Knowledge among the rural parents about the vaccinations and vaccination coverage of children in the first year of life in Papua New Guinea – analysis of data provided by Christian Health Services.

Ewelina Gowin (ewego@poczta.onet.pl)
Poznan University of Medical Sciences https://orcid.org/0000-0001-7443-0749
Jerzy Kuzma
Divine Word University
Danuta Januszkiewicz-Lewandowska
Uniwersytet Medyczny imienia Karola Marcinkowskiego w Poznaniu

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Abstract

Background: This analysis aimed to assess rural parents' knowledge about the diseases prevented by vaccinations and establish vaccination coverage in PNG.

Methods: Knowledge on vaccinations was checked through a standard questionnaire (five open questions). We analyzed data on vaccination coverage from 2016 to 2018 from all Catholic health facilities. Analyzed vaccinations were the pentavalent vaccine (DTaP-HiB-HepB) and measles vaccine given in the first year of life. Coverage was calculated based on the number of vaccines used compared to the number of eligible children.

Results: 56 parents, including 52 mothers and four fathers, participated in the interview. The majority of parents (46%) understood that the vaccine prevents the child from the sick. During the analyzed period, a total of 25,502 doses of measles vaccine was given, 31,428 children were vaccinated with the pentavalent vaccine. In 2016, the coverage rate for the measles vaccine was 26.6% and 33.4% for the pentavalent vaccine. In 2017, the coverage rate for measles and pentavalent vaccines was 12.5% and 16.6%, respectively. There were significant differences in immunization coverage between provinces. A decreasing trend in the number of administered vaccinations was observed.

Conclusion: The results of this analysis demonstrate that in PNG, the majority of children are not fully immunized. There are big differences in vaccination coverage between provinces. The problem is the lack of public understanding of the need for vaccinations. Lack of patient vaccination records makes it difficult to establish individual vaccination history.

Background

Papua New Guinea (PNG) has a population of around 8 million people, with a birth cohort estimated at 200,000 children (1,2). This is a country where vaccine-preventable diseases are still a problem. In 2017, according to Annual Report on Child Morbidity and Mortality in PNG, there were 11 cases of tetanus (4 deaths), 25 cases of whooping cough, 28 cases of acute flaccid paralysis (3 deaths), and 3 cases of measles (3). The latest polio outbreak showed a lack of community protection. In Morobe and Madang provinces, the vaccination coverage in children in the first year of life was far below advised (4). During an outbreak, catch up vaccinations were performed. The National Health Department, with the help of Provincial Health Authorities, organized four-round immunization campaigns from July to October 2018 to immunize children under five years (5). More than 5.7 million doses of oral polio vaccines (OPVs) had been procured for use in the vaccination campaign. This is much more than assumed based on the population number (children population under five years of age is around 1,000,000) (5,6).

In PNG, the immunization program was launched in 1977, providing vaccinations against tuberculosis, polio, diphtheria, pertussis, and tetanus. In 1981, the Expanded Program on Immunization (EPI) was started. In 2009, the pentavalent vaccine replaced the tetravalent vaccine used in 2007 and 2008. A

pneumococcal vaccine was introduced in 2013. The GAVI supports the introduction of the new vaccines. Vaccinations supported in PNG by GAVI are measles, polio, pneumococcal and pentavalent vaccines (7).

The Family Health Unit organizes immunization services in PNG in the Health Improvement Branch of the National Department of Health. They are offered as a part of public health services through a network of 800 Maternal and Child Health (MCH) clinics (8). Provincial Cold Chain Logistics Officers (PCCLO) are responsible for managing vaccines at a provincial level with support from the Provincial Family Health Coordinator. At the district level, EPI is managed by the District Manager through the health facility (Maternal & Child clinics and Well Baby clinics) Sister-In-Charge. It covers 30% of children; the rest are reached through outreach services (9). There are 29 outreach clinics for every 1000 children under the age of 5 years (2). Approximately 63% of health facilities in PNG are government-owned, and religious organizations organize the remaining. Church organizations offer a significant proportion of immunization services, and 99% of the population declares the Christian religion (1,2,10). The Christian Health Services (CHS) of PNG is the organization that represents all Christian Churches that provide health care services throughout PNG. CHS gets its funding from the Government of PNG through the National Department of Health. CHS is responsible for managing all 29 church-run health agencies within PNG. There are 713 healthcare facilities (hospitals, urban clinics, health centers, aid posts) in 22 provinces. The population targeted by EPI include those in the first year of life, children entering and leaving school (age 6 and 13 years), and pregnant women. The vaccination schedule in PNG is presented in Table 1.

The National Health Information System does the monitoring of vaccination. It is difficult to establish actual vaccination coverage due to the absence of a recent coverage survey. There are different types of data provided by the government (Sector Performance Annual Review), the World Health Organization (WHO), and UNICEF (11,12).

