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Vaccination status among users of private health care in Eastern Indonesia

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Abstract

Vaccination status among users of private health care in Eastern Indonesia

By Melissa T. Wardle

Background: In 2012, Indonesia ranked third in the world for having the most unvaccinated and partially vaccinated children. Over the past two decades the country's private health sector has undergone substantial growth, which may result in changes to the national health system. Collecting vaccine information to characterize the extent to which caretakers use private providers, the contribution of private providers to immunization coverage, and the private sector's capacity to provide immunization services within Indonesia is critical for understanding, and eventually improving, vaccine delivery services.

Objectives: This study was conducted to characterize public and private outpatient health facility visits and to compare vaccination status between children who visited private health facilities to children who visited public health facilities in Eastern Indonesia.

Methods: A secondary data analysis using household data from the 2012 Indonesian Family Life Survey, East (IFLS, E) was used to compare vaccination status among children 9-35 months of age based on type of outpatient health facility visited.

Results: Among 591 children between the ages of 9-35 months, 59% visited some type of health facility in the previous month; 47% had visited public health facilities only, 5% visited private health facilities only, and 7% of children visited both public and private health facilities. Children who exclusively visited private health facilities were significantly less likely to be vaccinated with three doses of diphtheria-tetanus-pertussis-hepatitis B (DTP-HepB) vaccination compared to children who only visited public health facilities (aOR: 0.29; 95% CI: 0.12, 0.69). Measles vaccination (MCV1) status and fully vaccinated status were also lower among children who only visited private health facilities albeit non-significant.

Conclusions: Children in Eastern Indonesia who exclusively visited private health facilities one month prior to the survey were vaccinated less than those who visited public health facilities. Private health facilities may be a source of missed opportunities to immunize children. More information is needed about immunization practices in the private sector in order to develop strategies and effective interventions used to improve immunization service delivery and to reduce the number of children who are not being vaccinated during health care visits.

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1. Background and Literature Review

1.1 Introduction

In many low- and middle-income countries immunization services are primarily provided through the government. In recent years, the private health sector has grown substantially within many of these countries and with it the role of the private health sector with delivering vaccines has also grown. However, the extent to which individuals use private providers and the private sector's capacity to provide immunization services is largely unknown [1]. In countries with a high number of partially vaccinated and unvaccinated children, such as Indonesia, understanding how frequently health services are accessed and in what type of health facility are being attended for pediatric care is important for understanding the immunization system as a whole and factors that affect vaccination delivery and acceptance; using this information will contribute towards efforts to reduce the proportion of partially vaccinated and unvaccinated children , and thus protect more children from vaccine-preventable diseases such as measles and polio.

1.2 Indonesia's Health Care System

1.2.1 History

Indonesia is home to approximately 247 million people who live across 6,000 inhabited islands that make up the largest island archipelago in the world. The islands are divided into 34 provinces, which are further split into 500 districts, 7,000 sub-districts, and over 80,000 villages[2]. Being so spread out, the country is highly diverse in its demographic, economic, social, political, and cultural makeup. Substantial geographic disparities in

health care are evident across districts with more greater differences in the eastern region of the country [3, 4].

During the 1950s, Indonesia first integrated preventive services into its health care system through the Bandung Plan[2, 5]. The plan built upon and expanded a network of health facilities that enabled community level health care. The plan's goal was to establish a health center in each sub-district. Pre-existing treatment and maternal and child health clinics were merged to create community health centers known as puskesmas.

Throughout the second half of the twentieth century Indonesia had a highly centralized government. District and health facility staff were restricted in regards to addressing local health needs and problems[2]. In the 1990s Indonesia's health sector was quickly decentralized. The new system intended to improve health system performance through efficiency, quality, and equity of public health service provision. After health sector decentralization, all government administrative sectors became decentralized in 2001[2]. However, this transition, in addition to other major changes in their government and economic instability, put a great strain on the county and health system overall. However, based on a recent study, there was no significant deterioration in Indonesia's childhood immunization coverage due to decentralization [3].

1.2.2 Health Service Delivery

To improve access to preventative and curative health services, Indonesia implemented a five-tier system for health service delivery: village, sub-district, district, province, and

central. Typically, hospitals are responsible for curative care at the district, province, and central level whereas community health centers focus on preventive care at the district, sub-district, and village level. The first line of care occurs at the integrated village health post, known as the posyandu. Village health posts are the main distributor of childhood vaccination services in Indonesia. More than 270,000 village health posts are established across Indonesia to provide preventative health services in villages once per month [6]. A recent study estimated that by increasing the number of posyandus by one per 1,000 people the probability of children who are completely immunized will increase by 54% [3].

Immunization services are also available at community health centers, known as puskesmas, at the sub-district level and at hospitals. Community health centers oversee the village health posts and provide primary health care services. Their services focus on health promotion, sanitation, maternal and child health, family planning, community nutrition, disease prevention, and minor emergencies [2]. Whereas hospitals focus mainly on curative services and treatment, village health posts, community health centers, and hospitals comprise the public health system in Indonesia. Private health centers, providers, and hospitals that offer preventative and curative services are interlaced alongside public facilities throughout the country but generally set services at a higher price. Both public and private health centers make up the network of health service delivery in Indonesia.

1.2.3 Medical Workforce

Providing immunization services requires a team of trained health care workers to carry out the appropriate administration, delivery, and storage of vaccines. For central, provincial, and district health offices, an Expanded Program on Immunization (EPI) manager and cold chain/logistics manager are responsible for immunization duties at their respective level. The district level is accountable for supplying community health centers and training health care workers. Typically a midwife or nurse administers vaccinations and a cold chain and logistics manager monitors that the vaccines are being delivered and stored appropriately at the puskesmas. Midwives are often in charge of administering vaccinations at village health posts. Community health volunteers, known as kaders, assist village health post activities through mobilization and outreach to promote the health care services available to the village.

