries)) OR (tw:(pregnan* exposure* registry)) OR (tw:(pregnan* exposure* registries))) – 108 records

tw:((ti:((pregnan* OR prenatal* OR antenatal* OR “ante-natal” OR “ante-natally” OR antepartum OR “ante-partum” OR perinatal* OR “peri-natal” OR “peri-natally” OR peripartum OR “peri-partum” OR maternal*) AND (data OR database* OR databank* OR register OR registers OR registry OR registries OR survey* OR surveillance OR pharmacovigilan* OR “pharmaco-vigilance”) AND (safe OR safety OR “side effect” of “side effects” OR “undesirable effect” OR “undesirable effects” OR “treatment emergent” OR tolerability OR toxicity OR adrs OR aefi)))) – 361 records

tw:(ti:((pregnan* OR prenatal* OR antenatal* OR “ante-natal” OR “ante-natally” OR antepartum OR “ante-partum” OR perinatal* OR “peri-natal” OR “peri-natally” OR peripartum OR “peri-partum” OR maternal*) AND (data OR database* OR databank* OR register OR registers OR registry OR registries OR survey* OR surveillance OR pharmacovigilan* OR “pharmaco-vigilance”) AND (MNCH or “maternal health” or “child health” or “infant health” or “birth defect” or “birth defects” or “birth outcome” or “birth outcomes” or “pregnancy outcome” or “pregnancy outcomes” or “neonatal outcome” or “neonatal outcomes”))) – 50 records

tw:(ti:((pregnan* OR prenatal* OR antenatal* OR “ante-natal” OR “ante-natally” OR antepartum OR “ante-partum” OR perinatal* OR “peri-natal” OR “peri-natally” OR peripartum OR “peri-partum” OR maternal*) AND (data OR database* OR databank* OR register OR registers OR registry OR registries OR survey* OR surveillance OR pharmacovigilan* OR “pharmaco-vigilance”) AND (vaccine or vaccines or vaccination* or immunization* or immunization* or “maternally-acquired”))) – 0 records

tw:((ti:((pregnan* OR prenatal* OR antenatal* OR “ante-natal” OR “ante-natally” OR antepartum OR “ante-partum” OR perinatal* OR “peri-natal” OR “peri-natally” OR peripartum OR “peri-partum” OR maternal*) AND (data OR database* OR databank* OR register OR registers OR registry OR registries OR survey* OR surveillance OR pharmacovigilan* OR “pharmaco-vigilance”) AND (drug OR drugs OR medicine OR medicines OR medication* OR pharmaceutical* OR “pharma-ceutical” OR “pharma-ceuticals” OR vaccin* OR immun* OR antimalarial* OR “anti-malarial” OR “anti-malarials” OR antiviral* OR “anti-viral” OR “anti-virals” OR antiretroviral* OR “anti-retroviral” OR “anti-retrovirals” OR “Anti-HIV” OR “Anti-AIDS”))))) – 10 records

tw:((ti:((pregnan* OR prenatal* OR antenatal* OR “ante-natal” OR “ante-natally” OR antepartum OR “ante-partum” OR perinatal* OR “peri-natal” OR “peri-natally” OR peripartum OR “peri-partum” OR maternal*) AND (data OR database* OR databank* OR register OR registers OR registry OR registries OR survey* OR surveillance OR pharmacovigilan* OR “pharmaco-vigilance”) AND (fetal* OR foetal* OR fetus* OR foetus* OR neonat* OR newborn* OR infant OR infants OR infanc* OR child*)))) – 125 records

tw:((ti:((pregnan* OR prenatal* OR antenatal* OR “ante-natal” OR “ante-natally” OR antepartum OR “ante-partum” OR perinatal* OR “peri-natal” OR “peri-natally” OR peripartum OR “peri-partum” OR maternal*) AND (data OR database* OR databank* OR register OR registers OR registry OR registries OR survey* OR surveillance OR pharmacovigilan* OR “pharmaco-vigilance”))) AND (tw:(drug OR drugs OR medicine OR medicines OR medication* OR pharmaceutical* OR “pharma-ceutical” OR “pharma-ceuticals” OR vaccin* OR immunisation* OR immunization* OR antimalarial* OR “anti-malarial” OR “anti-malarials” OR antiviral* OR “anti-viral” OR “anti-virals” OR antiretroviral* OR “anti-retroviral” OR “anti-retrovirals” OR “Anti-HIV” OR “Anti-AIDS”))) – 71 records

TOTAL: 725 records

6.1.5. Google Scholar

“pregnant|pregnancy|prenatal”+”registry|registries|surveillance|pharmacovigilance” + “expose|exposed|exposes|exposure|exposures”+[names of LMICs]

6.2. Data extraction form

PART 1: STUDY IDENTIFICATION / INCLUSION STATUS

Resource title:

Author(s):

Year of publication:

Resource type:
1. 1 - Peer reviewed journal
2. 2 - Grey literature
3. 3 - Registry
4. 4 - Website
5. 5 - Key informant survey / interview
6. 6 - Other

Database resource pulled from:

Final status:
1. 1 - included
2. 2 - excluded
3. 3 - incomplete/unclear

If excluded, explain reasoning:

PART 2: REGISTRY INFORMATION OR OTHER RESOURCE

Name of registry or other resource:

Primary goals/aims:

Funding source:

Years of operation:

Current status
1. Active
2. Inactive
3. On hold

Country(ies) where located:

Country representativeness:
1. Multi-national
2. National
3. State/Provincial
4. District
5. Sub-district
6. Community
7. Health clinic
8. Hospital
9. Other

Drug/vaccine exposure name and type:

Duration of follow up:

Current sample size:
1. <500 participants
2. 500 - 1,999 participants
3. 2,000 - 5,000 participants
4. 5,001 - 10,000 participants
5. 10,001 - 20,000 participants
6. >20,000 participants

Data collection:
1. Administrative databases
2. Medical databases
3. Registries
4. Research study
5. Program implementation
6. Other

Methodology:

Terminology and data system used:

PART 3: CHARACTERISTICS OF INCLUDED POPULATION

Age ranges included:

Target population:
1. Pregnant women
2. Non-pregnant women / women of reproductive age
3. Children
4. Infants (<28 days old)
5. General population
6. Other

Gestational age
1. First trimester
2. Second trimester
3. Third trimester

Underlying medical condition(s):

Maternal outcome(s) recorded:
1. Thrombosis and/or thrombocytopenia syndrome
2. Antenatal hospitalization (not including delivery)
3. Disability
4. Gestational diabetes
5. Gestational hypertension
6. Premature rupture of membranes
7. Preterm labor
8. Preeclampsia / Eclampsia
9. Post-partum hemorrhage
10. Antenatal hemorrhage
11. Corporeal infection
12. Spontaneous abortion / miscarriage / pregnancy loss (example: prior to 20 weeks gestation)
13. Maternal death (example: within 42 days of termination of pregnancy)
14. Late maternal death (example: >42 days of termination of pregnancy)
15. Other

Maternal death cause:
1. Direct cause
2. Indirect cause

Neonatal outcome(s) recorded:
1. Preterm birth
2. Small size for gestational age / restricted fetal growth
3. Still birth (death after 28 weeks of pregnancy but before birth)
4. Live birth
5. Congenital anomaly / birth defect
6. Death
7. Other

Neonatal death timeframe
1. Early neonatal (0-7 days)
2. Late neonatal (8-28 days)
3. Post neonatal (29 days - 1 year)

Which congenital anomaly does this monitor (if any)?

Infant/child outcome(s) recorded:
1. Infections
2. Respiratory illness
3. Developmental outcomes
4. Other

What is the duration of follow up?

PART 4: KEY FINDINGS

Populate as best you can if information is provided; answer N/A if it is not relevant or N/P if it is not provided.

Strengths of the registry or other resource:

Weaknesses / gaps of registry or other resource:

Challenges of registry or other resource in its specific context:

Does this resource have the possibility to add new interventions?
1. Yes
2. No
3. Maybe
4. Unknown Why?

Can this resource be combined with other systems?
1. Yes
2. No
3. Maybe
4. Unknown Why?

Any upcoming changes to the resource:

Additional comments

PART 1: STUDY IDENTIFICATION / INCLUSION STATUS

Resource title:

Author(s):

Year of publication:

Resource type:
1. 1 - Peer reviewed journal
2. 2 - Grey literature
3. 3 - Registry
4. 4 - Website
5. 5 - Key informant survey / interview
6. 6 - Other

Database resource pulled from:

Final status:
1. 1 - included
2. 2 - excluded
3. 3 - incomplete/unclear

If excluded, explain reasoning:

PART 2: REGISTRY INFORMATION OR OTHER RESOURCE

Name of registry or other resource:

Primary goals/aims:

Funding source:

Years of operation:

Current status
1. Active
2. Inactive
3. On hold

Country(ies) where located:

Country representativeness:
1. Multi-national
2. National
3. State/Provincial
4. District
5. Sub-district
6. Community
7. Health clinic
8. Hospital
9. Other

Drug/vaccine exposure name and type:

Duration of follow up:

Current sample size:
1. <500 participants
2. 500 - 1,999 participants
3. 2,000 - 5,000 participants
4. 5,001 - 10,000 participants
5. 10,001 - 20,000 participants
6. >20,000 participants

Data collection:
1. Administrative databases
2. Medical databases
3. Registries
4. Research study
5. Program implementation
6. Other

Methodology:

Terminology and data system used:

PART 3: CHARACTERISTICS OF INCLUDED POPULATION

Age ranges included:

Target population:
1. Pregnant women
2. Non-pregnant women / women of reproductive age
3. Children
4. Infants (<28 days old)
5. General population
6. Other

Gestational age
1. First trimester
2. Second trimester
3. Third trimester

Underlying medical condition(s):

Maternal outcome(s) recorded:
1. Thrombosis and/or thrombocytopenia syndrome
2. Antenatal hospitalization (not including delivery)
3. Disability
4. Gestational diabetes
5. Gestational hypertension
6. Premature rupture of membranes
7. Preterm labor
8. Preeclampsia / Eclampsia
9. Post-partum hemorrhage
10. Antenatal hemorrhage
11. Corporeal infection
12. Spontaneous abortion / miscarriage / pregnancy loss (example: prior to 20 weeks gestation)
13. Maternal death (example: within 42 days of termination of pregnancy)
14. Late maternal death (example: >42 days of termination of pregnancy)
15. Other

Maternal death cause:
1. Direct cause
2. Indirect cause

Neonatal outcome(s) recorded:
1. Preterm birth
2. Small size for gestational age / restricted fetal growth
3. Still birth (death after 28 weeks of pregnancy but before birth)
4. Live birth
5. Congenital anomaly / birth defect
6. Death
7. Other

Neonatal death timeframe
1. Early neonatal (0-7 days)
2. Late neonatal (8-28 days)
3. Post neonatal (29 days - 1 year)

Which congenital anomaly does this monitor (if any)?

Infant/child outcome(s) recorded:
1. Infections
2. Respiratory illness
3. Developmental outcomes
4. Other

What is the duration of follow up?

PART 4: KEY FINDINGS

Populate as best you can if information is provided; answer N/A if it is not relevant or N/P if it is not provided.

Strengths of the registry or other resource:

Weaknesses / gaps of registry or other resource:

Challenges of registry or other resource in its specific context:

Does this resource have the possibility to add new interventions?
1. Yes
2. No
3. Maybe
4. Unknown Why?

Can this resource be combined with other systems?
1. Yes
2. No
3. Maybe
4. Unknown Why?

