

Title: A Review of the Private Sector's Contribution to Immunization Service Delivery in Low, Middle, and High-Income Countries

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Key messages:

- Evidence remains limited about the private sector's contribution to immunization service delivery, impact on equity of immunization services, and interaction between pharmaceutical industry and the private sector.
- While there are a number of countries that have successfully engaged with the private sector, others have had limited involvement or experienced challenges with private sector provision of immunization services.
- Given countries' varying and unique characteristics, a standard approach to engaging the private sector is unrealistic. However, identifying characteristics of strong programmes to guide and adapt to the country context is useful.

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DRAFT

Abstract

Success of the Global Vaccine Action Plan and improvements in vaccination coverage rates at the sub-national, national, and global levels requires optimizing the private sector's engagement in the area of immunization delivery. However, the impact of the private sector on vaccination coverage and practices varies between countries and remains poorly understood. Expanding on a previous review published in 2011, the authors conducted a literature review and semi-structured interviews to assess private providers engagement in immunization delivery across low, middle, and high-income countries. To identify potential contributions, challenges, and ways to optimize private sector engagement in the area of immunization delivery, three key dimensions of the private sector were assessed: (1) contribution to immunization services; (2) impact on equity of immunization services; (3) interaction between pharmaceutical industry and private sector. Based on limited sources of information we were able to identify that while there are a number of countries that have successfully engaged with the private sector and used it as a platform to improve their immunization programmes, others have minimal involvement or have experienced challenges. To productively engage the private sector for immunization service delivery there needs to be increased collaboration between private sector providers and national immunization programs. This should start with a review of the private sector's contribution to immunization delivery, programme monitoring, adverse events, disease surveillance, and a look into quality of service delivery. Ideally, this would identify and inventory key stakeholders in the private sector involved or potentially involved in vaccination. This could be followed by determination of an optimal model of public private engagement, expansion of dialogue to achieve common immunization goals, and development of collaborative activities including potential memorandum of understanding, agreements or contracts. Globally, too few efforts have assessed the current and potential contribution of private providers to national immunization programs.

I. Introduction

With the ability to prevent communicable disease at the population level, vaccinations are a core component of the human right to health (1). In 2012, the World Health Assembly adopted Global Vaccine Action Plan (GVAP) with the aim to provide equitable access to vaccines by 2020 (1). Acknowledging a global health landscape that supports collaboration between sectors, the GVAP sets auspicious goals that are only attainable through shared responsibility and partnerships (1). Specifically, the success of GVAP and further improvements in vaccination coverage rates at the sub-national, national, and global levels requires optimization of interaction between public and private health care sectors. However, the impact of the private sector on vaccination coverage and practices varies between countries and remains poorly understood. This not only applies to contribution of vaccinations delivered, but interaction between sectors, level of monitoring, and degree of regulations imposed on private providers.

In every country the national immunization program (NIP) leads immunization service delivery with varied contributions from the private sector. Traditionally, immunizations are part of a package of basic health services provided and financed by the government and often supplemented by international donors in low and middle-income settings. A country's ability to deliver these services is directly affected by its economic level, governance, and administrative capacity (2). Frequently, in developing countries, the desire to provide preventative services is challenged by finances, health infrastructure, and competing health priorities (2). The private non-for-profit sector (NGOs) often provides immunization services to fill these gaps and increase access to services, whereas the private for-profit sector more typically provides services to those with the ability to pay.

Globally, there are a variety of models that describe the role of public and private providers and the health sector in delivery of immunization services. In the majority of low and middle-income countries (LMICs), publicly funded immunization services are provided solely by public providers, but in many countries private providers also contribute to delivery of these services (2,3). Private providers may work full-time in the private sector or they may be based out of the public sector and serve as part time private providers delivering immunizations; these private providers may also operate in school and occupational health services (4). High-income countries often rely on private providers as their primary means for delivering immunizations due to financing of vaccination services through established health insurance schemes. Increasingly, middle and low-income countries are using the private sector to deliver core health care services funded by Universal Health Coverage programs (2,3).

In 2011, Levin and Kaddar reviewed the role of the private sector in the provision of immunization services in LMICs and found that private providers play different roles in immunization delivery according to a country's economic development, infrastructure to support public healthcare services, and presence of private entities in the health sector (2). However, there were significant geographical and thematic gaps in their findings due to general lack of published literature on the topic. Our paper seeks to expand on the previous review by examining evidence published since their analysis, in addition to considering evidence from high-income countries and key informant interviews. Specifically, we consider three dimensions of private sector engagement: (1) contribution to immunization service delivery; (2) impact on equity of immunization services; (3) interaction between pharmaceutical industry and private sector. Following description of these dimensions, we identify potential contributions and challenges, as well as ways to optimize the private sector's engagement in the area of immunization delivery.

II. Methods

A literature review was conducted between May and August 2016, to assess the provision of vaccination services provided by entities outside of the government, including private independent practitioners¹, private for-profit providers, and private not-for-profit non-governmental organizations (NGOs). The review was limited to the private sector's role in service delivery and did not consider the role of the private sector through philanthropic donations or pharmaceutical company support.

Primary literature was identified in bibliographic databases: PubMed, Scopus, Cochrane Library, and Web of Science. The search was also extended to the WHO library database WHOLIS, which provides access to research published at the local level not indexed in MEDLINE or similar tools. Additionally, the literature review included World Bank reports on private sector healthcare utilization at the country level identified in the World Bank Documents and Reports repository. Indexed and free-text search terms were used in a variety of combinations and included 'immunization', OR 'immunization programs', OR 'vaccination', AND 'private-sector', OR 'public-private sector partnerships', OR 'health services', OR, 'non-governmental', OR 'for-profit', OR 'regulation'. Articles were included if they were set in low and middle-income countries published after 2009, and not included in the Levin and Kaddar analysis or set in high-income countries without a date restriction. Following the literature review, an additional search was conducted to identify any articles that cited Levin and Kaddar, as well as a hand search of references found in articles identified in the literature review.

After screening of titles abstracts were reviewed for inclusion if they directly addressed private sector delivery of immunization services, monitoring and regulation of immunization services (including mention in overall analysis of pharmaceutical regulations), or if immunization services were referenced as a package of maternal and child health services. Abstracts were excluded if they addressed private sector funding mechanisms or vaccine financing, immunization delivery in the context of a public health emergency (e.g. H1N1), or if they did not directly address private sector delivery of services.

Articles from selected abstracts then underwent a full review and were included in the report if they reported on one or more of the following topics: (1) immunization services provided by the private sector; (2) health care services provided by the private sector; (3) health facility assessments conducted in the private sector; (4) private provider attitudes and knowledge about immunizations; (5) contracted health services; (6) regulation of health services; (7) immunization coordination mechanisms; (8) immunization coverage; (9) equity of health services; (10) immunization decision-making processes including National Technical Advisory Groups; (11) interaction between pharmaceutical industry and private sector relative to immunization.

To expand information on the topic, semi-structured interviews were conducted with countries where geographic gaps in the literature were identified to obtain a more comprehensive assessment spanning all WHO regions. A limited convenience sample of countries was selected in which personal and direct contact with key informants could facilitate quick interaction and successful discussion. These countries either had known issues in engaging with the private sector or employed a successful model that could provide additional information. Identified countries included Mexico

¹ Private providers may include physicians, nurses, midwives, and pharmacists who are directly involved in the administration of vaccines; they may work full time in the private sector, full time in the public sector, or part-time in the private sector.

and Canada for the Region of the Americas, Germany for the European Region, and Lebanon and Bahrain for the Eastern Mediterranean Region. Countries in the African and South-East Asia Regions were not included because of existing information in these areas. Additionally, preliminary results from a survey on private sector utilization recently conducted in the WHO's Western Pacific Region were incorporated into this review.