A major issue with the medical workforce in Indonesia is the retention of health care workers in rural communities[2]. Frequently, rural health care centers are unable to provide both curative and preventive services because of a shortage of doctors and nurses. Many health care workers migrate to cities or more populous areas where th access to more patients and training opportunities is more likely. For many, the incentives of working at a rural health center are nonexistent.

1.2.4 Public and Private Health Sector

The public and private health sectors in Indonesia have been growing rapidly over the last decade. The number of public and private hospitals increased from 1,268 in 2005 to 1,523 in 2009[7]. During this same time, private sector growth has outpaced the public

health sector growth. As a result, an increase in out-of-pocket expenditure on health care has occurred [8, 9]. However, information regarding the private sector in Indonesia is limited. For example, in many studies that evaluate health facility visits where a child may be immunized, the private sector is overlooked; this omits information about the country's overall immunization system and therefore impedes progress toward health system strengthening.

Establishment of private clinics by government health care workers is one explanation for private sector expansion. Health care workers have been encouraged to supplement low government pay through private practice in addition to their public health facility duties[5]. Private health facilities are increasingly a more prominent component of the health care sector in Indonesia. Solo-private provider facilities are the largest category of outpatient care facilities in Indonesia[5]. Private health facilities include treatment clinics, private maternity hospitals and clinics, and private practices by doctors and midwives not employed by the government.

Immunizations are seen as both public and private goods; they control the spread, morbidity, and mortality of infectious diseases across populations and reduce individual risk for disease. Governments typically take on the responsibility of immunization service delivery and funding. For many developing counties, including Indonesia, EPI immunizations (Bacille Calmette-Guérin [BCG: tuberculosis meningitis], diphtheria-tetanus pertussis (whooping cough) [DTP], polio, and measles) are provided for free. The

private sector can provide immunization services increase access to services, and offer vaccines unavailable in the public sector for people who are willing to pay.

Overall, the private health sector can potentially help fill gaps in the immunization program by providing immunization services and improving access to traditional EPI vaccines. This has particularly been seen among countries in Asia[1]. Private facilities provide services to higher income populations and to people in areas that might not be reached by public health facilities. By integrating private health facilities the immunization system of the country could be strengthened more efficiently.

1.3 Routine Immunization Systems

In 1974 the EPI was established to provide global access to childhood immunizations [10, 11]. Since then, global immunization coverage for vaccines that protect against six major communicable diseases has increased from <5% to 84% [12]; vaccines include, BCG, DTP, polio, and measles vaccines. Several new vaccines such as, hepatitis B (HepB), Haemophilus influenzae meningitis conjugate vaccine, pneumococcal conjugate vaccine, and rotavirus vaccine have been introduced into country immunization programs as funding and resources have become available.

EPI was initiated in Indonesia in 1977 [2, 13]. Shortly after the start of the program, the impact of immunizations were quickly realized as the annual child morbidity rates from vaccine-preventable diseases plummeted[13]. Additionally, efforts to improve access to immunization services have resulted in the dramatic drop of completely unimmunized children from 32% in 1991 to 9.6% in 2007[14]. The proportion of partially immunized

children, however, has not changed during this period and remains the larger issue in Indonesia.

Indonesia aims to achieve universal immunization coverage in every village[8, 15]; to reach this goal, a joint effort between public and private sectors may be required to strengthen the immunization program and improve coverage across all regions[16]. In Indonesia, an estimated 7,800 health centers, 22,000 sub-health centers, 6,600 mobile clinics, and public and private hospitals offer immunization services. The village health posts are the main provider of immunization services; approximately 260,000 village health posts provide immunization services to children at the village level monthly [17].

Annually, the under one year birth cohort that are in need of immunization services is more than four million children [16]. Indonesia's vaccination schedule recommends that children receive vaccines during health facility visits at the following times: 1 dose of HepB vaccine given at birth; 1 dose of BCG and oral polio vaccine (OPV) at age 1 month, and 1 dose of OPV and quadravelent vaccine, containing antigens for diphtheria-tetanus-pertussis-hepatitis B (DTP-HepB) at ages 2, 3, and 4 months; and measles vaccine at age 9 months (table 1). Routine immunizations are manufactured locally in Indonesia and are financed by the Indonesian government, except for new vaccine introduction, which is supported by Gavi, the Vaccine Alliance [17].

Table 1. Routine Immunization Schedule for Indonesia [4, 18]

Age	Vaccine
Birth	HepB0
1 month	BCG and OPV1
2 months	DTP-HepB1 and OPV2

3 months	DTP-HepB2 and OPV3
4 months	DTP-HepB3 and OPV4
9 months	MCV1

Abbreviations: BCG, Bacillus Calmette–Guérin; DTP-HepB, diphtheria, tetanus, pertussis, hepatitis B; DTP-HepB1, 2, and 3, 1st, 2nd, and 3rd doses of DTP-HepB; HepB0, HepB birth dose; OPV, oral polio vaccine; OPV1, 2, 3, and 4, 1st, 2nd, 3rd, and 4th doses of OPV; MCV1, first dose of MCV

Measuring the third dose of DTP (DTP3) is used as a routine immunization program performance indicator [12]. DTP vaccine is used because it requires three contacts with the health system and the vaccine is primarily given through the routine immunization system rather than during campaigns or supplementary immunization activities[19]. Furthermore, dropout rates from the 3-dose antigen are used to assess immunization service utilization and missed opportunities. Globally, approximately 44% of all children started but did not receive 3 doses of DTP [12].