Any upcoming changes to the resource:

Additional comments

6.3. Key informant survey and interview

6.3.1. Pregnancy Exposure Data and Resources Stakeholder Survey

We are conducting a landscape analysis in collaboration with WHO to identify current and recent resources, including pregnancy exposure and surveillance registries, databases, cohort surveys, and routinely collected data, that record exposure to medicines and vaccines during pregnancy and maternal and perinatal outcomes in low- and middle-income countries (LMICs). We are asking for your help in identifying examples of these resources. We may follow up with you to discuss the appropriateness or fit for purpose of the resource you identify. Our goal is to understand what is currently available in LMICs and make connections for future evaluation of maternal use of medicines and vaccines in the product pipeline.

You have been identified as someone who is knowledgeable about or involved with these resources in LMICs. Please complete the following form for each resource you know of. We will ask for your name and contact information so that we may follow up with you for further information, if necessary. All of the personal information you provide will be kept confidential. When we report our findings, if we need to mention something you have said or information you have provided, we will refer to you by a unique study ID to keep your identity confidential. By submitting the form, you are agreeing to participate and allow us to use the information you have provided.

Please fill out the following questions to the best of your knowledge. If there are any specific points that are not included as options in the dropdown menus that are relevant to the resource, please type in the answer and hit “enter”.

Participant details

Please note we may contact you to follow up about the resource you describe if we have any questions.

Name*: _____

Email*: _____

Organization*: _____

Job Title: _____

Resource details

Below we will be asking you to fill in information about any resources you are familiar with as outlined above. If you know of multiple resources that should be brought to our attention, please fill out a separate survey for each resource. As a reminder, resources can include pregnancy exposure and surveillance registries, databases, cohort surveys, and routinely collected data, that record exposure to medicines and vaccines during pregnancy and maternal and perinatal outcomes in low- and middle-income countries (LMICs)

Resource or Project Name: _____

Please provide a link to the resource if available: _____

What location(s) does the resource cover (country/countries or region(s))? _____

Who oversees or maintains the resource? Please provide the name of the organization/s or specific person(s) and their contact information if available.

Name of organization: _____

Primary contact name: _____

Primary contact email: _____

How is data collected? Select all that apply.

- ☐ Administrative databases
- ☐ Medical databases
- ☐ Registries
- ☐ Research study
- ☐ Program implementation
- ☐ Other

If you selected “other”, please specify: _____

Any additional details you would like to provide? : _____

The data in this resource are captured at a:

- ☐ Multi-national
- ☐ National
- ☐ State / Provincial
- ☐ District
- ☐ Sub-district
- ☐ Community
- ☐ Health clinic
- ☐ Hospital
- ☐ Other

If you selected “other”, please specify: _____

How are these data collected?

- ○ Retrospectively
- ○ Prospectively

How many individuals are enrolled in this resource (total)?

- ○ <500 participants
- ○ 500 – 2,000 participants
- ○ 2,000 – 5,000 participants
- ○ 5,001 – 10,000 participants
- ○ 10,001 – 20,000 participants
- ○ >20,000 participants

What population(s) are the target for this resource. Select all that apply.

- ☐ Pregnant women
- ☐ Non-pregnant women / women of reproductive age
- ☐ Breastfeeding women
- ☐ Children
- ☐ Infants (<28 days old)
- ☐ General population

What intervention(s) does this resource include? Select all that apply.

- ● Vaccine/Immunization
  - ○ COVID-19
  - ○ Influenza
  - ○ Meningococcus
  - ○ Tetanus toxoid
  - ○ Pertussis
  - ○ Other

If you selected “other”, please specify: _____

- Medicines/Drugs/Biologics
  - Antimalarials
  - Antiretrovirals/HIV/AIDS
  - Medicines related to mental health
  - Medicines related to autoimmune diseases
  - Medicines related to cancer
  - Medicines related to diabetes
  - Medicines related to epilepsy
  - Other

If you selected “other”, please specify: _____

What outcome(s) is/are recorded while under observation in this resource? Please select all that apply.

- Maternal outcomes
  - ☐ Thrombosis and/or thrombocytopenia syndrome
  - ☐ Antenatal hospitalization not including delivery
  - ☐ Disability
  - ☐ Gestational diabetes
  - ☐ Gestational hypertension
  - ☐ Premature rupture of membranes
  - ☐ Preterm labor
  - ☐ Preeclampsia / eclampsia
  - ☐ Post-partum hemorrhage
  - ☐ Antenatal hemorrhage
  - ☐ Corporeal infection
  - ☐ Spontaneous abortion / miscarriage / pregnancy loss (example: prior to 20 weeks gestation)
  - ☐ Maternal death (example: within 42 days of termination of pregnancy)
  - ☐ Late maternal death (example: >42 days – 1 year after termination of pregnancy)
  - ☐ Other

If you selected “maternal death” or “late maternal death”, please specify the cause of death:

- Direct
- Indirect

If you selected “other”, please specify: _____

- Neonatal outcomes
  - ☐ Preterm birth
  - ☐ Small size for gestational age / restricted fetal growth
  - ☐ Stillbirth (death after 28 weeks of pregnancy but before birth)
  - ☐ Live birth
  - ☐ Congenital anomalies / birth defects
  - ☐ Death
  - ☐ Other

If “congenital anomalies / birth defects” is selected, please specify: _____

If neonatal “death” was selected, please specify the timeframe:

- Early neonatal (0-7 days)
- Late neonatal (8-28 days)
- Post neonatal (29 days – 1 year)

If you selected “other”, please specify: _____

- Infant/child outcomes
  - Neonatal infections
  - Respiratory illness
  - Developmental outcomes
    - Specify (motor, cognitive, neurologic, autism, etc.): _____
  - Other

If you selected “other”, please specify: _____

What is the duration of follow up? _____

Resource start date: _____

Resource end date (if applicable): _____

What is the current status of the resource?

- Open
- Closed

Who has access to this resource and its data? _____

Do you participate in the running of this resource?

- Yes
- No

Do you contribute data to this resource?

- Yes
- No
- Not applicable

Are you a user of this resource?

- Yes
- No

Related publications/links: _____

Anything else you'd like to share? _____

File upload. If available, please upload any relevant documents here from the resource, including templates, data collection forms, data dictionaries, data structures, publications, etc. These documents will help us understand the breadth of information that is captured in this resource.

6.3.2. PERLA Key Informant Interview

Consent script

Hello, my name is _____ and I work at PATH, an international NGO working in health. We are conducting a landscape analysis in collaboration with WHO to identify available resources, including pregnancy exposure and surveillance registries, databases, surveys, and routinely collected data, that record exposure to medical products during pregnancy and maternal and perinatal outcomes in low- and middle-income countries (LMICs). You either filled out a survey about one or more resources that fit this description, or have been identified as someone who may have more information on these types of resources and may be interested in telling us more. This interview will take between 15-30 minutes and we will ask for your feedback and impressions on the resource(s) you've identified. Please keep in mind there are no right or wrong answers, and we are interested in your understanding of the resource as someone who maintains or interacts with these types of resources. We may record this session to help us later with our report. No video footage will be recorded, only audio. Participation is voluntary and if you would like to stop or not answer a question, you may do so at any time. Your name or identity will not be associated with the feedback you provide. Results may be compiled into a report, peer reviewed manuscript, or other communications materials that will be made publicly available. If we make reference to something you have said in our report, you would be referred to as "Participant #1, or #2, etc." Please confirm your interest in participating in this session?

- Yes
- No

Thank you for agreeing to participate in this interview. Let's get started. (I will start the recording now.)

This is an interview with participant _____.

Interviewee information

For interviewer only: Please fill this section out before the interview and do not speak any identifying information over the recording. If any sections of their survey have been left blank, please include those as follow up questions.

Unique ID. Please reference the sheet if they have already filled out a survey and use their unique ID here. If they did not fill out a survey, assign them a new unique ID. _____

Name: _____

Email: _____

Organization: _____

Title: _____

Did they complete a survey form?

- ○ Yes
- ○ No

Resource information

For interviewers only: If "No" is selected under the previous question, all the questions from the survey will show up. If "Yes" is selected, the survey questions that have been answered will be skipped and go straight into the following questions.

We are interested in understanding whether this resource is well equipped or well suited for its designed role or purpose. This could include the possibility of the resource to be combined with others for broader safety surveillance purposes and to understand its impact on supporting maternal health generally.

1. Can you tell me about the overall goals of the resource you have described to us?

_____

_____

_____

Probe: target population, intervention monitored, outcomes monitored, enrollment size, etc.

2. How have findings from this resource been used? In particular, have they been useful decision-making?

_____

_____

_____

Probe: in public health? In regulation? For clinicians? For other healthcare bodies?

3. What are the advantages of this resource?

_____

_____

_____

Probe: Comprehensiveness (outcomes or breadth of resources), coverage, timeliness, usefulness, accuracy, completeness .

4. What are the most important gaps or needs of this resource?

_____

_____

_____

Probe on gaps: Comprehensiveness (outcomes or breadth of resources), coverage, timeliness, usefulness, accuracy, completeness.

5. What are the challenges this resource faces in the current context?

_____

_____

_____

Probe on challenges: Cost, time requirements to maintain the resource, software limitations, etc.

6. Could data from this resource be able to be combined with other health surveillance resources that are used in this region?

_____

_____

_____

Probe: Why/why not? Are there any challenges you foresee?

Probe: How could these systems link?

7. Are you aware of any changes that will be made to this resource in the foreseeable future?

_____

_____

_____

8. Is there anyone else you know who might have useful information about resources like the ones we discussed today?

_____

_____

_____

That was my last question. Before we finish, do you have any questions or additional comments regarding the topics discussed during this interview?

_____

_____

_____

Thank you for your time today. Your input is greatly appreciated.

6.4. Other listings

6.4.1 Retrospective Stand-alone studies

[195] Arriola CS, Vasconez N, Thompson MG, Olsen SJ, Moen AC, Bresee J, et al. Association of influenza vaccination during pregnancy with birth outcomes in Nicaragua. Vaccine 2017;35:3056–63. https://doi.org/10.1016/j.vaccine.2017.04.045

[196] Asavapiriyanont S, Kittikraisak W, Suntarattiwong P, Ditsungnoen D, Kaoiean S, Phadungkiatwatana P, et al. Tolerability of trivalent inactivated influenza vaccine among pregnant women, 2015. BMC Pregnancy and Childbirth 2018;18(1) (no pagination). https://doi.org/10.1186/s12884-018-1712-6.

[197] Bengtson AM, Phillips TK, le Roux SM, Brittain K, Zerbe A, Madlala HP, et al. High blood pressure at entry into antenatal care and birth outcomes among a cohort of HIV-uninfected women and women living with HIV initiating antiretroviral therapy in South Africa. Pregnancy Hypertension 2021;23:79–86. https://doi.org/10.1016/j.preghy.2020.11.005.

[198] Chaudhury S, Mayondi GK, Williams PL, Leidner J, Shapiro R, Diseko M, et al. In-utero exposure to antiretrovirals and neurodevelopment among HIV-exposed-uninfected children in Botswana. AIDS 2018;32:1173–83. https://doi.org/10.1097/qad.0000000000001790.

[199] Delicio AM, Lajos GJ, Amaral E, Cavichiolli F, Polydoro M, Milanez H. Adverse effects in children exposed to maternal HIV and antiretroviral therapy during pregnancy in Brazil: a cohort study. Reproductive Health 2018;15:76. https://doi.org/10.1186/s12978-018-0513-8.