Available data from the National Health Information System, WHO, and UNICEF estimates are presented in Table 2. Differences between data make it very difficult to analyze it and share it with the provinces. All reports indicate a decrease in vaccination coverage, with a simultaneous dynamic increase in the number of inhabitants in the last five years (10,11,12). This analysis aimed to assess rural parents' knowledge about the diseases prevented by vaccinations and establish vaccination coverage in PNG.

Material And Methods

The survey in villages was a cross-sectional study performed by a healthcare worker. During a visit, a healthcare worker identified all children younger than five years. Vaccination status was checked based on vaccination records or interviews with parents. Only families who agreed to participate in the study were asked for vaccination status.

Knowledge of vaccinations was checked through a standard questionnaire (five open questions). The structured questionnaire collected data on sociodemographic characteristics, vaccination status, and opinions on vaccinations. Parents were asked to bring children vaccination booklet, if available. The

individuals' vaccination status is verified by checking their vaccination certificate that provides details on both compulsory and recommended vaccines. Due to the high illiteracy rate, it was an interview with a manual recording by trained data collectors. Data obtained from questionnaires were uploaded to excel forms (no personal data were introduced to the system). Questionnaires are included as supplementary files. Collected data are recorded anonymously.

The questionnaire analysis was a descriptive analysis. Due to a small number of families participating in the study, a comparative analysis between the different regions was not performed.

Analysis of vaccination data provided by CHS from 2016 to 2018.

Each year the population of children younger than one year covered by CHS was around 50,000, which is ¼ of the birth cohort. The target population was based on data from the Census. We analyzed data on vaccination coverage from 2016 to 2018 from all Catholic health facilities that provide vaccinations in all PNG provinces. Analyzed vaccinations were the pentavalent vaccine (DTaP-HiB-HepB) and measles vaccine given in the first year of life. Coverage was calculated based on the number of vaccines used compared to the number of eligible children.

Patient and Public Involvement

The researchers did not assume any significant risk to themselves and the participants; the data are not sensitive. We adopt an implied consent, which assumes that when, following the information about the study, the participant agrees to self-administer the questionnaire or participate in the interview, he/she agrees to take part in the study. The study received the approval of the ethics committee of the Divine Word University.

Results

56 parents, including 52 mothers and four fathers from 2 areas Simbu Province (Kervagi district) and Morobe Province (Finschhafen district), participated in the interview. The healthcare workers identified 68 eligible families (response rate was 82%). The parents' education level was shallow: six had never been to school, 17 was four o less grade, 29 have 5-8 grade, seven have 9 or 10 classes completed. The average number of children in families was 2.5 children. The age range for participating children varies between nine months and nine years, while the average age of participating children was 3.3 years. Thirty-eight out of 56 parents (68%) have no vaccination records in the child's health book.

The majority of parents (26 out of 56; 46%) understood that "the vaccine prevents the child from the sick." Other single opinions were that "vaccination can prevent a child for disability" and "help a child to grow well" Almost all the women (50 out of 56) admitted to having no idea how a vaccination works. Only a few women mentioned that vaccination: "allow a child to grow," or "strengthen the child." Seventy percent thought that vaccination is to prevent the sick (40 out of 56) or even death. Some people answered that

the reason for vaccination is to treat the disease. To persuade other parents to vaccinate their child, the highest proportion (38%, 21 out of 56) will inform that vaccination "prevent a child from becoming sick" or from death. Others will provide a more general statement that vaccinated children "grow well." Knowledge of diseases that vaccinations can prevent was shallow. The most frequent known disease was polio 18 people, and TB 15. Other conditions were tetanus and hepatitis B mentioned by four parents. The average number of known diseases preventable by vaccination was 0.8. Details are presented in table 3.

During the analyzed period, 31,428 children were vaccinated with the pentavalent vaccine, and a total of 25,502 doses of measles vaccine were given. In 2016, the measles vaccine coverage rate was 26.6% and 33.4% for the pentavalent vaccine. In 2017, measles and pentavalent vaccines' coverage rate was 12.5% and 16.6%, respectively. There were significant differences in immunization coverage between provinces (Fig. 1, Fig. 2). In 2016, greater than 80% coverage was noted in one province for the measles vaccine and four provinces for the pentavalent vaccine. In 2017, in none of the provinces, the coverage rate, neither for pentavalent nor for measles vaccine, was higher than 80% (Fig. 2). A decreasing trend in the number of administered vaccinations was observed.

Eighteen children had vaccination booklets; half of them had one vaccination visit. The commonest given vaccine was DTP, followed by measles and rubella vaccines given in 16 patients. Details are presented in Table 4.