Provinces in the western islands of Indonesia have proven to sustain higher routine immunization coverage compared with eastern provinces [3, 20]. Impressive improvements in coverage seen in the west mask the large number of children who are incompletely immunized in more rural regions of the country. In 2012, Indonesia's DTP1-DTP3 dropout rate (i.e., children who receive 1 dose of DTP but fail to receive all 3 doses) estimated between 19-30%, was among the highest in the world [4, 21]. Each year in Indonesia, more than one million children under the age of 1are not being completely vaccinated with DTP [21]. The Strategic Advisory Group of Experts (SAGE) on Immunization recommends that measures should be taken in countries where the dropout rate is greater than 10%; SAGE further recommends a review of country policies

that potentially lead to missed opportunities and increased dropout rates as a means improve vaccination among all targeted children [19].

Determinants of children who do not receive immunizations or are partially immunized have been categorized into factors attributable to users and demand (e.g., family characteristics and knowledge and attitudes of parents) and factors attributable to the provision of services (e.g., health services and immunization programs; knowledge, attitudes, and practices of health workers)[22]. Common reasons leading to partially vaccinated children include immunization system factors such as access and vaccine service availability, use of all visits to immunize, cost and service quality, and lack of health worker knowledge. For immunization systems, poor access and distance from vaccination services, inadequate vaccine supply, health worker availability and knowledge, missed opportunity to vaccinate (e.g., including non-specified missed opportunities, misuse of contraindications, missing a vaccination card, and no screening for vaccination during curative services), vaccinator absence at the scheduled time for vaccinations, place of residence, low political and financial support for health system, and lack of integration with maternal health services contribute towards the proportion of children who remain unreached or retained by the system [11].

Beyond health system factors, family characteristics also are associated with partially immunized and unimmunized children. These include: caregiver education, socio-economic status, household size and composition, ethnicity, minority religious groups, migration, age, and marital status of mother[11].

1.4 2012 Indonesian Family Life Survey East

In 2012 the first round of Indonesia Family Life Survey (IFLS) East, a large-scale multi-topic household and community survey, was conducted in Eastern Indonesia [23, 24]. The survey was implemented by the National Team for Acceleration of Poverty Alleviation (Tim Nasional Percepatan Penanggulangan Kemiskinan or TNP2K), Poverty Reduction Support Facility (PRSF), and Australian Aid by SurveyMETER and modeled after an ongoing longitudinal IFLS that covers 83% of the Indonesian population. This survey was done to provide information on Eastern Indonesia not available from other data sources and to provide information regarding regional difference present in Eastern Indonesia[23].

By differentiating between public and private health facility visits, potential sources of immunization delivery in Eastern Indonesia will be described. Also, measuring the prevalence of health facility visits that do not result in the child being immunized at each type of health facility will reveal information that may differ about the populations and their immunization status. Furthermore, stratifying by age 9-11 months, second year of life, and third year of life can provide support for the health facilities to continue immunizing children beyond their first year of life for vaccines they have not yet received.

2. Manuscript

Vaccination status among users of private health care in Eastern Indonesia

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2.1 Introduction

In low- and middle-income countries immunization services are typically provided through government programs. However, in countries where the private health sector is emerging, private health care providers may assume a larger role in immunization service delivery. The extent to which caretakers use private providers, the contribution of private providers to immunization coverage, and the private sector's capacity to provide high quality immunization services within these countries is relatively unknown[1]. Collecting this information about the private sector is critical as private health care providers may lack sufficient training or knowledge in immunization policy or their practices may lack adequate infrastructure (e.g., vaccine storage and refrigeration) required for high quality vaccine delivery services [1, 25, 26].

In Indonesia, recent private health sector growth has outpaced public health sector growth. Currently out-of-pocket spending accounts for more than a third of all health care expenditure in the country [9]. In some areas the presence of the private sector is substantial; for example, among districts sampled in West, Central, and East Java Provinces 86% of health facilities were private-solo providers [5]. The use of private health facilities may be a potential source for missed opportunities to immunize a child, (i.e., when a child who is eligible to be vaccinated visits a health facility but leaves unvaccinated) [25, 27-29]. Other reasons why children who visit private health facilities but leave unvaccinated may include caretaker refusal due to cost or unfamiliarity with the public health system [25, 28].

Indonesia's routine immunization system aims to vaccinate over four million children per year who live across the largest island archipelago in the world [2]. Given the geographic spread and land separation, Indonesia is among the most diverse countries in demographic, economic, social, political, and cultural makeup. As such, the country's immunization program is faced with substantial and unique challenges for reaching immunization coverage goals. In 2012, the country ranked third in the world with the most unimmunized and partially immunized children and reported one of the highest dropout rates (30%) for diphtheria-tetanus-pertussis-hepatitis B (DTP-HepB) vaccination (i.e., children who receive at least one dose of DTP-HepB but fail to receive all three doses)[21, 30]. Constant measles, diphtheria, and pertussis outbreaks in Indonesia also highlight the country's need to strengthen their routine immunization program[31].

Our study was conducted to describe the distribution of public and private outpatient health facility visits in Eastern Indonesia and compare vaccination status between children who visited private health facilities to children who only visited public health facilities. Further understanding of the use of private and public health facilities will potentially contribute towards a stronger and more efficient immunization program and ultimately improve childhood immunization coverage.