Immunization experts (Table I) were identified by the WHO Secretariat and select members of the Strategic Advisory Group of Experts (SAGE) on Immunization. Experts either served as national immunization managers or WHO country office representatives serving as focal points for immunization in their country. They were contacted via email regarding their participation. Interviews were conducted over the phone and lasted roughly one hour. Interviews included six open-ended questions that addressed (1) role of private sector in immunization delivery including percentage of immunization services delivered; (2) interaction and relationship between public and private sectors; (3) quality standards including post market surveillance and reporting of doses; (4) equity of immunization service delivery. After each interview, a summary was shared with the interviewee to ensure accurate representation.

III. Results

The literature search identified a total of 1,166 references, of which 417 were duplicates. In total, 246 articles were reviewed for analysis, 39 publications were selected for inclusion, and five semi-structured interviews were conducted (Figure I, Table II). Data captured during the literature review and interviews were organized according to the following categories for ease of reporting:

1. Immunization Service Delivery
 - a. Contribution to Vaccine Delivery
 - i. Proportion of Private Facilities Providing Vaccination Services
 - ii. Proportion of Vaccinations Provided by Private Providers ("vaccination share"; results presented by WHO region²)
 - b. Quality Standards
 - c. Advocacy for Immunization
 - d. Programme Monitoring and Post Market Surveillance
 - e. Decision-Making
2. Impact on Equity of Immunization Services
3. Interaction Between Pharmaceutical Industry and Private Sector

1. Immunization Service Delivery

A. Contribution to Vaccine Delivery

Since Levin and Kaddar's review, limited information has captured the private sectors contribution to vaccine delivery. For this review, contribution to vaccine delivery was assessed as the *proportion of private facilities providing vaccination services* or the *proportion of vaccinations provided by private providers* ("vaccination share").

Proportion of Private Facilities Providing Vaccination Services

Three articles reported on the proportion of private facilities providing vaccinations in Kenya, the Republic of Korea, and Cambodia (Table II, III). In Kenya, 34% of private facilities and 80% of

² <http://www.who.int/about/regions/en/>

NGO-managed facilities provided vaccinations (3). In the Republic of Korea, 60% of private providers offered vaccinations (5). In a study in four cities in Cambodia, the percentage of private providers who provided some form of immunization services was 65%, but the percentage varied by antigen (6). Hepatitis B vaccine was provided at 56% of sites, tetanus vaccine at 35% of sites, but other vaccines were rarely provided (6).

Proportion of Vaccinations Provided by Private Providers (“vaccination share”)

WHO African Region

Six papers referenced private sector vaccine share in the African Region for Nigeria, Kenya, Uganda, Gabon, and Sub-Saharan Africa as a whole (Table II, III). Oluoha et al’s retrospective study in Nigeria considered utilization of private health facilities for immunization delivery. In 2009, the Ministry of Health (MOH) established a Memorandum of Understanding (MOU) with private health facilities in four local government authorities (LGAs) in Abia state for the provision of free immunization services. This collaboration included support from the MOH and in return private health facilities had to comply with the MOH’s reporting, monitoring, and evaluation requirements. In the four LGAs that fully operationalized the public-private partnership (PPP)³, 45% of private health facilities offered immunizations (8). These facilities provided 21% of overall immunization services compared to 79% administered by the public sector⁴ (8). In 2010, one year after the PPP was instated, the mean third dose diphtheria-tetanus-pertussis (DTP3) vaccination coverage was 95% in the four PPP LGAs compared to 59% in those who did not operationalize the PPP; the national reported DTP3 coverage in Nigeria was 68% at this time (8). Oluoha et al. postulated that the discrepancy in DTP3 coverage rates between LGAs who instated the PPP and those who did not could be attributed to increased accessibility to health facilities in the PPP areas (8).

Kenya’s utilization of the private for-profit sector in immunization delivery was assessed by Sood and Wagner who found that the odds of a child receiving no immunizations was 4.8 times higher in areas where all health facilities were for-profit compared to areas with no for-profit facilities (3). In a different study, only 29% of private for-profit facilities reported receipt of technical or financial assistance for immunizations (7).

A survey in Kampala, Uganda, found that 30% of respondents received services from private facilities, 68% from public facilities, and 2% obtained vaccines from outreach services provided by public providers and NGOs (9). Reasons reported for low involvement of the private sector included lack of financial support for immunization activities from the government and diminished technical capacity (9). According to a World Bank report, in Ghana the government provides free vaccines and promotional materials to private facilities without a contractual agreement; however, vaccine delivery share was not quantified (10).

In Libreville, Gabon, Ategbo et al. found that coverage rates for routine antigens in the for-profit sector were greater than those in the public sector. Coverage of the third doses of diphtheria, pertussis, tetanus, oral and inactivated polio vaccine DPT/OPV-IPV (90.2%), and measles (82.5%) vaccine was higher at private clinics compared to 74.5% and 64.4% respectively at public clinics (11). Explanation for the difference between the two sectors was not provided. Looking at Sub-Saharan Africa as a whole, Wagner et al. assessed the performance of public and private sector (for-profit

³ These local governments were located in urban/semi-urban areas and consisted of multiple private health facilities.

⁴ Public sector facilities were large teaching hospitals who had large catchment area and provided outreach activities to neighbouring communities where they immunized children in their homes (8).

and NGO) delivery of BCG vaccination where the private sector provides approximately half of all healthcare services (7). BCG coverage within the same calendar month of birth at private facilities was 9.2 percentage points lower than in public health facilities (45.3% versus 54.5%) (7).

WHO South-East Asia Region

When looking at the South-East Asia Region, information on the share of immunization services provided by the private sector was only available in studies from India and Bangladesh (four articles) (Table II, III). Due to rapid population growth in Bangladesh, non-government organizations (NGOs) supplement government provided health services (12). In Dhaka city, NGOs deliver more than 95% of immunizations through a PPP (12). The national Expanded Programme on Immunization (EPI) supports this partnership by ensuring vaccine supply and logistical support⁵ to both municipal governments and NGOs (12). Municipal governments in turn assist NGOs in planning, monitoring, and evaluation of immunization programs (12).

In urban Gujarat State in India, private providers contribute a large share of immunization services (24%), similar to other urban areas in India (13). In less urbanized, lower per-capita income states, the private sector contribution is lower (13). In a separate study that used private sector vaccine sales data, Sharma et al. found that in the 2009-2012 birth cohort in 16 states, the private sector contributed towards overall (both urban and rural) vaccination coverage: 4.7% towards BCG, 3.5% towards measles, 2.3% towards DPT3, and 7.6% towards OPV3 (14). A different study reported private sector contribution to Hib vaccine coverage at 4%, which varied among Indian states (0.3% - 4.6%) (15).

WHO Western Pacific Region

Within the Western Pacific Region, two articles referenced vaccine share in the Philippines and Viet Nam (Table II, III). In the Philippines, Patel et al. assessed coverage rates for a birth dose of hepatitis B (HepB-BD) across private and government hospitals, and government clinics. In private hospitals median timely HepB-BD, coverage was 50% and median total coverage (all hepatitis B vaccines received in the series) was 80%, compared to 87% and 80% respectively at government hospitals (16). At government clinics, median timely HepB-BD coverage was 90% and median total coverage was 100% (16). The estimated private sector contribution to overall vaccination coverage in the Philippines is reported to be 10% (from personal communication) (17).

A similar study conducted in Viet Nam assessed coverage of Hep-BD within 72 hours of birth. The proportion of birth doses delivered within 72 hours was lowest (47%) in the province with the highest percentage of deliveries in private facilities (18). This was attributed to weak linkages between private health facilities and the national EPI where EPI services are restricted to EPI facilities (18). Rigorous evidence was not provided to support this conclusion and statistical testing was not reported.

WHO Eastern Mediterranean Region

Since Levin and Kaddar, four articles have been published on vaccine share in the Eastern Mediterranean Region, all of which focus on Pakistan (Table II, III). To enhance information, interviews were conducted for Bahrain and Lebanon.