Discussion

Our analysis showed large differences between vaccination coverage in each province. In some medical facilities, the vaccination coverage was even more than 100%. This does not mean that some children were vaccinated twice, but more children than before. It was a case in 10 health facilities in 3 provinces. The lowest coverage was in provinces, where at least 60% of the population lives in areas not accessible by road. The access to services can be, in these provinces, the biggest problem in vaccine delivery. The vaccination coverage only in one province (Morobe) was equal to median vaccination coverage in PNG. Moreover, one province (Chibu) within the analyzed period experienced a marked decline in vaccination rates – to rates lower comparing to the country average.

There is often only one static clinic per week at the health center level in PNG, resulting in long waiting times for services. Although vaccinations are free of charge, some health facilities require user fees to run the operational costs. This discourages attendance at clinics unless the child is sick. It is proved by a mean number of outpatient visits per person per year, which in PNG is 1.28 (13). Neonatal mortality and under 5-year mortality are among the highest in this region of the world (57/1000 live births) (1,2,10). Services provided by the healthcare facilities also experience many troubles: lack of vaccinations, 30% of healthcare facilities are experiencing problems with vaccinations supply, or problems with maintaining cold chain (10). The other problem is a suboptimal number of healthcare professionals. According to

PNG's official data, there are 32 pediatricians, 0.5 physicians per 10,000 population, and 5.3 nurses per 10,000 population (2).

PNG has a relatively low coverage of essential services (Universal Health Coverage), according to WHO (12). Antenatal care is an indicator of access to and use of health care during pregnancy, and its low use is one of the well-known risk factors for incomplete vaccination. Mean antenatal care use in PNG is estimated at 54% (13). In regions with the lowest use of antenatal care, CHS's vaccination coverage was also low. In a study conducted by Russo in Cameroon, children born at health facilities had a higher immunization coverage rate than those born at home (14). The percentage of supervised deliveries in PNG is estimated at 37% (10).

The other problem is the lack of public understanding of the need for vaccinations (15,16). There are huge difficulties in communication. The adult literacy rate is estimated at 63.4 % (1). So far, no opposing opinions about vaccinations have been noticed in PNG, but the understanding of the idea of vaccinations is poor. For some people, there is no difference between vaccination – prevention and treatment. They view injection as a treatment and think there is no need to give them healthy children. The expected benefit of participation in the survey can be raising awareness of vaccinations and their importance in protection for children and adults.

Natural disasters and military conflicts also cause difficulties in access to health services.

On 26 February 2018, the earthquake took place in four provinces (Hela, Southern Highlands, Western Province, and Enga). 544,000 people were affected (46% children; 17,419 children in age 0-12 months). This natural disaster was then followed by inter-communal fighting in Hela Province.

This also caused considerable problems in vaccination. Out of 86 health facilities,18 were severely damaged. UNICEF estimated that only 10% of the target population (children younger than five years) received pentavalent and MR vaccination in this province (17).

According to the National Health Information System, the measles vaccine coverage in 2016 was 51% (10). None of the provinces reported over the target 80%. The proportion of districts reporting less than 50% DTP3 (all three doses of vaccine) coverage was as high as 60%. Only 8% of provinces reported vaccination coverage greater or equal to 90%.

Data concerning the vaccine coverage obtained from CHS are much lower than the official ones. Data recording and reporting in health facilities was a shortcoming, identified earlier by researchers performing studies in PNG (18,19,20). Wiesen, in 2014 in a study on assessing the hepatitis B birth dose vaccination program in PNG, found out that only 17% of the health facilities were able to provide a vaccination coverage figure.

A lack of reliable demographic data also causes the problem with the estimation of vaccination coverage. In PNG, birth and death registration systems are not yet sufficiently developed to estimate a birth cohort accurately. The population is growing very fast; hence, an entire birth cohort seems to be more significant.

The latest polio epidemic showed that the pediatric population might be bigger than assumed. In the first round of catch-up vaccination action covering the three high-risk provinces, the estimated number of children was 289,582, but 303,907 (105%) children under five years old were vaccinated (4). As a result of the recent polio campaign, 15/56 patients had proof of at least one dose of OPV.

A field survey is another way to obtain the vaccination coverage. It can be done by checking patients' vaccination records. However, in PNG, the so-called baby book is missed very often. In a survey conducted by Samiak, according to medical records of 70 patients and based on the interview with parents, only 15% of children had complete vaccination status (16). In our analysis, 68 % had no vaccination records. Based on vaccination records, half of the patients had only one vaccination visit.

The main limitation of the study is a small sample of questioned parents. Taking into consideration local customs, it is challenging to schedule extensive studies in PNG. Indigenous people are very wary of contact with strangers. There is a shortage of healthcare professionals in PNG, and because of their workload, they are not very eager to be involved with surveys. So this is why we should have accepted this small study as the only possible way of gaining insight into PNG vaccination practices.