2.2 Data and Methods

Data

Approximately 247 million people live in Indonesia across 6,000 inhabited islands divided into 34 provinces, which are further split into 500 districts, 7,000 sub-districts,

and over 80,000 villages[2]. This analysis used data from the 2012 Indonesia Family Life Survey, East (IFLS, E), a large-scale multi-topic household and community survey that was conducted in seven provinces in Eastern Indonesia [23, 24]. The 2012 survey was designed and implemented by the National Team for Acceleration of Poverty Alleviation (Tim Nasional Percepatan Penanggulangan Kemiskinan or TNP2K), Poverty Reduction Support Facility, and Australian Aid by SurveyMETER with a structure based on a large ongoing longitudinal IFLS that has been collecting data since 1994 [24].

Sampling was completed in four stages to be representative of the Indonesian population living in eastern provinces. First, two provinces were selected with equal probability from Kalimantan and Sulawesi regions while the remaining five were selected without sampling. Kalimantan Timur, Sulawesi Tenggara, Nusa Tenggara Timur, Maluku, Maluku Utara, Papua Barat, and Puapa were the seven final provinces included in the survey. Second, 14 villages were drawn from each province without replacement and with equal probability. Third, administrative unit levels were identified; these areas consisted of approximately 100-150 households and then were further divided into smallest local area (SLS) units. One SLS group from each village was randomly selected. The fourth and final step involved listing all households within the selected SLS. From this list, a simple random sample without replacement was taken for 30 rural households or 20 urban households. A more detailed description of IFLS East survey methods are described elsewhere [23].

For each level, both household and community level cross-sectional surveys were conducted to collect information associated with health, education, and socioeconomic status. In this analysis, we focused exclusively on household level data.

Outcome variables

Three binary vaccination statuses were evaluated in this study: fully vaccinated, vaccinated with three doses of DTP-HepB vaccine (DTP-HepB3), and vaccinated with first dose of measles vaccine (MCV1). Each status was based on the child's vaccination card, or if the card was not available, by caretaker recall. Fully vaccinated status was defined as the child receiving all recommended doses of vaccine. In Indonesia this includes: one dose of Bacille Calmette-Guérin (BCG), three doses of DTP-HepB, three doses of polio vaccine (OPV3), and one dose of MCV1. DTP-HepB3 and MCV1 status were assessed separately to evaluate vaccine specific outcomes. In Indonesia the immunization schedule in the public sector includes visits at 2, 3, and 4 months of age to receive one dose of DTP-HepB; receiving three doses of DTP-HepB was used an indicator for routine immunization system strength since doses of the vaccine are not delivered during immunization campaigns. MCV1 status was analyzed because the vaccine given at 9 months of age, the last vaccine in the first year of life, and as such, typically has lower coverage than other first year of life antigens.

Exposure variable

The exposure of interest was the type of outpatient health facility visits the child made one month prior to the survey. Visits were categorized into four groups: public health

facility visits only, private health facility visits only, both public and private health facility visits, and no health facility visit. Public health facility visits included village health posts (posyandus), community health clinics (puskesmas), or public hospital outpatient visits. Private health facility visits included solo-private providers (e.g., physician, nurse, or midwife), private clinic, or private hospital outpatient visits.

Potential Confounders

Potential confounders included in the study were factors that have previously been shown to be associated with vaccination status [11]: child age in months, sex, birth order, vaccination card retention, maternal age in years, maternal education, maternal employment, household size, household wealth, and urban/rural location of residence. Certain variables such as maternal TT (tetanus toxoid) vaccination status and maternal location of antenatal care were considered but were not included in the analysis due to a large portion (>15%) of missing data. Sex, vaccination card retention, mother's employment status, and urban/rural location were binary variables. The other potential confounder variables were categorized as follows: child age into three groups (9-11, 12-23, and 24-35 months); birth order into three groups (1^{st} born, 2^{nd} – 3^{rd} born, and $\geq 4^{th}$ born); maternal age into 5-year age groups; maternal education into four groups (none, primary, secondary, and higher education); maternal religion into three groups (Muslim, Christian, and other); household size in four groups (2-3, 4-5, 6-7, and ≥ 8 people). Wealth quartiles were calculated using the total household income divided by the household size.

Data Analysis

Survey design measures were accounted for in descriptive, bivariate, and multivariate analyses. The strata were identified by province, clusters by enumeration areas (villages), and household weights calculated by IFLS East were used [23]. Vaccination coverage, DTP-HepB1 – DTP-HepB3 dropout, and DTP-HepB1-MCV1 dropout were estimated using vaccination card information among children with a card, caretaker verbal recall among children without a card, and both card and recall (card+recall) among all children.

Bivariate analysis between the three outcomes and each potential confounder was evaluated using the Rao-Scott Chi-square test at the alpha 0.05 significance level. Simple and multiple logistic regression analyses were used to evaluate association between type of health facility visited and the three outcomes. The results were expressed as crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs). To address the potential difference in access to private health facilities by urban or rural location crude models were stratified by residence.

For our multivariate analysis, interaction terms between type of health facility visited and place of residence, vaccination card status, wealth quartiles, maternal employment, and maternal education were evaluated but not included in the final model due to model instability. Instead, a single effect multivariate model was run. Final models were selected using the all-possible subsets approach where all potential confounding variables were included in addition to the exposure of interest. Confounding and precision assessments were used to determine which variables should remain in each of the final

models. A meaningful change was defined as a >10% change in odds ratio estimates. If an effect estimate changed more than 10% we kept the variable in the final model to control for confounding. Confounding and precision assessments were completed as a function of all three OR and 95% CI. If confounding was present for one of the comparisons then the variable was kept in the model; furthermore, a variable was kept in the model if there was loss of precision for one of the comparisons. All Analyses were performed in SAS 9.3 (SAS Institute, Cary NC).