[200] Herce ME, Chagomerana MB, Zalla LC, Carbone NB, Chi BH, Eliya MT, et al. Community-facility linkage models and maternal and infant health outcomes in Malawi's PMTCT/ART program: A cohort study. PLoS Medicine 2021;18(9) (no pagination). https://doi.org/10.1371/journal.pmed.1003780.

[201,202] Manyando C, Mkandawire R, Puma L, Sinkala M, Mpabalwani E, Njunju E, et al. Safety of artemether-lumefantrine in pregnant women with malaria: results of a prospective cohort study in Zambia. Malaria Journal 2010;9:249. https://doi.org/10.1186/1475-2875-9-249, Manyando C, Njunju EM, Virtanen M, Hamed K, Gomes M, Van Geertruyden JP. Exposure to artemether-lumefantrine (Coartem) in first trimester pregnancy in an observational study in Zambia. Malaria Journal 2015;14:77. https://doi.org/10.1186/s12936-015-0578-6 and Manyando C, Mkandawire R, Puma, Sinkala M, Mpabalwani E, Njunju E, et al. Safety of artemether-lumefantrine in pregnant women with malaria: results of a prospective cohort study in Zambia. Malar J. 2010;9:249

[203] Oliveira MS de. Farmacovigilância de medicamentos anti-retrovirais em gestantes portadoras de HIV e em crianças espostas ao HIV durante a gestação em uso de profilaxia da transmissão vertical: estudo piloto de incidência 2007:x,123-x,123.

[204,205] Rulisa S. Pharmacovigilance of artemether-lumefantrine in pregnant women followed up till delivery in Rwanda. Tropical Medicine and International Health 2009;2):64–5. https://doi.org/10.1111/j.1365-3156.2009.02353.x and Rulisa S, Kaligirwa N, Agaba S, Karema C, Mens PF, de Vries PJ. Pharmacovigilance of artemether-lumefantrine in pregnant women followed until delivery in Rwanda. Malaria Journal 2012;11:225. https://doi.org/10.1186/1475-2875-11-225.

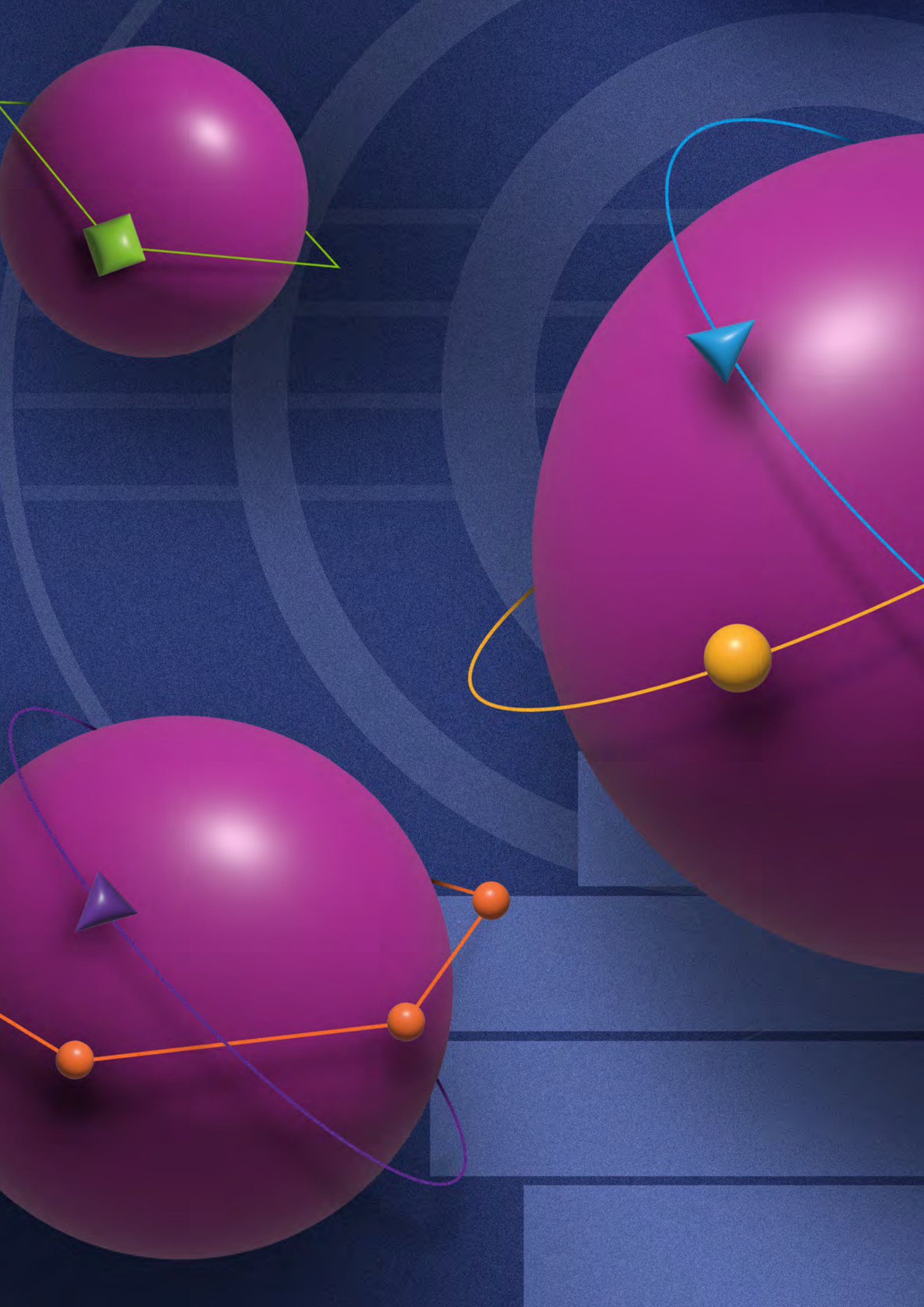
[206] Poda A, Hema A, Konate A, Kabore F, Zoungrana J, Kamboule E, et al. Pregnancy rate and birth outcomes among women receiving antiretroviral therapy in Burkina Faso: A retrospective cohort study. Pan African Medical Journal 2016;23. https://doi.org/10.11604/pamj.2016.23.105.7372.

6.4.2 Resources identified through the online survey of informants

Name
Perinatal Information System
Jos Antimalarials in Pregnancy Cohort
USAID MTAPS (Mali specifically)
National PV Centers (Egypt, Yemen)
National PV Centers with possible data collection activities focused on pregnancy (Tunisia, Mali, Algeria, Azerbaijan)
National PV perinatal database launching (Burundi)
MTN (Microbicide Trial Network)-032 in Uganda

Section

7 References



[1] Drake AL, Wagner A, Richardson B, John-Stewart G. Incident HIV during Pregnancy and Postpartum and Risk of Mother-to-Child HIV Transmission: A Systematic Review and Meta-Analysis. PLOS Medicine 2014;11:e1001608. https://doi.org/10.1371/journal.pmed.1001608

[2] Reddy V, Weiss DJ, Rozier J, ter Kuile FO, Dellicour S. Global estimates of the number of pregnancies at risk of malaria from 2007 to 2020: a demographic study. Lancet Glob Health 2022;11:e40–7. https://doi.org/10.1016/S2214-109X(22)00431-4

[3] White NJ, McGready RM, Nosten FH. New Medicines for Tropical Diseases in Pregnancy: Catch-22. PLOS Medicine 2008;5:e133. https://doi.org/10.1371/journal.pmed.0050133

[4] David AL, Ahmadzia H, Ashcroft R, Bucci-Rechtweg C, Spencer RN, Thornton S. Improving Development of Drug Treatments for Pregnant Women and the Fetus. Ther Innov Regul Sci 2022;56:976–90. https://doi.org/10.1007/s43441-022-00433-w

[5] Gliklich RE, Dreyer NA, Leavy MB. Pregnancy Registries. Agency for Healthcare Research and Quality (US); 2014.

[6] Gelperin K, Hammad H, Leishear K, Bird ST, Taylor L, Hampp C, et al. A systematic review of pregnancy exposure registries: examination of protocol-specified pregnancy outcomes, target sample size, and comparator selection. Pharmacoepidemiology and Drug Safety 2017;26:208–14. https://doi.org/10.1002/pds.4150

[7] Roque Pereira L, Durán CE, Layton D, Poulentzas G, Lalagkas P-N, Kontogiorgis C, et al. A Landscape Analysis of Post-Marketing Studies Registered in the EU PAS Register and ClinicalTrials.gov Focusing on Pregnancy Outcomes or Breastfeeding Effects: A Contribution from the ConcePTION Project. Drug Saf 2022;45:333–44. https://doi.org/10.1007/s40264-022-01154-7

[8] Tinto H, Sevene E, Dellicour S, Calip GS, D'Alessandro U, Macete E, et al. Assessment of the safety of antimalarial drug use during early pregnancy (ASAP): Protocol for a multicenter prospective cohort study in Burkina Faso, Kenya and Mozambique. Reproductive Health 2015;12(1) (no pagination). https://doi.org/10.1186/s12978-015-0101-0

[9] Mehta U, Clerk C, Allen E, Yore M, Sevene E, Singlovic J, et al. Protocol for a drugs exposure pregnancy registry for implementation in resource-limited settings. BMC Pregnancy and Childbirth 2012;12:89. https://doi.org/10.1186/1471-2393-12-89

[10] Wyszynski DF, Bhattacharya M, Martínez-Pérez O, Scialli AR, Tassinari M, Bar-Zeev N, et al. The COVID-19 Vaccines International Pregnancy Exposure Registry (C-VIPER): Protocol and Methodological Considerations. Drug Saf 2023;46:297–308. https://doi.org/10.1007/s40264-22-01271-3

[11] Berrueta M, Ciapponi A, Bardach A, Cairoli FR, Castellano FJ, Xiong X, et al. Maternal and neonatal data collection systems in low- and middle-income countries for maternal vaccines active safety surveillance systems: A scoping review. BMC Pregnancy and Childbirth 2021;21:217. https://doi.org/10.1186/s12884-021-03686-9

[12] AbuShweimeh R, Knudson S, Chaabane S, Pal SN, Skidmore B, Stergachis A, et al. Pregnancy exposure registries for drugs and vaccines in low-income and middle-income countries: scoping review protocol. BMJ Open 2023;13:e070543. https://doi.org/10.1136/bmjopen-2022-070543

[13] Peters MP, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Chapter 11: Scoping reviews - JBI Manual for Evidence Synthesis (2020 version) 2020. https://jbi-global-wiki.refined.site/space/MANUAL/4687342/Chapter+11%3A+Scoping+reviews

[14] Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Ann Intern Med 2018;169:467–73. https://doi.org/10.7326/M18-0850

[15] AbuShweimeh R, Knudson S, Stergachis A, Skidmore B, Bhat N. Landscape Analysis of Pregnancy Exposure Registries in Low- and Middle-Income Countries (PERLA) 2022. https://doi.org/10.17605/OSF.IO/FU5AT

[16] World Bank Country and Lending Groups – World Bank Data Help Desk n.d. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed April 15, 2023).

[17] McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS Peer Review of Electronic Search Strategies: 2015 Guideline Statement. Journal of Clinical Epidemiology 2016;75:40–6. https://doi.org/10.1016/j.jclinepi.2016.01.021

[18] Programme for International Drug Monitoring n.d. https://www.who.int/teams/regulation-prequalification/regulation-and-safety/pharmacovigilance/networks/pidm (accessed April 15, 2023).