⁵ Disposable syringes and needles, refrigerators, cold boxes, vaccine carriers, and vaccine transportation cost.

According to official estimates in Pakistan, the government provides approximately 97% of immunization services to children through the EPI with the remaining 3% being provided by the private sector (19,20). However, a recent population survey in Karachi (an urban area) revealed that among 75% of children who were immunized, 25% received vaccinations from the private sector (21,22). This discrepancy may possibly be due to a concentration of private providers in urban areas. The main source of private sector immunization were private for profit physicians (80%), with a smaller proportion provided by the non-profit sector (amount not quantified) (22). A separate study conducted by Zaidi et al. compared newborn BCG immunization and use of tetanus toxoid during pregnancy in contracted NGO facilities with government facilities in two remote rural districts in Pakistan (Chital and Thatta). BCG immunization coverage was 10.6 percentage points higher in contracted NGO clinics than in government clinics ($p < 0.01$) in Chital, but not in Thatta district. No difference was seen in tetanus toxoid coverage between contracted NGO facilities and government facilities in either district (23).

While the public sector administers more than 90% of vaccines for free in Bahrain, the for-profit sector fills the gap ($< 10\%$) via a collaborative relationship (from interview) (24). Vaccines administered at certified private health facilities are procured through the MOH, but the private provider sets the fee. In Lebanon, the MOH reports (from interview) that roughly 60% of the population receives vaccines in private for-profit clinics (25). These vaccines are administered by general practitioners, paediatricians, and gynaecologists in private practices. The remaining 40% of vaccines are administered by a large network of government supported health centres and managed by NGOs for a nominal fee (25).

WHO Region of the Americas

Articles (two) pertaining to the role of the private sector in the Region of Americas were limited to the United States and the Caribbean. To supplement published data two interviews were conducted for the province of Quebec, Canada and Mexico (Table II, III).

In Mexico, an estimated (from interview) 95% of childhood and adolescent vaccines are reported to be administered in the public sector with no fee (26). Accounting for roughly 5% of immunizations, the private sector is primarily used for vaccines that are not included in the EPI schedule and providers determine the price for vaccines procured outside of the government (e.g. Hepatitis A and varicella). For influenza vaccine, an estimated 8-9% of doses are administered by private practitioners (26). In the Caribbean, vaccination of children is predominantly administered by the public sector through a network of clinics (27). The private sector administers vaccines to an estimated 10%-20% of each birth cohort (27).

Vaccine administration in the United States is mixed between private providers and public health clinics with the private sector being dominant. This is largely due to the Vaccines for Children (VFC) program, a federally funded PPP, which provides vaccines at no cost to children who meet certain eligibility requirements⁶. Vaccines are distributed at no charge to private physicians' offices and public health clinics registered as VFC providers; approximately 70% of VFC providers are private providers (28). To capture the role of the private sector, Groom et al. utilized the National Immunization Survey (NIS) between 1996 and 2004, to determine proportion of respondents whose children exclusively visited private providers. Of immunizations administered to young children, 61% were administered exclusively in the private sector (29). The remaining 29% were split between the

⁶ Under the age of 19, Medicaid eligible, American Indian or Alaskan native, uninsured, or underinsured.

public sector (16%) and those administered in a combination of one or two provider types (23%) (29,30).

In Canada, immunization programs fall under provincial and territorial jurisdiction. They determine schedule and delivery systems based on recommendations put forth by the National Advisory Committee on Immunization. Historically, in Quebec, the private sector has administered a higher proportion of vaccines to children under five years of age than the public sector. However, over the last 10 years, the situation has gradually reversed with roughly 80% of vaccine administered by the public sector and 20% by the private sector (31). This change happened for a number of reasons, notably increasing complexity of the immunization schedule, strict application of vaccine storage standards, and time dedicated to answering questions of hesitant parents or individuals (31). Delayed vaccination was reported to be more common in the private sector compared to the public sector (32). Vaccines included in the immunization schedule are provided to the private sector by the MOH free of charge; vaccines provided outside of the schedule are procured by independent providers and charged at a price dictated by the private provider (31).

WHO European Region

For the WHO European Region, information was drawn from three articles and one interview. One article was a comprehensive coverage assessment conducted by the Vaccine European New Integrated Collaboration Effort's (VENICE II) that assessed vaccine administration by provider type across 29 European Union and European Economic Area countries (Table II, III).

In Catalonia, Spain, Borrás et al. found that 68.7% of children received vaccinations in public health centres compared to 31.3% in private offices (33). The private sector accounted for a larger proportion of non-EPI vaccines; 63.5% of children received varicella vaccine and 47.4% received pneumococcal vaccine, compared to 36.5% and 52.6% respectively at public health centres (33). A study in Greece found that 33.4% of parents sampled had their child vaccinated by their private paediatrician where they paid a doctor's fee, 65.7% were vaccinated by providers where fees were covered by insurance, and 0.9% were vaccinated in a public health clinic (34). A separate survey of immunization program managers reported a 70% share of vaccinations in the private sector in Greece (35).

In France, the majority of vaccines are reportedly administered in the private sector. Ninety-percent of immunizations (child <3yrs) are administered by private primary physicians (35). In these settings the client purchases vaccine from a pharmacist and brings it to their physician for administration. The remaining 10% of infant immunizations are administered in public maternal and child health clinics that provide services to children six years of age and under (35). For vaccines procured through the private sector, the Social Security Scheme reimburses 65% of the cost of vaccines with the remaining financial responsibility falling on the individual or their voluntary complementary insurance (35).

Similar to France, approximately 90% of vaccines administered in Germany are estimated (from interview) to occur in the private sector (36). The remaining 10% are administered by occupational health professionals or public health offices (36). There is no central government financing for immunizations, rather statutory and private health insurance policies pay for all recommended vaccines making them free of charge to the public (36). Payment for vaccines administered outside of the recommended schedule is out-of-pocket or supported by voluntary policies of single insurance companies (36).

B. Quality Standards

Information used to describe quality assurance mechanisms was drawn from eight articles and two interviews (Table II). Of the studies assessed in LMICs, a systematic review noted that quality standards for immunization delivery in the private sector were inferior to their public sector counterparts (4). In most high-income countries, mechanisms to monitor the quality of immunization delivery in both public and private health sectors were in place (30).

In Nigeria, where a MOU established requirements for both government and private providers, gaps were identified in immunization service quality. Highlighted gaps included the need for additional mechanisms to ensure proper vaccine storage and up-to-date knowledge (8). A study in Kampala, Uganda found that unqualified people participating in the immunization program were predominantly found in private facilities and that this was a main reason why consumers preferred public facilities (9). Supervisory visits in the Philippines showed that private sector staff did not store vaccine appropriately and were unaware of the significance of the vaccine vial monitor (16). These examples are consistent with previous studies conducted in the private sector in Malaysia that documented similar problems with vaccine maintenance, staff knowledge, and quality of care (2,6).

For vaccines included in the immunization schedule in Quebec, Canada, private physicians are required to complete a public health contract at the regional and provincial level. The contract outlines guidelines and quality standards for vaccine administration, including that private physicians undergo a storage and handling audit prior to approval. Following approval, further auditing, surveillance, and monitoring is conducted at the regional level. By December 31, 2018, for regulation purposes, all vaccines administered in both the private and public sector will be required to be entered in a Provincial vaccine registry (31).

The MOH in Bahrain sets quality standards for clinics requesting permission to provide vaccination services. Quarterly and annual evaluation visits are conducted by the MOH using a standard checklist to ensure fulfilment of required standards for provision of vaccinations services. Quarterly visits are used to ensure proper cold chain and storage procedures, whereas the annual monitoring visit is a comprehensive instructive field visit that includes adverse events following immunization (AEFI) reporting, capacity building, equipment, knowledge, compliance with standard operating procedures, and data quality. An annual data quality and accuracy assessment is also conducted using the WHO Data Quality Service (DQS) tool.