2.3 Results

Descriptive analyses

Among 1,601 children who provided vaccine information, 626 children met the required age range of 9-35 months for inclusion in our analysis. Thirty-five (5.6%) children were not living in the same household as their mother and were excluded because maternal information could not be identified. Final analyses included 591 children 9-35 months of age. Most children fell into the older age categories of either 12-23 months of age (40.9%) or 24-35 months of age (49.0%). Approximately half of the children included were female (48.2%) and either the second or third born (45.7%). Only 30.0% of children had an available immunization card at the time of the survey resulting in vaccination status being heavily reliant on caretaker recall (table 1).

Relative to maternal characteristics, maternal age was approximately evenly distributed among the 5-year age categories with the exception of mothers between the ages of 15-19 years who only made up 4.1% of mothers. Most mothers reported the completion of secondary education (54.6%), were employed in the past year (59.0%), and were Muslim

(52.5%). Among household variables, 57.3% of children lived in a rural residence and 41.5% lived in a house with 4-5 people (table 1).

Health facility visits

Approximately 59% of children had visited some type of health facility in the previous month (table 2a). Among all children, 47% percent had visited public health facilities only; 5% visited private health facilities only, 7% of children visited both public and private health facilities; and 41% of children did not visit any type of health facility. Among all public health facility visits, village health posts were most frequently visited and made up 66.2% of visits (table 2b). During village health post visits, children were most often weighed (98.5%) and given supplementary food (67.1%) (table 2d). During other public health facility (i.e., community health center or public hospital) and private health facility visits the most commonly received service was treatment for illness (78.0% and 88.4%, respectively) (table 2e).

Vaccination coverage

Coverage using card and recall vaccination information was 82.8% for BCG, 81.8% for DTP-HepB1, 55.3% for DTP-HepB3, 85.6% for OPV1, 58.0% for OPV3, and 74.0% for MCV1 (table 3a). More than a third of children who initiated the DTP-HepB series did not complete the series (DTP-HepB dropout; table 3b); DTP1-MCV1 dropout rate was 13.6%.

DTP-HepB3, MCV1, and fully vaccinated status differed by urban or rural residence, with generally better vaccination levels among children living in urban communities compared to those living in rural communities (table 5).

Bivariate analysis of potential confounders

Factors that significantly affected DTP-HepB3 vaccination status included: card availability (p-value: <0.0001), maternal employment (p-value: 0.001), urban/rural residence (p-value: <0.0001), maternal education (0.01), and maternal religion (p-value: 0.01) (table 4). Factors that were significant for MCV1 status were: maternal employment (p-value: 0.04), urban/rural (<0.0001), child's age (p-value: 0.04), birth order (p-value: 0.05), and maternal education (p-value: <0.0001) were significant. For fully vaccinated status card availability (p-value: <0.0001), maternal employment (p-value: 0.01), urban/rural (p-value: <0.0001), maternal education (p-value: 0.01) and household wealth quartiles (p-value: 0.04) differed significantly.

Adjusted odds ratio estimates

DTP-HepB3 status, after adjusting for child's age, birth order, household size, mother's education, mother's employment status, and residence, varied between private and public health facilities. The odds of being fully up to date for DTP-HepB3 vaccination was 71% lower among children who only visited private health facilities compared with children who only visited public health facilities (aOR: 0.29; 95% CI: 0.12, 0.69). The final model for MCV1 status adjusted for child's age, card retention, mother's education, mother's religion, and residence; while fully vaccinated status model adjusted for child's

age, birth order, child's sex, household size, mother's age, mother's education, mother's employment status, mother's religion, and household wealth. Both models, after adjustment, showed a similar trend. The odds of completed MCV1 status was 56% lower among children who only visited private health facilities than among children who only visited public health facilities (aOR: 0.44; 95% CI: 0.16, 1.21) and the odds for being fully vaccinated was 51% lower among children who only visited private facilities compared with children who visited public facilities (aOR: 0.49; 95% CI: 0.21, 1.17); however, neither of these findings were statistically significant (table 6). In regards to children who visited both public and private health facilities, their vaccination status for the three outcomes were similar to children who only visited public health facilities.

2.4 Discussion

Children who exclusively visited private health facilities consistently had lower odds of being vaccinated compared to children who only visited public health facilities for DTP-HepB3, MCV1, and fully vaccinated statuses, although only statistically significant for DTP-HepB3. However, because trends were similar for every outcome we examined, our findings do suggest that delivery of childhood vaccination in Indonesia has been generally more successful in the public versus the private health sector. Additionally, our results showed that children who visit both public and private health facilities did not differ in vaccination status compared to children who only visit public health facilities. This may indicate that while some caretakers who visit private health facilities are successfully navigating the whole health system to get their child vaccinated others are not.

The higher vaccination coverage among urban communities was consistent with previous findings in vaccination coverage [11]. Access to private health facilities, in addition to other factors that generally contribute to better health care and quality of life, are typically associated with urban locations. In rural locations children who only visited private health facilities accounted for a smaller proportion of visits compared to urban locations. This is consistent with the Indonesian public health infrastructure that relies on village health posts to deliver monthly preventative services to rural populations [3]. Another finding among private health facility users was that the majority of children did not have a vaccination card.

There are several possible reasons why vaccination delivery is weaker in the private health sector compared with the public sector in Indonesia. Immunization sessions may not be offered as regularly or as frequently as in public health facilities; vaccine stocks may be less reliable or complete; private provider training on vaccine policy and administration may be inadequate or unavailable; or private providers may not communicate to caretakers where and when their child can receive vaccination services[9]. In such situations, missed opportunities to immunize children are occurring. Our results indicated that children frequently visited private health facilities for curative care. These visits can be used as opportunities to assess a child's vaccination status and vaccinate or refer children who are unvaccinated or partially vaccinated.