[19] INDEPTH Network | Better Health Information for Better Health Policy n.d. http://www.indepth-network.org/ (accessed April 10, 2023).

[20] U.S. Food and Drug Administration. Guidance for Industry on Establishing Pregnancy Exposure Registries 2002.

[21] Committee for Medicinal Products for Human Use. Guideline on the exposure to medicinal products during pregnancy: need for post-authorisation data 2005.

[22] FDA Commissioner O of the. List of Pregnancy Exposure Registries. FDA 2023.

[23] Slogrove A, Davies M-A. CHERISH (Children HIV Exposed Uninfected Research to Inform Survival and Health) n.d.

[24] COVID-19 Vaccines International Pregnancy Exposure Registry (C-VIPER) n.d. https://c-viper.pregistry.com/ (accessed April 10, 2023).

[25] COVID-19 Vaccines International Pregnancy Exposure Registry - Full Text View - ClinicalTrials.gov n.d. https://clinicaltrials.gov/ct2/show/NCT04705116 (accessed June 29, 2023).

[26] Pregistry International Pregnancy Exposure Registry (PIPER) - Full Text View - ClinicalTrials.gov n.d. https://clinicaltrials.gov/ct2/show/NCT05352256 (accessed June 29, 2023).

[27] COVID-19 International Drug Pregnancy Registry (COVID-PR) n.d. https://covid-pr.pregistry.com/ (accessed April 10, 2023).

[28] COVID-19 International Drug Pregnancy Registry - Full Text View - ClinicalTrials.gov n.d. https://clinicaltrials.gov/ct2/show/NCT05013632 (accessed June 29, 2023).

[29] Wools-Kaloustian K. Measuring Adverse Pregnancy and Newborn Congenital Outcomes: An IeDEA Collaboration Study. clinicaltrials.gov; 2023.

[30] Oyungu E, El Kebbi O, Vreeman R, Nyandiko W, Monahan PO, Tu W, et al. Predicting neurodevelopmental risk in children born to mothers living with HIV in Kenya: protocol for a prospective cohort study (Tabiri Study). BMJ Open 2022;12:e061051. https://doi.org/10.1136/bmjopen-2022-061051

[31] Malaria in Mothers and Babies Pregnancy Exposure Registry - MiMBa | LSTM n.d. https://www.lstmed.ac.uk/MiMBa (accessed April 10, 2023).

[32] Liverpool School of Tropical Medicine. A Pregnancy Registry to Assess the Safety of Antimalarial Use in Pregnancy. clinicaltrials.gov; 2021.

[33] Huang S, Tan J, Xiong YQ, Liu CR, Qi YN, Sun X. PRO15 A Brief Introduction of DATA Governance for Congenital Anomalies Based on the Xiamen Registry of Pregnant Women and Offspring (REPRESENT): A Population-Based, LONG-TERM and Follow-up Database. Value in Health Regional Issues 2020;22(Supplement):S97–8. https://doi.org/10.1016/j.vhri.2020.07.510

[34] Tan J, Xiong Y, Qi Y, Liu C, Huang S, Yao G, et al. Data Resource Profile: Xiamen registry of pregnant women and offspring (REPRESENT): a population-based, long-term follow-up database linking four major healthcare data platforms. International Journal of Epidemiology 2021;50:27–8. https://doi.org/10.1093/ije/dyaa161

[35] Xin S. Xiamen Registry of Pregnant Women and Offspring (REPRESENT): A Population-based, Long-term Follow-up Database Linking Four Major Healthcare Data Platforms. clinicaltrials.gov; 2020.

[36] Ubomi Buhle Project | Cape Town | Birth defects in South Africa – The Ubomi Buhle project is establishing a National Pregnancy Exposure Registry (NPER) in South Africa. The project monitors the exposures to medicines during pregnancy and poor birth outcomes from exposures to substances. n.d. https://ubomibuhle.org.za/ (accessed April 10, 2023).

[37] Mehta UC, van Schalkwyk C, Naidoo P, Ramkissoon A, Mhlongo O, Maharaj NR, et al. Birth outcomes following antiretroviral exposure during pregnancy: Initial results from a pregnancy exposure registry in South Africa. Southern African Journal of HIV Medicine 2019;20:971. https://doi.org/10.4102/sajhivmed.v20i1.971

[38] Kalk E, Mehta U, Slogrove A, Jacob N, Myer L, Davies MA, et al. Pregnancy exposure registry/birth defects surveillance programme in the Western Cape, South Africa: A model for low- and middle-income countries. Drug Safety 2018;41(11):1212–3. https://doi.org/10.1007/s40264-018-0719-2

[39] Kalk E, Heekes A, Slogrove AL, Phelanyane F, Davies M-A, Myer L, et al. Cohort profile: the Western Cape Pregnancy Exposure Registry (WCPER). BMJ Open 2022;12:e060205. https://doi.org/10.1136/bmjopen-2021-060205

[40] van der Hoven J, Allen E, Cois A, de Waal R, Maartens G, Myer L, et al. Determining antenatal medicine exposures in South African women: a comparison of three methods of ascertainment. BMC Pregnancy and Childbirth 2022;22:466. https://doi.org/10.1186/s12884-022-04765-1

[41] Bera E, McCausland K, Nonkwelo R, Mgudlwa B, Chacko S, Majeke B. Birth defects following exposure to efavirenz-based antiretroviral therapy during pregnancy: a study at a regional South African hospital. AIDS 2010;24:283–9. https://doi.org/10.1097/QAD.0b013e328333af32

[42] Kabwigu S, Noguchi L, Moodley J, Palanee T, Kintu K, Nair L, et al. The MTN-016 Pregnancy Registry: baseline characteristics of enrollees from the VOICE Study and reasons for non-enrollment of eligible women. AIDS Research and Human Retroviruses 2014.

[43] Mhlanga FG, Noguchi L, Balkus JE, Kabwigu S, Scheckter R, Piper J, et al. Implementation of a prospective pregnancy registry for antiretroviral based HIV prevention trials. HIV Clinical Trials 2018;19:8–14. https://doi.org/10.1080/15284336.2017.1411419

[44] Makanani B, Balkus JE, Jiao Y, Noguchi LM, Palanee-Phillips T, Mbilizi Y, et al. Pregnancy and Infant Outcomes Among Women Using the Dapivirine Vaginal Ring in Early Pregnancy. J Acquir Immune Defic Syndr 2018;79:566–72. https://doi.org/10.1097/QAI.0000000000001861

[45] MTN-016 | Microbicide Trials Network n.d. https://www.mtnstopshiv.org/research/studies/mtn-016 (accessed April 10, 2023).

[46] Chamanga R, Katumbi C, Gadama L, Kawalazira R, Dula D, Makanani B, et al. Comparison of adverse birth outcomes among HIV-infected and HIV-uninfected women delivering in high and low risk settings in the era of universal ART in Malawi: a registry study. Paediatr Int Child Health 2021;41:112–22. https://doi.org/ 10.1080/20469047.2021.1874200

[47] Allen EN, Gomes M, Yevoo L, Egesah O, Clerk C, Byamugisha J, et al. Influences on participant reporting in the World Health Organisation drugs exposure pregnancy registry; a qualitative study. BMC Health Services Research 2014;14:525. https://doi.org/10.1186/s12913-014-0525-1

[48] McClure EM, Garces AL, Hibberd PL, Moore JL, Goudar SS, Saleem S, et al. The Global Network Maternal Newborn Health Registry: a multi-country, community-based registry of pregnancy outcomes. Reproductive Health 2020;17:184. https://doi.org/10.1186/s12978-020-01020-8

[49] Belizán M, Rodriguez Cairoli F, Mazzoni A, Goucher E, Zaraa S, Matthews S, et al. Data collection systems for active safety surveillance of vaccines during pregnancy in low- and middle-income countries: developing and piloting an assessment tool (VPASS). BMC Pregnancy Childbirth 2023;23:172. https://doi.org/10.1186/s12884-023-05417-8

[50] Pereira GFM, Kim A, Jalil EM, Fonseca FF, Shepherd BE, Veloso VG, et al. Dolutegravir and pregnancy outcomes in women on antiretroviral therapy in Brazil: a retrospective national cohort study. The Lancet HIV 2021;8:e33–41. https://doi.org/10.1016/S2352-3018(20)30268-X

[51] Batista CJB, Correa RG, Evangelista LR, Fleck K, Silva L, Renaud F, et al. The Brazilian experience of implementing the active pharmacovigilance of dolutegravir. Medicine (Baltimore) 2019;98:e14828. https://doi.org/10.1097/MD.0000000000014828

[52] Msukwa MT, Keiser O, Jahn A, van Oosterhout JJ, Edmonds A, Phiri N, et al. Timing of combination antiretroviral therapy (cART) initiation is not associated with stillbirth among HIV-infected pregnant women in Malawi. Tropical Medicine & International Health 2019;24:727–35. https://doi. org/10.1111/tmi.13233

[53] Kalk E, Heekes A, Mehta U, de Waal R, Jacob N, Cohen K, et al. Safety and Effectiveness of Isoniazid Preventive Therapy in Pregnant Women Living with Human Immunodeficiency Virus on Antiretroviral Therapy: An Observational Study Using Linked Population Data. Clinical Infectious Diseases 2020;71:e351–8. https://doi.org/10.1093/cid/ciz1224

[54] Ekouevi DK, Coffie PA, Ouattara E, Moh R, Amani-Bosse C, Messou E, et al. Pregnancy outcomes in women exposed to efavirenz and nevirapine: an appraisal of the IeDEA West Africa and ANRS Databases, Abidjan, Côte d'Ivoire. Journal of Acquired Immune Deficiency Syndromes 2011;56:183–7. https://doi.org/10.1097/QAI.0b013e3181ff04e6

[55] Gadoth A, Mukadi Nkamba D, Arena PJ, Hoff NA, Dzogang C, Kampilu D, et al. Assessing the feasibility of passive surveillance for maternal immunization safety utilizing archival medical records in Kinshasa, Democratic Republic of the Congo. Vaccine 2022;40:3605–13. https://doi.org/10.1016/j. vaccine.2022.04.073

[56] Arena PJ, Dzogang C, Gadoth A, Nkamba DM, Hoff NA, Kampilu D, et al. Comparison of adverse pregnancy and birth outcomes using archival medical records before and during the first wave of the COVID-19 pandemic in Kinshasa, Democratic Republic of Congo: a facility-based, retrospective cohort study. BMC Pregnancy and Childbirth 2023;23:31. https://doi.org/10.1186/s12884-022-05291-w

[57] Ford N, Mofenson L, Kranzer K, Medu L, Frigati L, Mills EJ, et al. Safety of efavirenz in first-trimester of pregnancy: a systematic review and meta-analysis of outcomes from observational cohorts. AIDS 2010;24:1461–70. https://doi.org/10.1097/QAD.0b013e32833a2a14

[58] Chammartin F, Dao Ostinelli CH, Anastos K, Jaquet A, Brazier E, Brown S, et al. International epidemiology databases to evaluate AIDS (IeDEA) in sub-Saharan Africa, 2012-2019. BMJ Open 2020;10:e035246. https://doi.org/10.1136/bmjopen-2019-035246

[59] Zaniewski E, Tymejczyk O, Kariminia A, Desmonde S, Leroy V, Ford N, et al. IeDEA–WHO Research-Policy Collaboration: contributing real-world evidence to HIV progress reporting and guideline development. J Virus Erad 2018;4:9–15.