The United States conducts extensive monitoring of vaccination services through the VFC program where it provides oversight of approximately 90 million VFC doses distributed annually (37). When a provider enrolls in the program they must adhere to oversight requirements that include a one-time initial site visit to educate provider staff, periodic site visits, development of a vaccine accountability system and a fraud and abuse policy. During site visits in 2010, government grantees identified vaccine management deficiencies and developed corrective action plans for 57% of private providers and 46% of public providers (28). Providers may be suspended or terminated if they do not meet requirements after implementing corrective action plans.

C. Advocacy for Immunization

Information regarding the private sector's role in advocating for immunization was only gathered during interviews with Germany, Mexico, and Quebec, Canada (Table II). In Germany, information on the benefits and risks of vaccination is disseminated to the public by a large number of stakeholders including national and state health authorities, professional societies, insurance companies, and vaccine manufacturers (36). It has been noted that these messages are often

divergent due to competing interests, making advocacy amongst private providers challenging (36). This varies from the situation in Quebec where the private provider's role is to advocate and educate the public on the importance of vaccination (31). In Mexico, manufacturers use the private sector to lobby for the introduction of new vaccines (26).

D. Program Monitoring and Post Market Surveillance

Since Levin and Kaddar's review, six publications were identified that discussed reporting of vaccine coverage rates, adverse events following immunization (AEFI), and notifiable diseases. This information was supplemented with information from four interviews (Table II).

In India, the government provides limited monitoring and supervision at the field level for private practitioners (38). Assessment teams who conducted visits to private practitioners providing hepatitis B vaccines noted that reporting of doses administered from the private sector were fragmented and sporadic (38). In states where there were coordinated mechanisms for the private sector to systematically collect information on vaccination status of children, results were consistently reported (38). In a separate study conducted in Gujarat State, 22% of private providers stated that they reported doses administered to the government; 69% did not report and 9% reported that government staff collected their data in lieu of self-reporting (39). For notifiable disease surveillance, 54% of private providers reported that they would report a suspected case of measles and 63% would report acute flaccid paralysis (39). Of the providers who reported treating a patient with an AEFI, only 15% reported the case (39).

Patel et al.'s assessment in the Philippines found that 36% of private hospitals reported vaccination coverage to the government immunization program compared to 96% of government clinics (16). Approximately half of private hospitals reported that they had not received a supervisory visit within the previous six months compared to 6% at government clinics and 31% at government hospitals (16). The MOH does not have jurisdiction in the private sector for reporting AEFI, but encourages them to report AEFI in a timely manner to the manufacturer or the Food and Drug Administration (17). Considering the Western Pacific Region as a whole, the availability of a system/institutions(s) to monitor and regulate immunization services by private providers was greatest in high-income and lower-middle income countries, with the greatest gaps seen in upper-middle income countries (40).

In Mexico, where the private sector plays a minimal role in immunization delivery, the government does not implement program monitoring mechanisms or post market surveillance for the private sector (26). Private providers are encouraged, but not obligated to report AEFIs and there are no clear penalties for failure to report (26). Guidelines for reporting and vaccine administration are made readily available to the private sector. In Germany, where the private sector is utilized for immunization activities, the National Public Health Institute (NPHI) does not have regulatory control over vaccine distribution, administration, or cold chain in the private sector (36). The NPHI receives claims data from the Associations of Statutory Health Insurance Physicians only on a voluntary basis to assess coverage and conduct independent post-marketing assessments of vaccine-effectiveness and impact (36). By law, AEFI and regulatory issues are to be reported by private physicians or vaccine manufacturers to the National Regulatory Authority (36).

Vaccine use in the United States of America is monitored by a biologics surveillance system and various immunization surveys (30). The Centers for Disease Control and Prevention's (CDC) biologic surveillance system collects voluntary reports from manufacturers on the number of doses they distribute (30). Private facilities receiving vaccine from the VFC program are required to report

vaccine administration rates and AEFI as a term of their contract (29,30). In Bahrain, the MOH issues circulars requesting that all health facilities offering immunizations, including private providers, report administrative data and AEFI (24). Similarly, in Quebec, the government mandates that any private provider offering immunizations report both administrative data and AEFI to the MOH within a designated timeframe (31).

E. Decision-Making

Because the literature review yielded only two articles (from United States and Republic of Korea) pertaining to the private sector's contribution to decision-making, information on the private sector's role in decision-making primarily came from the key informant interviews (Table II). Involvement in decision-making varied significantly across countries, regardless of private sector vaccine share.

In Bahrain, where there is a comprehensive and supportive partnership between the public and private sectors, the private sector is included in the decision-making process. A nominee from the private sector serves as a core member of the National Immunization Technical Advisory Group (NITAG), contributing to technical and scientific issues and final recommendations (24). Additionally, the private sector is notified in advance when modifications are made to immunization policies, vaccination schedules, and administration procedures to ensure buy-in and cooperation (24). Similar to Bahrain, the Korean Advisory Committee on Immunization Practices (KACIP), an advisory body of the MOH, provides practical guidance and policies for immunization. The Committee includes representatives from private associations, experts, and government officials, but private providers do not play a role in decision-making (5). When the MOH approves a new recommendation they work with both public and private sectors to plan implementation of the recommendation (5).

In Germany, the NITAG is hosted by the NPHI and is responsible for developing vaccine policy. NITAG recommendations are the basis for the "vaccine directive" that is endorsed by the Federal Joint Committee (G-BA) (36). A permanent guest from the G-BA sits on the NITAG, as well as several voting members who are private physicians serving as individual experts (36). Private physicians have voting rights whereas the permanent guest does not (36). Physician associations may officially ask the NITAG to develop a specific recommendation, but the NITAG decides what topics are to be prioritized and recommended (36). After the NITAG develops a draft recommendation it is sent to federal states, the G-BA, and relevant societies for comment (36). It is at the discretion of the NITAG to consider comments received from outside private parties in formulation of the final recommendation (36). Decisions outside of the NITAG purview (decisions on distribution, administration, reimbursement, and tender contracts) are the responsibility of private sector partners including insurance companies, physicians, physician associations, vaccines manufacturers, and wholesalers (36).

While Mexico sees minimal engagement of the private sector for immunization delivery, the country maintains private sector representation for decision-making on the National Immunization Council (26). The council includes representation from different government agencies, the Mexican Academy of Paediatrics, internal medicine groups, and private providers (26). Only one to two seats are held by the private sector placing them in a minority vote (26). Quebec, Canada utilizes a similar process where the private sector representative sits on the provincial expert committee that provides recommendations to the MOH (31). Nominees from the private sector serve as official consultants and when the MOH implements a new program or major changes it is based on a scientific consensus between private physicians and public health experts (31).

In the United States, the Advisory Committee on Immunization Practices (ACIP) is a group of medical and public health experts that develop recommendations on use of vaccines in the civilian population of the United States (30). The ACIP includes 15 voting members, 14 of which have expertise in a vaccination related field; 1 member is a consumer representative who provides perspectives on the social and community aspects of vaccination (41). In addition to the 15 voting members, ACIP includes 8 “ex officio” members who represent other federal agencies that share responsibility for immunization programs in the United States and 30 non-voting representatives of liaison organizations that bring related immunization expertise (41).

2. Impact on Equity of Immunization Services

Since Levin and Kaddar’s review, eight studies have evaluated the impact of the private sector on equity of immunization services with additional information gathered in three interviews (Table II).