Other studies have shown varying levels of vaccination delivery among the private sector in South East Asia. In Bangladesh private health facilities account for 1% of vaccination services while in Thailand they account for about 10% of vaccination services. Private providers in India are estimated to provide 27% of immunization services in urban areas and 15% in rural areas [1]. A study completed in Sri Lanka showed significant differences among the demographic characteristics of caretakers who visited private or public health facilities for their child's immunizations; family income, social class, ethnicity, religion and educational level of the mother were all significantly associated with using private health facilities [32]. However, people from lower socio-economic backgrounds also use private health care. This was particularly evident if a private health facility was closer to where the person was living or provided shorter waiting times [1].

The results of this study should be interpreted with certain limitations in mind. First, this study was a secondary analysis of cross-sectional data from a survey not specifically designed for country vaccination program purposes. This may result in limited indicators for vaccination coverage compared to other surveys. Second, the exposure of interest was based on health facility visits only within the past month, possibly resulting in an incomplete assessment of this exposure variable as a proxy for type of service utilization. Third, only 30% of the population had a vaccination card and most vaccination history data relied on caretaker recall. This is important because low card retention can introduce misclassification bias of the measured outcomes. Several studies have shown that caretaker recall typically underestimates the number of vaccine doses the child actually received [33]. Other vaccination surveys conducted in Indonesia have reported similar

card retention indicating the need to improve card retention or the use additional sources of vaccination information (e.g., health facility-based records) to estimate vaccine coverage more accurately and completely [34]. Of note, the MCV1 coverage in the survey population was atypically higher than DTP-HepB3 coverage, raising questions about the reliability of this coverage estimate for MCV1 received during a health facility visit. Between 2010 and 2011 Indonesia conducted follow up measles campaigns targeted at children between the ages of 9-59 months to address coverage gaps [35]. During this time, MCV doses given during the campaign, may have been inadvertently recorded on the child's vaccination card or recalled by the caretaker as a routine dose. Finally, the number of children who visited private health facilities in the study was small thus limiting our interaction and sensitivity assessments.

In any country, the delivery of vaccination services is a complex process that includes several activities and stakeholder collaboration. This is particularly challenging for a country such as Indonesia, where the health system has undergone recent changes related to decentralization, in addition to natural disasters, geographic challenges, and limited resources. Further research should evaluate both health facility and individual level factors that contribute towards low vaccination coverage in Indonesia, especially in private sector settings. The knowledge and practices of private providers and quality of immunization services in the private sector should be further characterized in order to identify needed improvements, and to test and measure interventions designed to improve vaccine delivery services. Collaboration between the public and private sectors in Indonesia to ensure high-quality and standardized immunization service deliver, as well

as systematic recording and reporting of vaccination doses would help achieve the country's goal of universal childhood vaccine coverage.

3. Public Health Implications

There is a gap of knowledge about immunization service delivery in Indonesia's private sector. Using data collected in eastern Indonesia from the 2012 Indonesian Family Life Survey East, this analysis showed differences in vaccination coverage between children who seek outpatient care at private health facilities compared to those who use public sector care. Reasons for lower coverage in children with recent visits to private providers should be explored further. Information presented in this thesis suggests a focus on the development of strategies and interventions aimed to bridge the gap between private and public sector immunization delivery, improve immunization service delivery and coverage, and ultimately decrease vaccine-preventable disease morbidity and mortality in Indonesia.

Tables

Table 1. Distribution of child, maternal, and household characteristics among the 591 children 9-35 months of age, 2012 Indonesian Family Life Survey East[a]

	Total Children (n=591)	
	No.	**%**
Child's Age, months		
9-11	63	10.1
12-23	250	40.9
24-35	278	49.0
Child's Sex		
Female	295	48.2
Male	296	51.8
Birth Order		
1	162	31.4
2-3	268	45.7
4+	161	22.9
Vaccination Card Retained		
Yes	179	30.0
No	412	70.0
Maternal age, years		
15-19	26	4.1
20-24	126	21.0
25-29	164	29.2
30-34	141	21.3
35+	134	24.5
Maternal Education		
None	37	5.9
Primary	199	28.9
Secondary	292	54.6
Higher	63	10.6
Maternal Employment		
Yes	378	59.0
None	213	41.0
Maternal Religion		
Muslim	308	52.5
Christian	266	46.3
Other[b]	17	1.2
Urban/Rural		
Urban	152	42.7
Rural	439	57.3
Household size		
2-3 people	79	16.7
4-5 people	239	41.5
6-7 people	174	26.3
8+ people	99	15.6
Household Wealth Quartiles[c]		
1	146	24.7
2	146	21.5
3	145	28.1
4	147	25.8

[a]All proportions reported in the table reflect survey sample weights
[b]Other includes Hindu and Buddhism
[c]Based on total household salary earned in the past year divided by household size

Table 2a. Distribution of health facility visits among 591 children 9-35 months of age, 2012 Indonesian Family Life Survey East [a]

	Total Children (n=591)	
	No.	**%**
Type of health facility visited[b]		
Public health facility only	272	47.1
Private health facility only	32	4.5
Both public and private health facilities	36	6.9
No health facility visited	251	41.4
Number of visits in past month		
0	251	41.4
1	228	37.2
2	82	15.5
3+	30	5.9

[a]All proportions reported in table reflect survey sample weights
[b]Health facilities visited during outpatient visits one month preceding the survey