[60] IeDEA International epidemiology Databases to Evaluate AIDS. IeDEA International Epidemiology Databases to Evaluate AIDS 2023. https://www.iedea.org/ (accessed April 10, 2023).

[61] East Africa International Epidemiology Database to evaluate AIDS (IeDEA) Regional Consortium n.d. https://reporter.nih.gov/search/QE33W75NjkuXdm4MZtAhfg/project-details/10239930 (accessed April 10, 2023).

[62] Dodoo ANO, Ako-Aduonvo S, Mshinda H, Mwisongo A, Binka FN. INESS - A new platform for evaluating anti-malarial drug safety and effectiveness in Africa. Drug Safety 2010;33(10):959. https://doi.org/10.2165/11532470-000000000-00000

[63] Ndirangu J, Newell ML, Thorne C, Bland R. Treating HIV-infected mothers reduces under 5 years of age mortality rates to levels seen in children of HIV-uninfected mothers in rural South Africa. Antiviral Therapy 2012;17:81–90. https://doi.org/10.3851/imp1991

[64] Odhiambo FO, Laserson KF, Sewe M, Hamel MJ, Feikin DR, Adazu K, et al. Profile: The KEMRI/CDC health and demographic surveillance system-Western Kenya. International Journal of Epidemiology 2012;41(4):977–87. https://doi.org/10.1093/ije/dys108

[65] Oduro AR, Wak G, Azongo D, Debpuur C, Wontuo P, Kondayire F, et al. Profile of the Navrongo health and demographic surveillance system. International Journal of Epidemiology 2012;41(4):968–76. https://doi.org/10.1093/ije/dys111

[66] Scott JAG, Bauni E, Moisi JC, Ojal J, Gatakaa H, Nyundo C, et al. Profile: The Kilifi health and demographic surveillance system (KHDSS). International Journal of Epidemiology 2012;41(3):650–7. https://doi.org/10.1093/ije/dys062

[67] Alabi O, Doctor HV, Jumare A, Sahabi N, Abdulwahab A, Findley SE, et al. Health & demographic surveillance system profile: The Nahuche health and demographic surveillance system, northern Nigeria (Nahuche HDSS). International Journal of Epidemiology 2014;43(6):1770–80. https://doi.org/10.1093/ije/dyu197

[68] Dellicour S, Desai M, Aol G, Oneko M, Ouma P, Bigogo G, et al. Risks of miscarriage and inadvertent exposure to artemisinin derivatives in the first trimester of pregnancy: A prospective cohort study in western Kenya. Malaria Journal 2015;14(1) (no pagination). https://doi.org/10.1186/s12936-015-0950-6

[69] Wak G, Williams J, Oduro A, Maure C, Zuber PLF, Black S. The safety of PsA-TT in pregnancy: An assessment performed within the navrongo health and demographic surveillance site in Ghana. Clinical Infectious Diseases 2015;61(Supplement 5):S489–92. https://doi.org/10.1093/cid/civ625

[70] Arnaldo P, Rovira-Vallbona E, Langa JS, Salvador C, Guetens P, Chiheb D, et al. Uptake of intermittent preventive treatment and pregnancy outcomes: health facilities and community surveys in Chókwè district, southern Mozambique. Malaria Journal 2018;17:109. https://doi.org/10.1186/s12936-018-2255-z

[71] Koné S, Hürlimann E, Baikoro N, Dao D, Bonfoh B, N'Goran EK, et al. Pregnancy-related morbidity and risk factors for fatal foetal outcomes in the Taabo health and demographic surveillance system, Côte d'Ivoire. BMC Pregnancy and Childbirth 2018;18:216. https://doi.org/10.1186/s12884-018-1858-2

[72] Ambia J, Kabudula C, Risher K, Xavier Gómez-Olivé F, Rice BD, Etoori D, et al. Outcomes of patients lost to follow-up after antiretroviral therapy initiation in rural north-eastern South Africa. Trop Med Int Health 2019;24:747–56. https://doi.org/10.1111/tmi.13236

[73] Thysen SM, Fernandes M, Benn CS, Aaby P, Fisker AB. Cohort profile: Bandim Health Project's (BHP) rural Health and Demographic Surveillance System (HDSS) - A nationally representative HDSS in Guinea-Bissau. BMJ Open 2019;9(6) (no pagination). https://doi.org/10.1136/bmjopen-2018-028775

[74] Waiswa P, Akuze J, Moyer C, Kwesiga D, Arthur S, Sankoh O, et al. Status of birth and pregnancy outcome capture in Health Demographic Surveillance Sites in 13 countries. Int J Public Health 2019;64:909–20. https://doi.org/10.1007/s00038-019-01241-0

[75] Augusto O, Stergachis A, Dellicour S, Tinto H, Valá A, Ruperez M, et al. First trimester use of artemisinin-based combination therapy and the risk of low birth weight and small for gestational age. Malaria Journal 2020;19:144. https://doi.org/10.1186/s12936-020-03210-y

[76] Rouamba T, Sondo P, Derra K, Nakanabo-Diallo S, Bihoun B, Rouamba E, et al. Optimal Approach and Strategies to Strengthen Pharmacovigilance in Sub-Saharan Africa: A Cohort Study of Patients Treated with First-Line Artemisinin-Based Combination Therapies in the Nanoro Health and Demographic Surveillance System, Burkina Faso. Drug Design, Development and Therapy 2020;14:1507–21. https://doi.org/10.2147/dddt.S224857

[77] Argeseanu Cunningham S, Kwon C, Naser AM, Eilerts H, Reniers G. Pregnancy Surveillance Methods within Health and Demographic Surveillance Systems. Gates Open Research 2021;5 (no pagination). https://doi.org/10.12688/gatesopenres.13332.1

[78] Kwesiga D, Tawiah C, Imam MA, Tesega AK, Nareeba T, Enuameh YAK, et al. Barriers and enablers to reporting pregnancy and adverse pregnancy outcomes in population-based surveys: EN-INDEPTH study. Popul Health Metr 2021;19:15. https://doi.org/10.1186/s12963-020-00228-x

[79] NICHD DASH - Study Overview n.d. https://dash.nichd.nih.gov/study/20225 (accessed April 10, 2023).

[80] NICHD Global Network for Women's and Children's Health. Global Network for Women's and Children's Health Research Maternal Newborn Health Registry. clinicaltrials.gov; 2021.

[81] Althabe F, Moore JL, Gibbons L, Berrueta M, Goudar SS, Chomba E, et al. Adverse maternal and perinatal outcomes in adolescent pregnancies: The Global Network's Maternal Newborn Health Registry study. Reprod Health 2015;12 Suppl 2:S8. https://doi.org/10.1186/1742-4755-12-s2-s8

[82] Bucher S, Marete I, Tenge C, Liechty EA, Esamai F, Patel A, et al. A prospective observational description of frequency and timing of antenatal care attendance and coverage of selected interventions from sites in Argentina, Guatemala, India, Kenya, Pakistan and Zambia. Reprod Health 2015;12 Suppl 2:S12. https://doi.org/10.1186/1742-4755-12-s2-s12

[83] Goudar SS, Carlo WA, McClure EM, Pasha O, Patel A, Esamai F, et al. The Maternal and Newborn Health Registry Study of the Global Network for Women's and Children's Health Research. International Journal of Gynaecology and Obstetrics 2012;118:190–3. https://doi.org/10.1016/j.ijgo.2012.04.022

[84] Bose CL, Bauserman M, Goldenberg RL, Goudar SS, McClure EM, Pasha O, et al. The Global Network Maternal Newborn Health Registry: a multi-national, community-based registry of pregnancy outcomes. Reprod Health 2015;12 Suppl 2:S1. https://doi.org/10.1186/1742-4755-12-s2-s1

[85] Goudar SS, Stolka KB, Koso-Thomas M, Honnungar NV, Mastiholi SC, Ramadurg UY, et al. Data quality monitoring and performance metrics of a prospective, population-based observational study of maternal and newborn health in low resource settings. Reprod Health 2015;12 Suppl 2:S2. https://doi.org/10.1186/1742-4755-12-s2-s2

[86] Kodkany BS, Derman RJ, Honnungar NV, Tyagi NK, Goudar SS, Mastiholi SC, et al. Establishment of a Maternal Newborn Health Registry in the Belgaum District of Karnataka, India. Reprod Health 2015;12 Suppl 2:S3. https://doi.org/10.1186/1742-4755-12-s2-s3

[87] McClure EM, Saleem S, Goudar SS, Moore JL, Garces A, Esamai F, et al. Stillbirth rates in low-middle income countries 2010 - 2013: a population-based, multi-country study from the Global Network. Reprod Health 2015;12 Suppl 2:S7. https://doi.org/10.1186/1742-4755-12-s2-s7

[88] Pasha O, Saleem S, Ali S, Goudar SS, Garces A, Esamai F, et al. Maternal and newborn outcomes in Pakistan compared to other low and middle income countries in the Global Network's Maternal Newborn Health Registry: an active, communitybased, pregnancy surveillance mechanism. Reproductive Health 2015;12:1–10.

[89] McClure EM, Garces A, Saleem S, Moore JL, Bose CL, Esamai F, et al. Global Network for Women's and Children's Health Research: probable causes of stillbirth in low- and middle-income countries using a prospectively defined classification system. BJOG: An International Journal of Obstetrics and Gynaecology 2018;125:131–8. https://doi.org/10.1111/1471-0528.14493

[90] Saleem S, Tikmani SS, McClure EM, Moore JL, Azam SI, Dhaded SM, et al. Trends and determinants of stillbirth in developing countries: results from the Global Network's Population-Based Birth Registry. Reprod Health 2018;15:100. https://doi.org/10.1186/s12978-018-0526-3

[91] Aghai ZH, Goudar SS, Patel A, Saleem S, Dhaded SM, Kavi A, et al. Gender variations in neonatal and early infant mortality in India and Pakistan: a secondary analysis from the Global Network Maternal Newborn Health Registry. Reprod Health 2020;17:178. https://doi.org/10.1186/s12978-020-01028-0

[92] Billah SM, Haque R, Chowdhury AI, Siraj MS, Rahman QS, Hossain T, et al. Setting up a maternal and newborn registry applying electronic platform: an experience from the Bangladesh site of the global network for women's and children's health. Reproductive Health 2020;17(Supplement 2) (no pagination). https://doi.org/10.1186/s12978-020-00993-w

[93] Goudar SS, Goco N, Somannavar MS, Kavi A, Vernekar SS, Tshefu A, et al. Institutional deliveries and stillbirth and neonatal mortality in the Global Network's Maternal and Newborn Health Registry. Reprod Health 2020;17:179. https://doi.org/10.1186/s12978-020-01001-x

[94] Short VL, Hoffman M, Metgud M, Kavi A, Goudar SS, Okitawutshu J, et al. Safety of daily low-dose aspirin use during pregnancy in low-income and middle-income countries. AJOG Global Reports 2021;1:100003. https://doi.org/10.1016/j.xagr.2021.100003

[95] Naqvi S, Naqvi F, Saleem S, Thorsten VR, Figueroa L, Mazariegos M, et al. Health Care in Pregnancy During the COVID-19 Pandemic and Pregnancy Outcomes in Six Low-and-Middle-Income Countries: Evidence from a Prospective, Observational Registry of the Global Network for Women's and Children's Health. BJOG: An International Journal of Obstetrics and Gynaecology 2022. https://doi.org/10.1111/1471-0528.17175

[96] Naqvi S, Saleem S, Naqvi F, Billah SM, Nielsen E, Fogleman E, et al. Knowledge, attitudes, and practices of pregnant women regarding COVID-19 vaccination in pregnancy in 7 low- and middle-income countries: An observational trial from the Global Network for Women and Children's Health Research. BJOG: An International Journal of Obstetrics and Gynaecology 2022. https://doi.org/10.1111/1471-0528.17226

[97] Welcome to PREPARE - St George's, University of London 2019. https://gbsprepare.org/ (accessed April 10, 2023).