Two studies conducted in LMICs, found that for-profit sector services favour those in urban locations and/or those with higher family incomes (4,7). The private sector’s contribution to vaccination coverage in India was limited to states with high per capita GDP and high levels of urbanization (14,15). Similarly, in the urban area of Kampala, Uganda, the odds of using private facilities for immunization services were three times higher in the wealthiest household income quintile than in the lowest wealth quintile (9). In Kenya, Sood and Wagner found that in geographic areas with a larger proportion of for-profit providers, the population was wealthier, more educated, and had fewer children per household than areas with a larger proportion of non-profit private providers (3). For-profit providers were more common in urban compared to rural areas; smaller urban-rural differences were seen in the NGO sector (7).

Since the VFC program was enacted in the United States of America, immunizations have become more equitable across the public/private sector divide, yet disparities remain (29). Typically, children are less likely to be up-to-date with their immunizations if they live below the poverty line, reside in urban areas, and are non-White (29). Groom et al. found that children receiving immunization services in the private sector were predominantly white (60%), from suburban areas (52%), and at or above the poverty line (71%), compared to those receiving immunization services in the public sector (38%, 32%, and 41% respectively) (29). This suggests that the most at-risk children, both racially and economically, are served by the public sector.

Although lack of published evidence exists in Bahrain and Germany, equitable access to immunization services reported in key informant interviews is minimal. In Bahrain, HPV is offered in the private, but not in the public sector as it is currently under review for burden of disease, cost effectiveness, and feasibility of vaccination. If the MOH decides to incorporate the vaccine into the standard schedule after the review period access to the vaccine would be more equitable between the two sectors. Similarly, in Germany, equity is not an issue if the vaccine is included in the recommended schedule. If it is not included (e.g. meningococcal B vaccine) then it is at the discretion of the insurance company and favours those of a higher socio-economic status if paid out-of-pocket.

3. Interaction between Pharmaceutical Industry and Private Sector

One topic that was not included in Levin and Kaddar’s review and was intended to be the third dimension for this paper was the private sector’s interaction with the pharmaceutical industry. During the literature review no information was identified that pertained to regulatory requirements

and standard operating practices for vaccines procured by the private sector. Specifically, we were unable to identify if private providers were securing licensed vaccines and how they engaged in business with the pharmaceutical industry, including regulations imposed on procurement mechanisms for donated vaccines. Thus, information was limited to what was collected during interviews with key informants from Germany and Bahrain.

In Germany, once a vaccine is licensed and brought to market by the manufacturer, it is purchased by large, private wholesalers who distribute vaccines to private physicians and local pharmacies. Quality standards are implemented and enforced by the manufacturer on the basis of defined regulatory requirements laid forth in national and European guidelines such as the European Medicines Agency (EMA) or the European Directorate for the Quality of Medicines & HealthCare (EDQM) (36). Furthermore, within the European Union (EU) Official Control Authority Batch Release (OCABR) network every vaccine batch is tested for quality compliance with EDQM requirements before marketing in the EU (36). Vaccine batches already delivered into the supply chain in Germany are subject to control by respective state authorities (36). To ensure reliability and safety of vaccines in Bahrain, the MOH procures all vaccines, receives all shipments, and checks them upon arrival before distribution to private providers (24). Thus, they guarantee that all vaccines are procured from licensed manufactures and meet the same standards as vaccines administered in the public sector (24).

V. Discussion

The contribution of the private sector to immunization service delivery and its level of engagement with the government varies widely between countries and is not fully understood. Our review attempted to fill in the thematic gaps identified by Levin and Kaddar and to identify characteristics of a strong programme to guide and adapt to the country context. In LMIC's, we found that access, affordability, and quality of immunization services were influenced by the scope of the government's involvement. Contractual agreements, communication channels, performance monitoring, and regulation of the private sector were more likely to improve quality of vaccination services. By adding the dimension of high-income countries we were able to identify governments that had successfully engaged with the private sector and used them as a platform to extend their immunization programmes. This highlights that a concerted effort between sectors to ensure vaccine access, coupled with policies that cross cut both sectors, should in theory result in higher coverage rates.

This review suggests that for-profit services may be more difficult to assess than not-for-profit because delivery of vaccination services is not as closely monitored and reporting to the government is sporadic at best. Ensuring equitable access to immunization services is instrumental to achieve coverage goals. For-profit services favour those in urban areas and of higher socio-economic status, creating potential for inequity if the poorest populations are unable to access public sector services and those services are sub-optimal. Studies in this review suggest that service delivery in the private-for-profit sector was associated with poor performance due to lack of training, quality standards, and programme monitoring, corroborating Levin and Kaddar's findings (2).

Contracting services to NGOs has also been shown to improve access to immunizations and primary health care services (2,6). Not-for-profit private services were more likely to be coordinated with government services through formal contracts or MOUs than for-profit services (2,8,42). Not-for-profit services are more commonly provided in rural areas or poor populations where access to health services is limited. This suggests that contracts or MOUs that encompass technical support,

with defined program goals and consistent monitoring, have a greater chance of producing quality vaccination service delivery and ultimately higher immunization coverage.

One of the more concerning findings of this review is the lack of program monitoring and adverse event reporting and participation in vaccine preventable disease surveillance in the private sector. In LMICs with monitoring and surveillance programmes in place, evidence suggests that it is often insufficient with gaps in enforcement and adherence. Even in high-income countries where there is adequate government infrastructure and mechanisms to capture this information, reporting is often suboptimal. Inadequate reporting from the private sector results in loss of information on coverage, vaccine-preventable disease incidence, and adverse events, which can affect planning, prioritization, resource allocation, and timely response to outbreaks and vaccine safety concerns. Additionally, our understanding of how private providers engage in with the pharmaceutical industries is minimal at best. Lack of knowledge in this area makes it difficult to formulate recommendations for optimal vaccine introduction, use, and regulatory requirements.

Although this review describes private sector engagement for immunization across a wider spectrum than the previous review, our ability to fully describe the situation is limited by available data. Since Levin and Kaddar in 2011, the scope and depth of new information has been minimal. One explanation may be that immunization service delivery by the private sector has not been a priority area for immunization programs. Additionally, studies have often focused on an individual vaccine, or a geographic area within a country, providing a limited picture. Furthermore, information about the role of the private sector may be embedded in publications on overall immunization system performance, practices to improve coverage of a specific vaccine, or in a general analysis of private sector healthcare delivery. Thus, all information relevant to this study may not have been captured in a literature review targeting private sector engagement as it pertains to immunization services.

Moreover, scant information from high-income countries was identified. Conceivably, in high-income countries where private sector delivery is predominant, the public-private model of collaboration has not been evaluated because its effectiveness and functionality is not in question. Infrastructure is already in place to operate within the scope of immunization best practices and high coverage rates have been achieved. Therefore, our review was somewhat limited to a qualitative descriptive review rather than a quantifiable assessment. While findings have been elucidated, they do not capture all the dimensions at play, cannot be generalized between countries, and limit comparisons between the two sectors. Extending qualitative interviews to representatives of the International Paediatric Association and other organizations and private providers could further inform the issue of private sector engagement.

VI. Conclusion

Evidence remains limited about the private sector's contribution to immunization services, impact on equity of immunization services, and the interaction between the pharmaceutical industry and private sector. Additionally, too few surveys and studies of the current or potential contributions of the private sector to NIPs have been conducted. Based on limited sources of information we were able to identify that while there are a number of countries that have successfully engaged with the private sector, using it as a platform to improve their immunization programmes, others have minimal involvement or have experienced challenges.

There needs to be increased collaboration between private sector providers and the NIP. In a significant portion of the LMICs included in this study, private sector immunization services were

not as efficient or accountable as their public sector counterparts. While NIPs may not have the financial and staffing resources to support private providers, private providers would benefit from their subject matter expertise and best practice guidelines until mechanisms are established at the national level. It is not until private sector immunization delivery is strengthened and regulated that their services can support progress towards GVAP goals.