Table 2b. Distribution of public health facility type among children who only visited public health facilities, 2012 Indonesian Family Life Survey East [a]

	Public health facility visits (n=272)	
	No.	**%**
Village health post	179	66.2
Public health facility	33	11.7
Both village health post and public health facility	60	22.1

[a]All proportions reported in table reflect survey sample weights
[b]Public health facility visits include community health clinics or public hospitals visited for outpatient services

Table 2c. Distribution of public health facility type among children who visited both public and private health facilities, 2012 Indonesian Family Life Survey East [a]

	Both Public and Private Health Facility Visits[b,c] (n=36)	
	No.	**%**
Village health post and private health facility	29	73.1
Public and private health facility	4	18.3
Village health post, public, and private health facility	3	8.6

[a]All proportions reported in table reflect survey sample weights
[b]Public health facility visits include community health clinics or public hospitals visted for outpatient services
[c]Private health facility visits include private providers, private clinics, or private hospitals visited for outpatient services

Table 2d. Distribution of child health care received during village health post visits, 2012 Indonesian Family Life Survey East [a, b]

	Village health posts visits	
	No.	**%**
Weighing	269	98.5
Supplementary food	171	67.1
Vitamin A	119	43.1
ORS	29	11.7
Immunizations	117	45.4
Medical exam	176	60.5
Child development activity	48	22.7

[a]All proportions reported in table reflect survey sample weights
[b]Care received during visit was not mutually exclusive

Table 2e. Distribution of child health care received during public health facility and private health facility visits, 2012 Indonesian Family Life Survey East [a, b]

	Public health facility visits[c] n=100		Private health facility visits[d] n=68	
	No.	**%**	**No.**	**%**
Immunization	1	3.6	1	2.0
Consult	6	3.2	2	1.6
Medical Check-up	19	20.5	10	10.8
Medications	16	15.1	10	15.2
Injection	5	4.7	0	0.0
Treatment of illness	79	78.0	58	88.4
Treatment of Injury	1	0.4	0	0.0
Massage	4	4.1	1	0.7

[a]All proportions reported in the table reflect survey sample weights
[b]Care received during visit was not mutually exclusive
[c]Public health facility visits include community health clinics or public hospitals visited for outpatient services
[d]Private health facility visits include private providers, private clinics, or private hospitals visited for outpatient services

Table 3a. Vaccination coverage by source of vaccination information for children 9-35 months of age, 2012 Indonesian Family Life Survey East

	Children vaccinated	BCG	DTP-HepB			Polio			MCV1
			1	2	3	1	2	3	
Source of Vaccination Information	**N**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Card	179	86.0	87.2	82.7	78.4	89.6	88.8	83.0	75.2
Recall	412	81.4	79.6	62.3	45.4	83.9	66.5	47.2	73.5
Card+Recall	591	82.8	81.8	68.4	55.3	85.6	73.2	58.0	74.0

Table 3b. DTP-HepB1-3 dropout and DTP-HepB1-MCV dropout rate by vaccination information source, 2012 Indonesian Family Life Survey East

	%
Card DTP3 dropout	13.1
Recall DTP3 dropout	45.0
Card+Recall dropout	34.4
Card DTP-MCV dropout	20.3
Recall DTP-MCV dropout	10.4
Card+Recall DTP-MCV dropout	13.6

Table 4. Vaccination status of 591 children, 9-35 months of age by child maternal, and household characteristics, 2012 Indonesian Family Life Survey East[a]

	Total Children (N=591)	DTP-HepB3[b]		MCV1[c]		Fully Vaccinated[d]	
	N	%	p-value*	%	p-value*	%	p-value*
Vaccination Card Retained							
Yes	179	78.4	**<.0001**	75.2	0.7739	67.2	**<.0001**
No	412	45.4		73.5		37.5	
Child's Age, months							
9-11	63	64.0	0.4977	57.0	**0.0374**	41.4	0.651
12-23	250	53.5		74.4		45.3	
24-35	278	55.1		77.2		48.4	
Child's Sex							
Female	295	55.3	0.9845	75.0	0.6819	44.3	0.4509
Male	296	55.4		73.1		48.4	
Birth Order							
1	162	51.3	0.3727	76.0	**0.0486**	40.2	0.1285
2-3	268	59.3		77.6		52.4	
4+	161	53.0		64.2		42.9	
Maternal age, years							
15-24	152	48.5	0.3336	71.2	0.5474	34.8	0.0752
25-29	164	55.2		76.7		51.2	
30-34	141	57.1		70.1		47.8	
35+	134	61.0		77.2		51.4	
Maternal Education							
None	37	24.3	**0.0004**	20.9	**<.0001**	12.9	**0.0001**
Primary	199	43.0		68.0		34.9	
Secondary	292	63.3		81.1		53.6	
Tertiary	63	65.4		83.4		59.4	
Maternal Employment							
Yes	378	67.2	**0.0007**	69.6	**0.044**	39.4	**0.0067**
None	213	47.1		80.4		56.6	
Maternal Religion							
Muslim	308	61.6	**0.0122**	79.3	0.0963	52.1	0.076
Christian	266	47.6		68.4		40.0	
Other[e]	17	75.9		59.7		42.2	
Urban/Rural							
Urban	152	71.1	**<.0001**	86.8	**<.0001**	62.7	**<.0001**
Rural	439	43.6		64.5		34.2	
Household size							
2-3 people	79	48.6	0.2425	73.7	0.2586	41.2	0.0731
4-5 people	239	58.9		75.1		50.6	
6-7 people	174	50.0		67.6		37.1	
8+people	99	62.0		82.4		56.6	
Household Wealth Quartiles[f]							
1	146	49.5	0.188	73.7	0.6611	39.8	**0.0428**
2	146	49.5		69.2		38.3	
3	145	55.7		77.1		47.4	
4	147	63.9		75.8		58.4	