[98] SMRU | Shoklo Malaria Research Unit n.d. https://www.shoklo-unit.com/ (accessed April 10, 2023).

[99] Moore KA, Simpson JA, Paw MK, Pimanpanarak M, Wiladphaingern J, Rijken MJ, et al. Safety of artemisinins in first trimester of prospectively followed pregnancies: an observational study. The Lancet Infectious Diseases 2016;16:576–83. https://doi.org/10.1016/S1473-3099(15)00547-2

[100] Saito M, Dahal P, Tyrosvoutis MEG, Stepniewska K, Humphreys GS, Paw MK, et al. Optimal duration of follow-up for assessing efficacy of drugs for uncomplicated falciparum malaria in pregnancy in Asia: A systematic review and individual patient data metaanalysis. Tropical Medicine and International Health 2017;22(Supplement 1):95. https://doi.org/10.1111/%28ISSN%291365-3156

[101] Sub-Saharan Congenital Anomalies Network n.d. https://sscan.tghn.org/ (accessed April 15, 2023).

[102] Garcia AM, Machicado S, Gracia G, Zarante IM. Risk factors for congenital diaphragmatic hernia in the Bogota birth defects surveillance and follow-up program, Colombia. Pediatric Surgery International 2016;32(3):227–34. https://doi.org/10.1007/s00383-015-3832-7

[103] ECLAMC - Latin American Colaborative Study of Congenital Malformations n.d. http://www.eclamc.org/eng/index.php (accessed April 10, 2023).

[104] Castilla EE, Orioli IM. ECLAMC: The Latin-American Collaborative Study of Congenital Malformations. PHG 2004;7:76–94. https://doi.org/10.1159/000080776

[105] CHAMPS - We Build Knowledge to Save Children's Lives. CHAMPS Health n.d. https://champshealth.org/(accessed April 10, 2023).

[106] Zhou Y, Tao J, Wang K, Deng K, Wang Y, Zhao J, et al. Protocol of a prospective and multicentre China Teratology Birth Cohort (CTBC): association of maternal drug exposure during pregnancy with adverse pregnancy outcomes. BMC Pregnancy and Childbirth 2021;21(1) (no pagination). https://doi. org/10.1186/s12884-021-04073-0

[107] Assessment of Birth Outcomes in Eswatini after Transition to Dolutegravir-based Treatment - EGPAF. Elizabeth Glaser Pediatric AIDS Foundation n.d. https://pedaids.org/research/assessment-of-birth-outcomes-in-eswatini-after-transition-to-dolutegravir-based-treatment/ (accessed April 10, 2023).

[108] NEURAL TUBE AND OTHER BIRTH DEFECTS BY HIV STATUS AND ART REGIMEN IN ESWATINI. CROI Conference n.d. https://www.croiconference.org/abstract/neural-tube-and-other-birth-defects-by-hiv-status-and-art-regimen-in-eswatini/ (accessed April 10, 2023).

[109] Mumpe-Mwanja D, Barlow-Mosha L, Williamson D, Valencia D, Serunjogi R, Kakande A, et al. A hospital-based birth defects surveillance system in Kampala, Uganda. BMC Pregnancy and Childbirth 2019;19:372. https://doi.org/10.1186/s12884-019-2542-x

[110] Barlow-Mosha L, Mumpe DM, Williamson D, Valencia D, Serunjogi R, Matovu JN, et al. Neural tube defects, HIV, and antiretrovirals: Birth-defect surveillance in Uganda. Topics in Antiviral Medicine 2019;27(SUPPL 1):285s–6s.

[111] Barlow-Mosha L, Serunjogi R, Kalibbala D, Mumpe-Mwanja D, Williamson D, Valencia D, et al. Prevalence of neural tube defects, maternal HIV status, and antiretroviral therapy from a hospital-based birth defect surveillance in Kampala, Uganda. Birth Defects Res 2022;114:95–104. https://doi.org/10.1002/bdr2.1964

[112] Birth Defects Surveillance in Malawi. I-TECH 2022. https://www.go2itech.org/2022/03/birth-defects-surveillance-in-malawi/ (accessed April 10, 2023).

[113] Birth Defects Surveillance in Malawi - Project brief n.d.

[114] Albano JD, Vannappagari V, Scheuerle A, Watts H, Thorne C, Ng L, et al. Insti exposure and neural tube defects: Data from antiretroviral pregnancy registry. Topics in Antiviral Medicine 2019;27(SUPPL 1):287s.

[115] Caniglia EC, Abrams J, Diseko M, Mayondi G, Mabuta J, Makhema J, et al. Seasonality of adverse birth outcomes in women with and without HIV in a representative birth outcomes surveillance study in Botswana. BMJ Open 2021;11:e045882. https://doi.org/10.1136/bmjopen-2020-045882

[116] Hill A, Van De Ven NS, Pozniak A, Levi JA, Garratt A, Redd C, et al. Reports of neuraltube defects for 8 arts, in FDA, who, EMA, and UK safety databases. Topics in Antiviral Medicine 2019;27(SUPPL 1):286s–7s.

[117] Raesima MM, Ogbuabo CM, Thomas V, Forhan SE, Gokatweng G, Dintwa E, et al. Dolutegravir use at conception - Additional surveillance data from Botswana. New England Journal of Medicine 2019;381(9) (no pagination). https://doi.org/10.1056/NEJMc1908155

[118] Zash R, Caniglia EC, Diseko M, Mayondi G, Mabuta J, Luckett R, et al. Maternal weight and birth outcomes among women on antiretroviral treatment from conception in a birth surveillance study in Botswana. Journal of the International AIDS Society 2021;24(6) (no pagination). https://doi.org/10.1002/jia2.25763

[119] Zash R, Holmes L, Diseko M, Jacobson DL, Brummel S, Mayondi G, et al. Neural-Tube Defects and Antiretroviral Treatment Regimens in Botswana. New England Journal of Medicine 2019;381:827–40. https://doi.org/10.1056/NEJMoa1905230

[120] Birth Outcomes Surveillance Study: Tsepamo Study | Botswana Harvard Partnership n.d. https://bhp.org.bw/node/52 (accessed April 15, 2023).

[121] Thomas SV, Indrani L, Devi GC, Jacob S, Beegum J, Jacob PP, et al. Pregnancy in women with epilepsy: Preliminary results of Kerala registry of epilepsy and pregnancy. Neurology India 2001;49(1):60–6.

[122] Thomas SV, Ajaykumar B, Sindhu K, Nair MKC, George B, Sarma PS. Motor and mental development of infants exposed to antiepileptic drugs in utero. Epilepsy & Behavior 2008;13:229–36. https://doi.org/10.1016/j.yebeh.2008.01.010

[123] Tomson T, Battino D, Craig J, Hernandez-Diaz S, Holmes LB, Lindhout D, et al. Pregnancy registries: Differences, similarities, and possible harmonization. Epilepsia 2010;51:909–15. https://doi.org/10.1111/j.1528-1167.2010.02525.x

[124] Thomas SV, Syam UK, Asha PT, Sucharitha DJ, Sabarinathan S, Sarma PS. Pregnancy outcome and fetal malformation risk of women with epilepsy: Pregnancy registry based experience from Kerala, India. Birth Defects Research Part A - Clinical and Molecular Teratology 2011;91(5):388. https://doi.org/10.1002/bdra.20834

[125] Thomas SV, Jose M, Divakaran S, Sankara Sarma P. Malformation risk of antiepileptic drug exposure during pregnancy in women with epilepsy: Results from a pregnancy registry in South India. Epilepsia 2017;58(2):274–81. https://doi.org/10.1111/epi.13632

[126] Keni RR, Jose M, A.S R, Baishya J, Sankara Sarma P, Thomas SV. Anti-epileptic drug and folic acid usage during pregnancy, seizure and malformation outcomes: Changes over two decades in the Kerala Registry of Epilepsy and Pregnancy. Epilepsy Research 2020;159:106250. https://doi.org/10.1016/j.eplepsyres.2019.106250

[127] Seshachala BB, Jose M, Lathikakumari AM, Murali S, Kumar AS, Thomas SV. Valproate usage in pregnancy: An audit from the Kerala Registry of Epilepsy and Pregnancy. Epilepsia 2021;62:1141–7. https://doi.org/10.1111/epi.16882

[128] Thomas SV, Jeemon P, Pillai R, Jose M, Lalithakumari AM, Murali S, et al. Malformation risk of new anti-epileptic drugs in women with epilepsy; observational data from the Kerala registry of epilepsy and pregnancy (KREP). Seizure - European Journal of Epilepsy 2021;93:127–32. https://doi.org/10.1016/j.seizure.2021.10.015

[129] Avila WS, Rivera MAM, Marques-Santos C, Rivera IR, Costa MENC, Lucena AJG de, et al. The REBECGA Brazilian Registry of Pregnancy and Heart Disease: Rationale and Design. Int j Cardiovasc Sci (Impr) 2021;34:452–8. https://doi.org/10.36660/ijcs.20200419

[130] Gnanaraj JP, Princy SA, Sliwa-Hahnle K, Sathyendra S, Jeyabalan N, Sethumadhavan R, et al. Tamil Nadu Pregnancy and Heart Disease Registry (TNPHDR): design and methodology. BMC Pregnancy and Childbirth 2022;22:80. https://doi.org/10.1186/s12884-021-04305-3

[131] Meischenguiser R, D'Giano CH, Ferraro SM. Oxcarbazepine in pregnancy: clinical experience in Argentina. Epilepsy & Behavior 2004;5:163–7. https://doi.org/10.1016/j.yebeh.2003.11.020

[132] Bagkeris E, Malyuta R, Volokha A, Cortina-Borja M, Bailey H, Townsend CL, et al. Pregnancy outcomes in hiv-positive women in ukraine, 2000-12 (european collaborative study in eurocoord): An observational cohort study. The Lancet HIV 2015;2(9):e385–92. https://doi.org/10.1016/S2352-3018%2815%2900079-X

[133] European Network of HIV/AIDS Cohort Studies to Coordinate at European and International Level Clinical Research on HIV/AIDS | EUROCOORD Project | Fact Sheet | FP7 | CORDIS | European Commission n.d. https://cordis.europa.eu/project/id/260694 (accessed April 10, 2023).

[134] UCL. EuroCoord: Enhancing clinical & epidemiological HIV research in Europe through cohort collaboration. Institute for Global Health 2019. https://www.ucl.ac.uk/global-health/research/z-research/eurocoord-enhancing-clinical-epidemiological-hiv-research-europe-through-cohort (accessed April 10, 2023).