In order to productively engage the private sector for immunization service delivery several steps could be pursued. This could start with a review of the private sector's contribution to immunization delivery, programme monitoring, adverse events, disease surveillance, and a look into the quality of service delivery. Ideally, this would identify and inventory key stakeholders in the private sector involved or that could be potentially involved in vaccination. This could be followed by determination of an optimal model of public private engagement, expansion of dialogue to achieve common immunization goals, and development of collaborative activities including potential memorandum of understanding, agreements or contracts. Clearly, there is a need to put in place mechanisms to allow for some regulation and quality control of the immunization service delivery. Moreover, it is important to ensure exchange of information between the public and the private sector, as well as training and capacity building of private providers.

Additionally, utilization of the private sector for immunization delivery should be placed in the context of health system strengthening and Universal Health Coverage (43). In August 2016, the Lancet published a four article series on the performance of private sector health care in LMICS. Morgan et al. noted that deriving population benefit from the private sector requires interventions that target the sector as a whole rather than individual providers or specific services (44). By anchoring this topic in the continuum of care and sustainable health outcomes the policy dialogue at the national level may have more traction. Thus, it may gain further buy-in to adapt to changes in service delivery partners, programme design, and expectations.

Furthermore, expanding the current body of evidence is essential to elucidate characteristics of a well-functioning immunization program. Areas that need to be highlighted as a research priority include: 1) private sectors role in geographic scope leading to forecasting demand and stock-outs; 2) effectiveness of regulatory requirements and potential enforcement mechanisms; 3) best practices for incorporation of private sector provision of immunization services into the NIP; 4) identification of where private providers are securing vaccines and if vaccines are licensed. Additionally, the role of immunization delivery in private schools was not captured and should be addressed as a priority area given centrality of school-based immunization programs to meet coverage targets and compliance with national schedules. Through these mechanisms and extension of research, the interaction between public and private sectors can be optimized and immunization services can be strengthened to meet the goals laid forth by GVAP.

Figure I: Results from literature search and review process, 2016

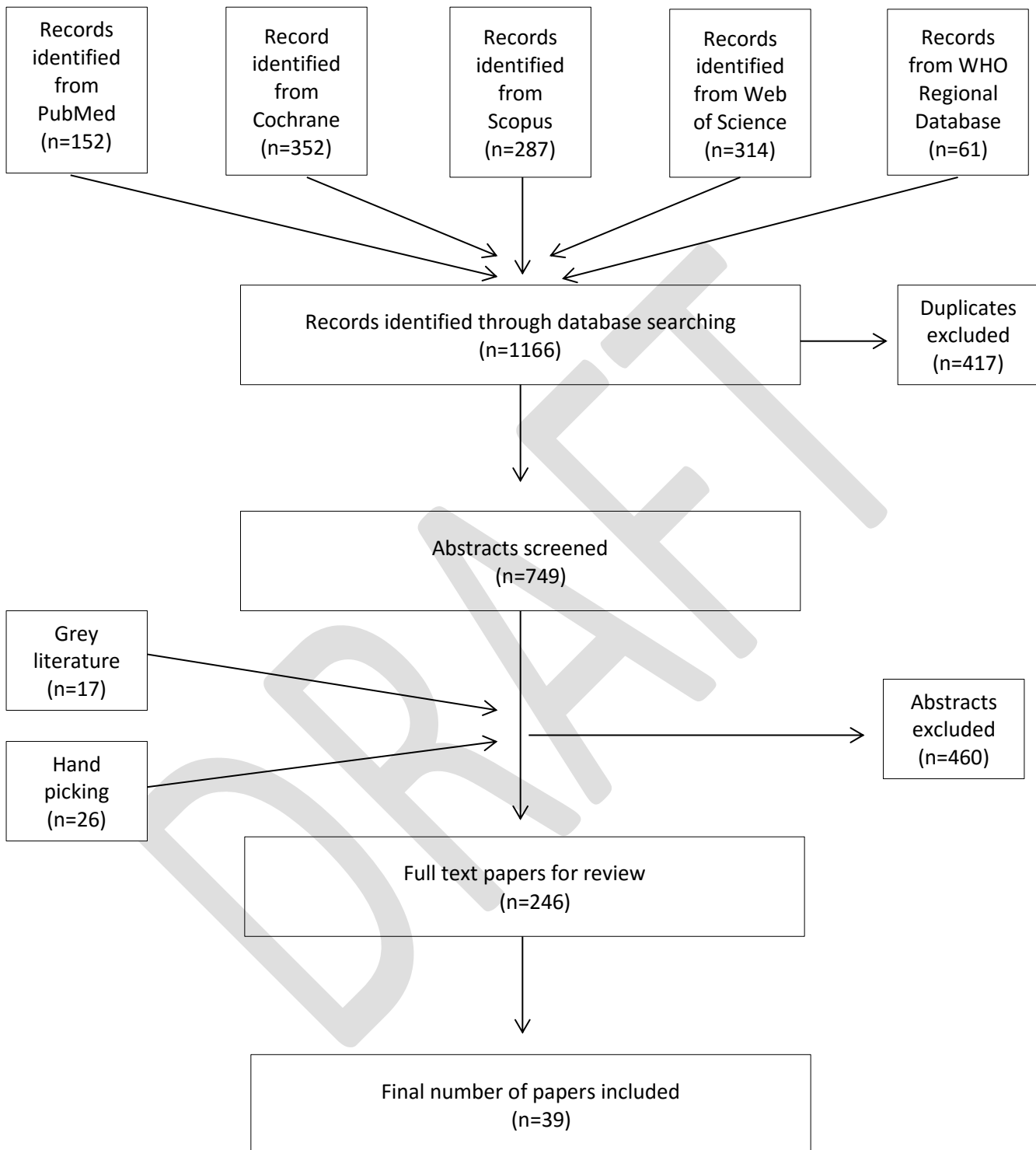


Table I: Immunization experts included in semi-structured interviews, by affiliation, country and WHO region, 2016

Name	Affiliation	Country	WHO Region
Dr José Ignacio Santos	National Autonomous University of Mexico	Mexico	AMR
Dr Monique Landry	Ministère de la Santé et des Services sociaux du Québec	Canada	AMR
Dr Jaleela S. Jawad	Ministry of Health, Bahrain	Bahrain	EMR
Dr Alissar Rady	World Health Organization, Lebanon	Lebanon	EMR
Dr Ole Wichmann	Robert Koch Institut, Berlin	Germany	EUR

Table II: Literature included in final analysis, by country, WHO region, classification and topic area, 2016

Source	Country	WHO Region	Country's Economic Classification	Topic Area
Articles/Reports				
Amarasinghe 2016	Western Pacific Region	WPR	-	Program monitoring & post market surveillance
Ategbo et al. 2011	Gabon	AFR	Upper-middle	Contribution to vaccine delivery
Babirye et al. 2014	Uganda	AFR	Low	Contribution to vaccine delivery, quality standards, equity
Basu et al. 2012	Systematic Review	-	-	Background (private sector healthcare), quality standards
Boulianne, N. et al. 2015	Canada	AMR	High	Contribution to vaccine delivery
Cho et al. 2010	Republic of Korea	WPR	High	Contribution to vaccine delivery, decision-making
Dominguez et al. 2008	Spain	EUR	High	Contribution to vaccine delivery
Groom et al. 2007	United States	AMR	High	Contribution to vaccine delivery, program monitoring & post market surveillance, equity
Hagan et al. 2016	India	SEAR	Lower-middle	Program monitoring & market surveillance
Hasan et al. 2010	Pakistan	EMR	Low	Contribution to vaccine delivery
Irons & Dobbins 2011	Caribbean	AMR	-	Contribution to vaccine delivery
Lahariya et al. 2013	India	SEAR	Lower-middle	Program monitoring & post market surveillance
Levin & Kaddar 2011	-	-	-	Background (private sector, immunization)
Levinson, D. 2012	United States	AMR	High	Contribution to vaccine delivery, quality standards
Mackintosh et al. 2016	-	-	-	Background (private sector healthcare)
Makinen et al. 2011	Ghana	AFR	Low	Contribution to vaccine delivery