[a]All proportions reported in the table reflect survey sample weights
[b]Received three doses of DTP-HepB
[c]Received a dose of MCV
[d]Child received one dose of BCG, three doses of DTP-HepB, three doses of OPV, and one dose of MCV1
[e]Other includes Hindu and Buddhism
[f]Based on total household salary earned in the past year divided by household size
*Rao-Scott Chi-square p-value; significant values at alpha are bolded

Table 5. Vaccination status of 591 children 9-35 months of age and crude odds ratio (cOR) by outpatient health facility visit type and OR stratified by rural or urban, 2012 Indonesian Family Life Survey East[a]

	Total Children (N=591)*		DTP-HepB3[b]				MCV1[c]				Fully Vaccinated[d]			
	N	%	%	cOR	95% CI		%	cOR	95% CI		%	cOR	95% CI	
Overall: Type of health facility visited[e]														
Public health facility only	272	47.1	62.9	1.00			78.6	1.00			53.7	1.00		
Private health facility only	32	4.5	44.6	0.47	0.20	1.15	73.1	0.74	0.27	2.05	44.6	0.69	0.28	1.69
Both public and private health facilities	36	6.8	59.3	0.86	0.36	2.04	75.3	0.83	0.29	2.39	45.3	0.72	0.30	1.72
No health facility visited	251	41.1	47.3	0.53	0.30	0.93	68.7	0.60	0.30	1.21	38.6	0.54	0.31	0.96
Rural: Type of health facility visited[e]														
Public health facility only	208	51.5	49.6	1.00			76.4	1.00			42.1	1.00		
Private health facility only	18	3.3	32.8	0.49	0.15	1.58	62.5	0.52	0.13	2.10	32.8	0.67	0.21	2.11
Both public and private health facilities	27	7.2	56.3	1.31	0.52	3.27	71.8	0.79	0.24	2.57	50.0	1.38	0.54	3.50
No health facility visited	186	38.0	33.9	0.52	0.28	0.97	47.1	0.28	0.14	0.55	20.8	0.12	0.19	0.68
Urban: Type of health facility visited[e]														
Public health facility only	64	41.2	85.1	1.00			82.3	1.00			73.1	1.00		
Private health facility only	14	6.3	52.8	0.20	0.05	0.84	80.6	0.89	0.18	4.39	52.8	0.41	0.09	1.80
Both public and private health facilities	9	6.5	63.8	0.31	0.06	1.68	80.4	0.88	0.10	7.57	38.4	0.23	0.05	1.15
No health facility visited	65	46.0	62.1	0.29	0.12	0.68	92.6	2.69	0.87	8.36	58.3	0.51	0.23	1.16

[a]All proportions reported in the table reflect survey sample weights
[b]Received three doses of DTP-HepB
[c]Received a dose of MCV
[d]Child received one dose of BCG, three doses of DTP-HepB, three doses of OPV, and one dose of MCV1
[e]Health facility visits occurred one month prior to survey
*Column percentages given for total number of children

Table 6. Vaccination status by type of facility visited in prior month, Gold Standard (GS) model adjusted odds ratios (aOR), and final model adjusted odds ratios among 591 children 9-35 months of age, 2012 Indonesian Family Life Survey East[a]

	Total Children (N=591)	DTP-HepB3[b]				MCV1[c]				Fully Vaccinated[d]			
	N	%	aOR	95% CI		%	aOR	95% CI		%	aOR	95% CI	
GS model: Type of health facility visited[e,f]													
Public health facility only	272	62.9	1.00			78.6	1.00			53.7		1.00	
Private health facility only	32	44.6	0.32	0.13	0.82	73.1	0.48	0.17	1.36	44.6	0.49	0.18	1.33
Both public and private health facilities	36	59.3	0.93	0.27	3.14	75.3	1.17	0.36	3.76	45.3	0.92	0.26	3.32
No health facility visited	251	47.3	0.45	0.28	0.74	68.7	0.54	0.29	1.00	38.6	0.43	0.26	0.73
Final Models: Type of health facility visited[e]													
Public health facility only	272	62.9	1.00			78.6	1.00			53.7	1.00		
Private health facility only	32	44.6	0.29	0.12	0.69	73.1	0.44	0.16	1.21	44.6	0.49	0.21	1.17
Both public and private health facilities	36	59.3	0.90	0.29	2.83	75.3	1.23	0.40	3.77	45.3	0.95	0.30	2.96
No health facility visited	251	47.3	0.41	0.25	0.68	68.7	0.56	0.32	0.98	38.6	0.41	0.24	0.70

[a]All proportions reported in the table reflect survey sample weights

[b]Received three doses of DTP-HepB; final model adjusted for child's age, birth order, household size, mother's education, mother's employment status, and residence

[c]Received a dose of MCV; final model adjusted for child's age, card retention, mother's education, mother's religion, and residence

[d]Child received one dose of BCG, three doses of DTP-HepB, three doses of OPV, and one dose of MCV1; final model adjusted for child's age, birth order, child's sex, household size, mother's age, mother's education, mother's employment status, mother's religion, and household wealth

[e]Health facility visits reflect visits that occurred one month prior to survey

[f]GS model contained child's age (months), child's sex, child's sex, child's birth order, child's vaccination card retention, maternal age (years), maternal education, maternal employment, maternal religion, residence (urban/rural), household size, and wealth quartiles

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