[135] Siddiqi M, Zaman Q, Mehboob N, Mansoor S. A registry of maternal and fetal outcomes in pregnant epileptic women from Pakistan. J Neurol Neurosci 2019;10:303. https://doi.org/10.36648/2171-6625.10.4.303

[136] Tilson HH. Using Registries to Monitor HIV Pre-Exposure Prophylaxis Safety in Clinical Settings. American Journal of Preventive Medicine 2013;44:S151–5. https://doi.org/10.1016/j. amepre.2012.09.042

[137] Wang L, Kourtis AP, Ellington S, Legardy-Williams J, Bulterys M. Safety of Tenofovir During Pregnancy for the Mother and Fetus: A Systematic Review. Clinical Infectious Diseases 2013;57:1773–81. https://doi.org/10.1093/cid/cit601

[138] Vannappagari V, Koram N, Albano J, Tilson H, Gee C. Abacavir and Lamivudine Exposures During Pregnancy and Non-defect Adverse Pregnancy Outcomes: Data From the Antiretroviral Pregnancy Registry. JAIDS Journal of Acquired Immune Deficiency Syndromes 2015;68.

[139] Vannappagari V, Albano JD, Koram N, Tilson H, Scheuerle AE, Napier MD. Prenatal exposure to zidovudine and risk for ventricular septal defects and congenital heart defects: data from the Antiretroviral Pregnancy Registry. European Journal of Obstetrics, Gynecology, and Reproductive Biology 2016;197:6–10. https://doi.org/10.1016/j. ejogrb.2015.11.015

[140] Mofenson LM, Vannappagari V, Scheuerle AE, Baugh B, Beckerman KP, Betman H, et al. Periconceptional antiretroviral exposure and central nervous system (CNS) and neural tube birth defects-data from Antiretroviral Pregnancy Registry (APR). Journal of the International AIDS Society Conference: 10th IAS Conference on HIV Science Mexico City Mexico 2019;22. https://doi.org/10.1002/jia2.25327

[141] Hellwig K, Duarte Caron F, Wicklein E-M, Bhatti A, Adamo A. Pregnancy outcomes from the global pharmacovigilance database on interferon beta-1b exposure. Therapeutic Advances in Neurological Disorders 2020;13:1756286420910310. https://doi. org/10.1177/1756286420910310

[142] Beghi E, Annegers JF, Epilepsy for the CGPR in. Pregnancy Registries in Epilepsy. Epilepsia 2001;42:1422–5. https://doi.org/10.1046/j.1528-1157.2001.11201.x

[143] Gogatishvili N, Ediberidze T, Mamukadze S, Lomidze G, Tatishvili N, Kasradze S. Cognitive outcomes of children with fetal antiepileptic drug exposure at the age of 3-6 years-preliminary data. European Journal of Neurology 2015;1):329. https://doi. org/10.1111/ene.12807

[144] The EURAP Study Group. Utilization of antiepileptic drugs during pregnancy: Comparative patterns in 38 countries based on data from the EURAP registry. Epilepsia 2009;50:2305–9. https://doi.org/10.1111/j.1528-1167.2009.02093.x

[145] Tomson T, Battino D, Bonizzoni E, Craig J, Lindhout D, Sabers A, et al. Dose-dependent risk of malformations with antiepileptic drugs: an analysis of data from the EURAP epilepsy and pregnancy registry. The Lancet Neurology 2011;10:609–17. https://doi.org/10.1016/S1474-4422(11)70107-7

[146] Kochen S, Salera C, Seni J. Pregnant women with epilepsy in a developing country. Open Neurology Journal 2011;5(1):63–7. https://doi.org/10.2174/187 4205X01105010063

[147] EURAP - International Registry of Antiepileptic Drugs and Pregnancy. EURAP n.d. https://eurapinternational.org/ (accessed April 10, 2023).

[148] Tennis P, Eldridge RR, International Lamotrigine Pregnancy Registry Scientific Advisory Committee. Preliminary Results on Pregnancy Outcomes in Women Using Lamotrigine. Epilepsia 2002;43:1161–7. https://doi.org/10.1046/j.1528-1157.2002.45901.x

[149] GlaxoSmithKline Pregnancy Registries n.d. https://pregnancyregistry.gsk.com/ (accessed April 10, 2023).

[150] GlaxoSmithKline. MENVEO Pregnancy Registry: an Observational Study on the Safety of MENVEO Exposure in Pregnant Women and Their Offspring. clinicaltrials.gov; 2019.

[151] GlaxoSmithKline. Fluarix/ FluLaval/ Fluarix Quadrivalent/ FluLaval Quadrivalent Pregnancy Registry: a Prospective, Exploratory, Cohort Study to Detect and Describe Abnormal Pregnancy Outcomes in Women Intentionally or Unintentionally Vaccinated With Fluarix or Fluarix Quadrivalent or FluLaval or FluLaval Quadrivalent During Pregnancy or Within 28 Days Preceding Conception. clinicaltrials.gov; 2020.

[152] GlaxoSmithKline. Twinrix [Hepatitis A Inactivated & Hepatitis B (Recombinant) Vaccine] Pregnancy Registry. clinicaltrials.gov; 2018.

[153] GlaxoSmithKline. A Post-marketing, Observational, Retrospective, Cohort Study to Assess the Safety of RefortrixTM (Tdap) When Administered During Pregnancy in a Maternal Immunization Program in Brazil. clinicaltrials.gov; 2019.

[154] The Gilenya Pregnancy Registry. Novartis Recruiting Clinical Trials n.d. https://www.novartis.com/clinicaltrials/study/nct01285479 (accessed April 10, 2023).

[155] The Gilenya Pregnancy Registry. Novartis n.d. https://www.novartis.com/clinicaltrials/study/nct01285479 (accessed June 29, 2023).

[156] GILENYA REGISTRY n.d. https://www.gilenyapregnancyregistry.com/ (accessed June 29, 2023).

[157] Khromava A, Cohen CJ, Mazur M, Kanesa-thasan N, Crucitti A, Seifert H. Manufacturers' postmarketing safety surveillance of influenza vaccine exposure in pregnancy. American Journal of Obstetrics and Gynecology 2012;207:S52–6. https://doi.org/10.1016/j.ajog.2012.06.074

[158] Ledlie S, Gandhi-Banga S, Shrestha A, Mallett Moore T, Khromava A. Exposure to quadrivalent influenza vaccine during pregnancy: Results from a global pregnancy registry. Influenza and Other Respiratory Viruses 2022;16:90–100. https://doi.org/10.1111/irv.12897

[159] Sanofi Pasteur Pregnancy Registries n.d. https://www.sanofipasteurpregnancyregistry.com/ (accessed April 10, 2023).

[160] Sanofi Pasteur, a Sanofi Company. Sanofi Pasteur Quadrivalent Influenza Vaccine Pregnancy Registry Protocol. clinicaltrials.gov; 2020.

[161] Sanofi Pasteur, a Sanofi Company. Sanofi Pasteur Quadrivalent Intradermal Influenza Vaccine Pregnancy Registry Protocol. clinicaltrials.gov; 2020.

[162] Sanofi Pasteur, a Sanofi Company. A Pregnancy Registry to Evaluate the Safety of Dengue Vaccine Among Inadvertently Exposed Pregnant Women and Their Offsprings (DNG16). clinicaltrials.gov; 2023.

[163] GARFIELD-VTE - Global Anticoagulant Registry in the Field - observed treatment and outcomes in partients with acute venous thromboembolism in the real world. GARFIELD-VTE Registry n.d. https://vte.garfieldregistry.org/ (accessed April 10, 2023).

[164] Haas S, Ageno W, Weitz JI, Goldhaber SZ, Turpie AGG, Goto S, et al. Anticoagulation therapy patterns for acute treatment of venous thromboembolism in GARFIELD-VTE patients. Journal of Thrombosis and Haemostasis 2019;17:1694–706. https://doi.org/10.1111/jth.14548

[165] Friend S, Richman S, Bloomgren G, Cristiano LM, Wenten M. Evaluation of pregnancy outcomes from the Tysabri® (natalizumab) pregnancy exposure registry: a global, observational, follow-up study. BMC Neurology 2016;16:150. https://doi.org/10.1186/s12883-016-0674-4

[166] Biogen. TYSABRI® Pregnancy Exposure Registry. clinicaltrials.gov; 2014.

[167] Dehnavieh R, Haghdoost A, Khosravi A, Hoseinabadi F, Rahimi H, Poursheikhali A, et al. The District Health Information System (DHIS2): A literature review and meta-synthesis of its strengths and operational challenges based on the experiences of 11 countries. HIM J 2019;48:62–75. https://doi.org/10.1177/1833358318777713

[168] DHIS2. DHIS2 n.d. https://dhis2.org/ (accessed April 15, 2023).

[169] Boulle A, Vega I de, Moodley M, Shand L, Loff A, Fredericks N, et al. Data Centre Profile: The Provincial Health Data Centre of the Western Cape Province, South Africa. International Journal of Population Data Science 2019;4. https://doi.org/10.23889/ijpds.v4i2.1143

[170] Perinatal Information System - PAHO/WHO | Pan American Health Organization n.d. https://www.paho.org/en/latin-american-center-perinatology-women-and-reproductive-health-clap/perinatal-information-system (accessed April 15, 2023).

[171] Karolinski A, Mercer R, Bolzán A, Salgado P, Ocampo C, Nieto R, et al. Bases para el desarrollo e implementación de un modelo de información en salud de la mujer y perinatal orientado a la gestión en Latinoamérica. Rev Panam Salud Publica 2018;42:e148. https://doi.org/10.26633/RPSP.2018.148

[172] Bradley H, Tapia V, Kamb ML, Newman LM, Garcia PJ, Serruya SJ, et al. Can the Perinatal Information System in Peru be used to measure the proportion of adverse birth outcomes attributable to maternal syphilis infection? Rev Panam Salud Publica 2014;36:73–9.

[173] Serruya SJ, Duran P, Martinez G, Romero M, Caffe S, Alonso M, et al. Maternal and congenital syphilis in selected Latin America and Caribbean countries: a multi-country analysis using data from the Perinatal Information System. Sex Health 2015;12:164–9. https://doi.org/10.1071/SH14191

[174] World Health Organization (WHO). Global Spending on Health: A World in Transition 2019.

[175] Ng JYS, Ramadani RV, Hendrawan D, Duc DT, Kiet PHT. National Health Insurance Databases in Indonesia, Vietnam and the Philippines. PharmacoEconomics Open 2019;3:517–26. https://doi.org/10.1007/s41669-019-0127-2

[176] Durizzo K, Harttgen K, Tediosi F, Sahu M, Kuwawenaruwa A, Salari P, et al. Toward mandatory health insurance in low-income countries?
An analysis of claims data in Tanzania.
Health Economics 2022;31:2187–207. https://doi.org/10.1002/hec.4568

[177] Kolbe-Alexander TL, Buckmaster C, Nossel C, Dreyer L, Bull F, Noakes TD, et al. Chronic disease risk factors, healthy days and medical claims in South African employees presenting for health risk screening. BMC Public Health 2008;8:228. https://doi.org/10.1186/1471-2458-8-228

[178] Nachega JB, Hislop M, Nguyen H, Dowdy DW, Chaisson RE, Regensberg L, et al. Antiretroviral Therapy Adherence, Virologic and Immunologic Outcomes in Adolescents Compared With Adults in Southern Africa. JAIDS Journal of Acquired Immune Deficiency Syndromes 2009;51:65. https://doi.org/10.1097/QAI.0b013e318199072e

[179] Ankrah D, Hallas J, Odei J, Asenso-Boadi F, Dsane-Selby L, Donneyong M. A review of the Ghana National Health Insurance Scheme claims database: possibilities and limits for drug utilization research. Basic & Clinical Pharmacology & Toxicology 2019;124:18–27. https://doi.org/10.1111/bcpt.13136

[180] Haas AD, van Oosterhout JJ, Tenthani L, Jahn A, Zwahlen M, Msukwa MT, et al. HIV transmission and retention in care among HIV-exposed children enrolled in Malawi's prevention of mother-to-child transmission programme. Journal of the International AIDS Society 2017;20:21947. https://doi.org/10.7448/ias.20.1.21947

[181] Home - Baobab Health Trust 2022. https://baobabhealthtrust.org/ (accessed April 10, 2023).