Source	Country	WHO Region	Country's Economic Classification	Topic Area
Morgan et al. 2016	-	-		Background (private sector healthcare)
Murakami et al. 2008	Vietnam	WPR	Middle	Contribution to vaccine delivery
O'Flanagan et al. 2012	EU/EAA	-	-	Contribution to vaccine delivery
Oluoha, C., Umeh, C. & Ahaneku, H., 2014	Nigeria	AFR	Lower-middle	Contribution to vaccine delivery, quality standards
Orenstein et al. 2005	United States	AMR	High	Contribution to vaccine delivery, quality standards, program monitoring & post market surveillance, decision-making
Pakistan Ministry of Health	Pakistan	EMR	Low	Contribution to vaccine delivery
Patel et al. 2014	Philippines	WPR	Lower-middle	Contribution to vaccine delivery, quality standards, program monitoring & post market surveillance
Pavlopoulou et al. 2013	Greece	EUR	High	Contribution to vaccine delivery
Sharma et al. 2015	India	SEAR	Lower-middle	Contribution to vaccine delivery, equity
Sharma et al. 2016	India	SEAR	Lower-middle	Contribution to vaccine delivery, equity
Siddiqui et al. 2010	Pakistan	EMR	Low	Contribution to vaccine delivery
Soeung et al. 2008	Cambodia	WPR	Lower-middle	Contribution to vaccine delivery, quality standards
Sood, N. & Wagner, Z. 2013	Kenya	AFR	Lower-middle	Contribution to vaccine delivery, equity
Uddin et al. 2010	Bangladesh	SEAR	Low	Contribution to vaccine delivery
UNICEF 2009	India	SEAR	Lower-middle	Contribution to vaccine delivery
Vaccine European New Integrated Collaboration Effort 2006	France	EUR	High	Contribution to vaccine delivery
Wagner, Z., Szilagyi, P.G., Soodn, N. 2014	Sub-Saharan Africa	AFR	-	Contribution to vaccine delivery, equity
Whitney et al. 2014	United States	AMR	High	Quality standards
World Health Organization 2008	-	-	-	Background (private sector healthcare)
World Health Organization 2011	-	-	-	Background (Global Vaccine Action Plan)
Zaidi, A. 2012	Pakistan			Contribution to vaccine delivery
Zaidi et al. 2015	Pakistan	EMR	Low	Contribution to vaccine delivery
Personal Communication				
J Jawad 2016	Bahrain	EMR	High	Contribution to vaccine delivery, quality standards, program

Source	Country	WHO Region	Country's Economic Classification	Topic Area
				monitoring & post market surveillance, decision-making, equity, interaction with pharmaceutical industry
M Landry 2016	Quebec, Canada	AMR	High	Contribution to vaccine delivery, quality standards, advocacy, program monitoring & post market surveillance, decision-making
A Rady 2016	Lebanon	EMR	Upper-middle	Contribution to vaccine delivery
J Santos 2016	Mexico	AMR	Upper-middle	Contribution to vaccine delivery, program monitoring & post market surveillance, decision-making
L Suy 2016	Philippines	WPR	Lower-middle	Contribution to vaccine delivery, program monitoring & post market surveillance
O Wichmann 2016	Germany	EUR	High	Contribution to vaccine delivery, advocacy, program monitoring & post market surveillance, decision-making, equity, interaction with pharmaceutical industry

Table III. Proportion of private providers providing vaccination services and proportion of vaccinations provided by private providers, by World Health Organization (WHO) Region as reported in publications and expert interviews

Country (year data collected)	% Private providers providing vaccinations	% Vaccinations provided by private providers	Source	Comment
WHO African Region				
Kenya (2010)	34 (for-profit), (80 not for-profit)		Sood & Wagner 2013	Odds of not being vaccinated 4.8 times higher where facilities are for-profit compared to areas with no for-profit facilities. Modeling from DHS, SPA surveys.
Nigeria, Abia State, 4 LGAs, urban, peri-urban (2011)		21	Oluoha et al. 2014	Monthly administrative data; 45% of facilities offering vaccine were private.
Uganda, Kampala (2010)		30	Babirye et al. 2014	30% respondents reported using for-profit providers
WHO South-East Asia Region				
India total (2009)		9	UNICEF Coverage Survey 2009	Household survey; % partially/fully immunized in private sector
India urban		21	"	"
India rural		6	"	"
India, 16 states >90% India birth cohort (2009-12)		5 (BCG)	Sharma et al. 2016	Estimate based on sales data. Weighted mean. Range 1 (Bihar) - 17 (Punjab-Haryana)
		4 (Measles)	"	Range 1 (Assam) - 19 (Kerala)
		2 (DTP3)	"	Range 1 (Orissa) - 7 (Kerala)
		4 (OPV)	"	Range 0.1 (W Bengal) - 82 (Kerala) OPV3> actual due to likelihood of >4OPV doses/child
		4 (Hib)	Sharma et al. 2015	
Bangladesh, Dhaka city		95	Uddin et al. 2010	
WHO Western-Pacific Region				
Philippines		10	L Suy 2016	Estimate from interview

Republic of Korea	60		Cho et al. 2010	
Cambodia	65 (provided at least 1 antigen)		Soeung et al. 2008	% of for-profit facilities offering specific antigens: 56 (HepB), 35 (tetanus), 10 (BCG), 4 (DTP), 4 (measles), 36 (rabies), 12 (typhoid), 10 (JE)
WHO Eastern Mediterranean Region				
Bahrain		<10	J Jawad 2016	Estimate from interview
Lebanon		60 (for-profit 40 (not for-profit)	A Rady 2016	Estimate from interview
Pakistan		3	Pakistan Ministry of Health as referenced in Hasan et al 2010	
Pakistan (Karachi)		25	Siddiqui N et al. as referenced in Zaidi 2012	Of 75% of vaccinated children in Karachi, 25% vaccinated in private sector
WHO Region of the Americas				
Caribbean		10-20	Irons & Dobbins 2011	
Mexico		5	J Santos 2016	Estimate provided in interview
Quebec, Canada		20	M Landry 2016	Estimate provided in interview
United States		61 - exclusively in private 23 - combination public/private	Groom et al. 2007	61% children vaccinated exclusively in private sector; 23% combination of public and private
WHO European Region				
Catalonia, Spain (2003-2004)		31 (EPI series) 63 (varicella) 47 (PCV7) 52 (Hep B)	Borras et al. 2009	Telephone survey of parents of 3 yr-olds. No difference in coverage (basic series+booster); 88% for both private and public.
Germany		90	O Wichmann 2016	Estimate from interview
Greece		33	Pavlopoulou et al.	