[182] Zhang J, Ung COL, Guan X, Shi L. Safety of medication use during pregnancy in mainland China: Based on a national health insurance database in 2015. BMC Pregnancy and Childbirth 2019;19(1) (no pagination). https://doi.org/10.1186/s12884-019-2622-y

[183] Wilms MC, Mbembela O, Prytherch H, Hellmold P, Kuelker R. An in-depth, exploratory assessment of the implementation of the National Health Information System at a district level hospital in Tanzania. BMC Health Services Research 2014;14:91. https://doi.org/10.1186/1472-6963-14-91

[184] Venkateswaran M, Mørkrid K, Khader KA, Awwad T, Friberg IK, Ghanem B, et al. Comparing individual-level clinical data from antenatal records with routine health information systems indicators for antenatal care in the West Bank: A cross-sectional study. PLOS ONE 2018;13:e0207813. https://doi.org/10.1371/journal.pone.0207813

[185] Venkateswaran M, Ghanem B, Abbas E, Khader KA, Ward IA, Awwad T, et al. A digital health registry with clinical decision support for improving quality of antenatal care in Palestine (eRegQual): a pragmatic, cluster-randomised, controlled, superiority trial. The Lancet Digital Health 2022;4:e126–36. https://doi.org/10.1016/S2589-7500(21)00269-7

[186] Hassan S, Vikanes A, Laine K, Zimmo K, Zimmo M, Bjertness E, et al. Building a research registry for studying birth complications and outcomes in six Palestinian governmental hospitals. BMC Pregnancy Childbirth 2017;17:112. https://doi.org/10.1186/s12884-017-1296-6

[187] Dias B. DHIS2 tracker e-Registry in Palestine. DHIS2 2020. https://dhis2.org/palestine-tracker-user-story/ (accessed April 10, 2023).

[188] Maternal and Child Health e-Registry n.d. https://www.pniph.org/index.php/en/component/content/article/93-health-systems/167-maternal-and-child-health-e-registry (accessed April 10, 2023).

[189] Fescina R. History of the Perinatal Information System. Making Pregnancy Safer. 2010.

[190] Gumede-Moyo S, Todd J, Schaap A, Mee P, Filteau S. Effect of prevention of mother-to-child transmission strategies on antiretroviral therapy coverage in pregnant women in Zambia: analysis using routinely collected data (2010-15). The Lancet Global Health 2019;7(Supplement 1):S25. https://doi.org/10.1016/S2214-109X%2819%2930110-X

[191] Gumede-Moyo S, Todd J, Bond V, Mee P, Filteau S. A qualitative inquiry into implementing an electronic health record system (SmartCare) for prevention of mother-to-child transmission data in Zambia: a retrospective study. BMJ Open 2019;9:e030428. https://doi.org/10.1136/bmjopen-2019-030428

[192] Kaumba PC. Factors affecting the implementation of the SmartCare EHR system in Zambia. Social Sciences & Humanities Open 2023;7:100399. https://doi.org/10.1016/j.ssaho.2023.100399

[193] Mehta U, Heekes A, Hons Bm, Kalk E, Boulle A. Assessing the value of Western Cape Provincial Government health administrative data and electronic pharmacy records in ascertaining medicine use during pregnancy. S Afr Med J 2018;108:439–43.

[194] Mehta U, Smith M, Kalk E, Hayes H, Swart A, Tucker L, et al. Understanding and Responding to Prescribing Patterns of Sodium Valproate-Containing Medicines in Pregnant Women and Women of Childbearing Age in Western Cape, South Africa. Drug Safety 2021;44(1):41–51. https://doi.org/10.1007/s40264-020-00987-4

[195] Arriola CS, Vasconez N, Thompson MG, Olsen SJ, Moen AC, Bresee J, et al. Association of influenza vaccination during pregnancy with birth outcomes in Nicaragua. Vaccine 2017;35:3056–63. https://doi.org/10.1016/j.vaccine.2017.04.045

[196] Asavapiriyanont S, Kittikraisak W, Suntarattiwong P, Ditsungnoen D, Kaoiean S, Phadungkiatwatana P, et al. Tolerability of trivalent inactivated influenza vaccine among pregnant women, 2015. BMC Pregnancy and Childbirth 2018;18(1) (no pagination). https://doi.org/10.1186/s12884-18-1712-6

[197] Bengtson AM, Phillips TK, le Roux SM, Brittain K, Zerbe A, Madlala HP, et al. High blood pressure at entry into antenatal care and birth outcomes among a cohort of HIV-uninfected women and women living with HIV initiating antiretroviral therapy in South Africa. Pregnancy Hypertension 2021;23:79–86. https://doi.org/10.1016/j.preghy.2020.11.005

[198] Chaudhury S, Mayondi GK, Williams PL, Leidner J, Shapiro R, Diseko M, et al. In-utero exposure to antiretrovirals and neurodevelopment among HIV-exposed-uninfected children in Botswana. AIDS 2018;32:1173–83. https://doi.org/10.1097/qad.0000000000001790

[199] Delicio AM, Lajos GJ, Amaral E, Cavichiolli F, Polydoro M, Milanez H. Adverse effects in children exposed to maternal HIV and antiretroviral therapy during pregnancy in Brazil: a cohort study. Reproductive Health 2018;15:76. https://doi.org/10.1186/s12978-018-0513-8

[200] Herce ME, Chagomerana MB, Zalla LC, Carbone NB, Chi BH, Eliya MT, et al. Community-facility linkage models and maternal and infant health outcomes in Malawi's PMTCT/ART program: A cohort study. PLoS Medicine 2021;18(9) (no pagination). https://doi.org/10.1371/journal.pmed.1003780

[201] Manyando C, Mkandawire R, Puma L, Sinkala M, Mpabalwani E, Njunju E, et al. Safety of artemether-lumefantrine in pregnant women with malaria: results of a prospective cohort study in Zambia. Malaria Journal 2010;9:249. https://doi.org/10.1186/1475-2875-9-249

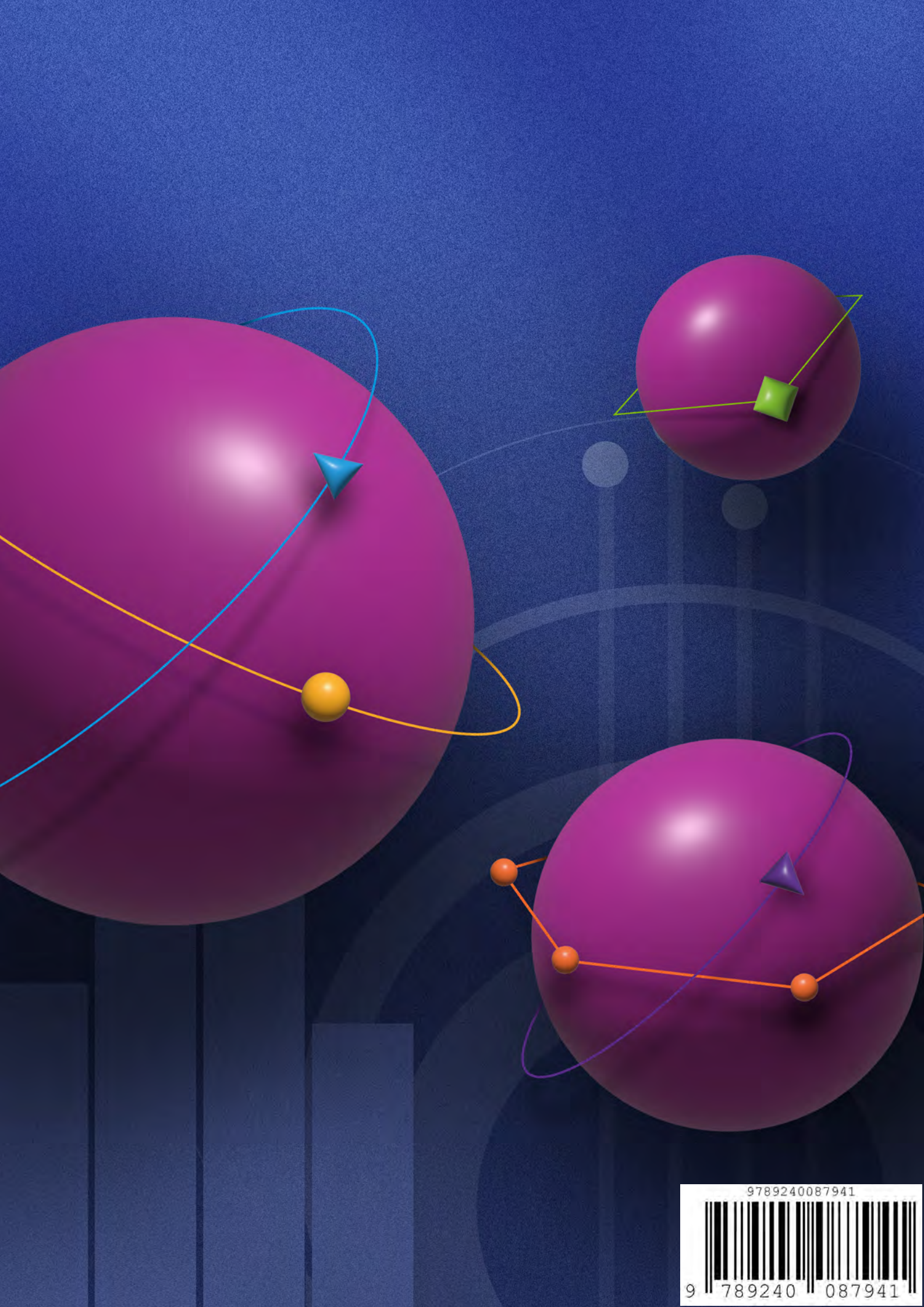
[202] Manyando C, Njunju EM, Virtanen M, Hamed K, Gomes M, Van Geertruyden JP. Exposure to artemether-lumefantrine (Coartem) in first trimester pregnancy in an observational study in Zambia. Malaria Journal 2015;14:77. https://doi.org/10.1186/s12936-015-0578-6

[203] Oliveira MS de. Farmacovigilância de medicamentos anti-retrovirais em gestantes portadoras de HIV e em crianças espostas ao HIV durante a gestação em uso de profilaxia da transmissão vertical: estudo piloto de incidência 2007:x,123-x,123.

[204] Rulisa S. Pharmacovigilance of artemether-lumefantrine in pregnant women followed up till delivery in Rwanda. Tropical Medicine and International Health 2009;2):64–5. https://doi.org/10.1111/j.1365-3156.2009.02353.x

[205] Rulisa S, Kaligirwa N, Agaba S, Karema C, Mens PF, de Vries PJ. Pharmacovigilance of artemether-lumefantrine in pregnant women followed until delivery in Rwanda. Malaria Journal 2012;11:225. https://doi.org/10.1186/1475-2875-11-225

[206] Poda A, Hema A, Konate A, Kabore F, Zoungrana J, Kamboule E, et al. Pregnancy rate and birth outcomes among women receiving antiretroviral therapy in Burkina Faso: A retrospective cohort study. Pan African Medical Journal 2016;23. https://doi.org/10.11604/pamj.2016.23.105.7372



9789240087941