			2013	
Austria		90	O'Flanagan et al. 2012	Estimate reported in survey of vaccine program managers (children <3 yrs)
Belgium		20	"	"
Cyprus		57	"	"
Czech Republic		95	"	"
France		90	"	"
Greece		70	"	"
Hungary		<1	"	"
Ireland		100	"	"
Latvia		1	"	"
Luxemburg		100	"	"
Malta		10	"	"
Poland		5	"	"
Romania		10	"	"

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References

1. World Health Organization. Global Vaccine Action Plan. *Vaccine*. 2011;1–147.
2. Levin A, Kaddar M. Role of the private sector in the provision of immunization services in low- and middle-income countries. *Health Policy Plan*. 2011;26(SUPPL. 1):4–12.
3. Sood N, Wagner Z. For-profit sector immunization service provision: Does low provision create a barrier to take-up? *Health Policy Plan*. 2013;28(7):730–8.
4. Basu S, Andrews J, Kishore S, Panjabi R, Stuckler D. Comparative performance of private and public healthcare systems in low- and middle-income countries: A systematic review. *PLoS Med*. 2012;9(6).
5. Cho H, Kim C, Go U, Lee H. Immunization decision-making in the Republic of Korea: The structure and functioning of the Korea Advisory Committee on Immunization Practices. *Vaccine*. Elsevier Ltd; 2010;28:A91–5.
6. Soeung SC, Grundy J, Morn C, Samnang C. Evaluation of immunization knowledge, practices, and service-delivery in the private sector in Cambodia. *J Heal Popul Nutr*. 2008;26(1):95–104.
7. Wagner Z, Szilagyi PG, Sood N. Comparative performance of public and private sector delivery of BCG vaccination: Evidence from Sub-Saharan Africa. *Vaccine*. 2014;32:4522–8.
8. Oluoha C, Umeh C, Ahaneku H. Assessing the contributions of private health facilities in a pioneer private-public partnership in childhood immunization in Nigeria. *J Public Health Africa*. 2014;5(1):40–2.
9. Babirye JN, Engebretsen IMS, Rutebemberwa E, Kiguli J, Nuwaha F. Urban settings do not ensure access to services: findings from the immunisation programme in Kampala Uganda. *BMC Health Serv Res*. 2014;14(1):111.
10. Makinen M et al. Private Health Sector Assessment in Ghana [Internet]. World Bank Working Paper. 2011. Available from: <http://www.resultsfordevelopment.org/sites/resultsfordevelopment.org/files/R4D Private Health Sector Assessment in Ghana.pdf>
11. Atebo et al. Immunization coverage of children aged 0 to 5 years in Libreville (Gabon). *Sante*. 2011;20(4):215–9.
12. Uddin MJ, Larson CP, Oliveras E, Khan AI, Quaiyum MA, Saha NC. Child immunization coverage in urban slums of Bangladesh: Impact of an intervention package. *Health Policy Plan*. 2010;25(1):50–60.
13. UNICEF. 2009 Coverage Evaluation Survey. Government of India Ministry of Health & Family Welfare; 2010.
14. Sharma A, Kaplan WA, Chokshi M, Zodpey SP. Role of the private sector in vaccination service delivery in India: evidence from private-sector vaccine sales data, 2009–12. *Health Policy Plan*. 2016;31(7):884–96.
15. Sharma A, Kaplan W, Chokshi M, Hasan Farooqui H, Zodpey S. Implications of private sector Hib vaccine coverage for the introduction of public sector Hib-containing pentavalent vaccine in India: evidence from retrospective time series data. *BMJ Open*. 2015;5.
16. Patel MK, Capeding RZ, Ducusin JU, de Quiroz Castro M, Garcia LC, Hennessey K. Findings from a hepatitis B birth dose assessment in health facilities in the Philippines: Opportunities to engage the private sector. *Vaccine*. 2014;32:5140–4.
17. Suy LL, Director, Disease Prevention & Control Bureau R of PD of H. Personal Communication. 2016.
18. Murakami H, Van Cuong N, Huynh L, Hipgrave DB. Implementation of and costs associated with providing a birth-dose of hepatitis B vaccine in Viet Nam. *Vaccine*. 2008;26(11):1411–9.
19. Pakistan Ministry of Health. Coverage Evaluation Survey 2006. Expanded Program on Immunization, Islamabad; 2007.
20. Hasan Q, Bosan A, Bile K. A review of EPI progress in Pakistan towards achieving coverage targets: present situation and the way forward. *East Mediterr Heal J*. 2010;16 Suppl:S31–8.
21. Siddiqui N, Owais A, Zaidi A. Role of private sector in childhood immunizations in Karachi - a population representative survey. Masters thesis, Aga Khan Univ. 2010;
22. Zaidi A. Evaluation of GAVI Support to Civil Society Organisations: Country Evaluation Report - Pakistan. 2012.
23. Zaidi, S, Riaz, A, Rabbani, F, Azam, SI, Imran, SN, Pradhan N. Can contracted out health facilities improve access, equity, and quality of maternal and newborn health services? Evidence from Pakistan. *Heal Res Policy Syst*. *Health Research Policy and Systems*; 2015;13(1).
24. Jawad, Jalilah, Head of Vaccination M of HB. Personal Communication. 2016.
25. Rady, Alissar, National Professional Officer, World Health Organization L. Personal Communication. 2016.

26. Santos, Jose Ignacio, Professor, School of Medicine, National Autonomous University of Mexico M. Personal Communication. 2016.
27. Irons B, Dobbins JG. The Caribbean experience in maintaining high measles vaccine coverage. *J Infect Dis.* 2011;204(SUPPL. 1).
28. Levinson DR. Vaccines for Children Program: Vulnerabilities in Vaccine Management. 2012.
29. Groom H, Kolasa M, Wooten K, Ching P, Shefer A. Childhood immunization coverage by provider type. *J Public Heal Manag Pract.* 2007;13(6):584–9.
30. Orenstein WA, Douglas RG, Rodewald LE, Hinman AR. Immunizations in the United States: Success, structure, and stress - A complex collaboration involving government, industry, providers, academe, professional societies, and third-party payers. *Health Aff.* 2005;24(3):599–610.
31. Landry, Monique, Medical Advisor, Public Health Directorate, Ministry of Health and Social Services of Quebec C. Personal Communication. 2016.
32. Boulianne N, Audet D, Ouakki M. Enquête sur la couverture vaccinale des enfants de 1 an et 2 ans au Québec en 2010 [Internet]. 2015. Available from: https://www.inspq.qc.ca/pdf/publications/1973_Enquete_Couverture_Vaccinale_Enfants.pdf
33. Dominguez A, Oviedo M, Batalla J, Salleras L, Borrás E. The influence of public or private paediatric health care on vaccination coverages in children in Catalonia (Spain). *Eur J Public Health.* 2008;19(1):69–72.
34. Pavlopoulou ID, Michail KA, Samoli E, Tsiftis G, Tsoumakas K. Immunization coverage and predictive factors for complete and age-appropriate vaccination among preschoolers in Athens, Greece: a cross-sectional study. *BMC Public Health.* 2013;13(908):1–10.
35. O’Flanagan, Darina, Cotter, Suzanne, Mereckiene J. Vaccination coverage assessment in EU/EEA, 2011. 2012.
36. Wichmann, Ole, Head, Immunization Unit, Department of Infectious Disease Epidemiology, Robert Koch Institute G. Personal Communication. 2016.
37. Whitney C et al. Benefits from Immunization During the Vaccines for Children Program Era - United States, 1994-2013. *Morb Mortal Wkly Rep.* 2014;63(13):352–5.
38. Lahariya C, Subramanya BP, Sosler S. An assessment of hepatitis B vaccine introduction in India: Lessons for roll out and scale up of new vaccines in immunization programs. *Indian J Public Health.* 2013;57(1):8–14.
39. Hagan, J et al. Private provider immunization practices in Gujarat India. *Pap Prep.* 2016;
40. Amarasinghe DA (Western PRO. Survey on private providers’ engagement in immunization in Western Pacific Region: preliminary findings. *Pers Commun.* 2016;
41. Centers for Disease Control and Prevention. Advisory Committee on Immunization Practices (ACIP) [Internet]. 2016 [cited 2016 Sep 24]. Available from: <https://www.cdc.gov/vaccines/acip/about.html>
42. Mackintosh M, Channon A, Karan A, Selvaraj S, Zhao H, Cavagnero E, et al. What is the private sector ? Understanding private provision in the health systems of low-income and middle-income countries. *Lancet.* Elsevier Ltd; 2016;6736(16):1–10.
43. World Health Organization. Weekly epidemiological record Relevé épidémiologique hebdomadaire. 2008;21(83):421–8.
44. Morgan R, Ensor T, Waters H. Performance of private sector health care: implications for universal health coverage. *Lancet.* Elsevier Ltd; 2016;6736(16):1–7.