Improving vaccination coverage in PNG is essential for outbreak control. It is necessary to improve the quality of services delivered by healthcare facilities and increasing community awareness of the role of vaccinations. Declining coverage rates observed in our analysis are in accordance with data provided by GAVI, WHO, and Country Official estimates. This is a very worrisome trend.

Conclusion

The results of this analysis demonstrate that in PNG, the majority of children are not fully immunized. As protection from diseases is low, there is a very high risk of an outbreak of the vaccine-preventable disease in the community.

There are significant differences in vaccination coverage between provinces. This can be improved by a better distribution of healthcare services, especially in rural areas.

The problem is a lack of public understanding of the need for vaccinations – this can be improved by media campaigns oriented to inform people about the benefits of vaccinations.

Lack of patient vaccination records makes it difficult to establish individual vaccination history.

There is a need for a central registry, where each given dose of vaccine will be recorded.

Disclosures

Ethical Approval and Consent to participate

The study received ethical approval from the Ethical Comitee of Divine Word University in PNG.

Consent for publication

All the authors gave consent for publication.

Availability of data and materials

All the data are available upon request.

Competing interests

All the authors declare no competing interests.

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Authors' contributions

Ewelina Gowin study design, statistical analysis, data interpretation, manuscript preparation, literature search

Jerzy Kuzma study design, data collection, manuscript preparation

Danuta Januszkiewicz-Lewandowska study design, data interpretation, manuscript preparation, literature search

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Authors' information

Ewelina Gowin Professor Assistant

Poznan University of Medical Sciences

Health Promotion Department

Fredry 10, 61-701 Poznan, Poland

Danuta Januszkiewicz-Lewandowska Professor

Poznan University of Medical Sciences

Fredry 10, 61-701 Poznan, Poland

Jerzy Kuzma Professor

Faculty of Medicine and Health Sciences

Divine Word University, Madang Papua New Guinea

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Tables

Table 1. Vaccination schedule in PNG

Vaccine	Age at administration
BCG *(Bacillus Calmette–Guérin, vaccine against tuberculosis)*	birth
HepB *(vaccine against hepatitis B)*	birth
DTP Hib HepB (*vaccine against diphtheria, tetanus, pertussis, Haemophilus influenzae type B, and hepatitis B)*	1, 2, 3 months
IPV *(inactivated poliovirus given by injection)*	3 months
MR *(vaccine against measles and rubella)*	6, 9, 18 months
OPV *(weakened poliovirus given by mouth)*	1, 2, 3 months
Pneumococcal *(vaccine against Streptococcus pneumoniae)*	1, 2, 3 months
TT *(Tetanus toxoid vaccination)*	7, 13 years

Table 2. Vaccination coverage in PNG in years 2014-2017.

Vaccine	Data source	2014	2015	2016	2017
DTP	National data	61%	54%	44%	51%
	WHO/UNICEF estimates	73%	73%	72%	62%
	Our Survey	-	-	33.4%	16.6%
Measles	National data	65%	60%	51%	43%
	WHO/UNICEF estimates	84%	79%	70%	62%
	Our survey	-	-	26.6%	12.5%

Table 3. Results of the parents survey.

Number of parents (n=56)
List, what diseases can be prevented by vaccination?
Polio 18 TB 15 tetanus 4 hepatitis B 4 pneumonia 3
What is the role of vaccination for the child?
“the vaccine prevents the child from the sick” “vaccination can prevent a child from disability” “help a child to grow well”
Any idea how vaccination is working?
no idea “allow a child to grow” “strengthen the child”
Why it is important to vaccinate your child?
“to prevent the sick” “to prevent the death”
What would you tell if you like convince your neighbor to take child for vaccination?
“vaccination prevent a child from becoming sick” “vaccination prevent a child from death” “don't know”

Table 4. Vaccination status based on child’s book and observation from the rural setting of Papua New Guinea, 2019 (n=18).

	Number of patients (n=18)	Percentages (%)
One vaccination visit	9	50.00%
Two vaccination visits	3	16.67%
Three vaccination visits	6	33.3%
Measles vaccine	16 (8 1dose; 6- 2 doses, 2 – 3 doses)	88.89%
Mumps vaccine	0	
Rubella vaccine	16 (8 1dose; 6- 2 doses, 2 – 3 doses)	88.89%
Varicella vaccination status	0	
Te De Pe (DTP) vaccinated	17	94.44%
Hepatitis B vaccination x1dose	16	88.89%
Hepatitis B vaccination x 2 doses	5	27.78%
Hepatitis B vaccination x 3 doses	1	5.55%
Polio Oral vaccination x1 dose	15	83.33%
Polio Oral vaccination x2 doses	7	38.89%
Polio Oral vaccination x3 doses	6	33.3%
BCG scar present	18	100.00%

Figures

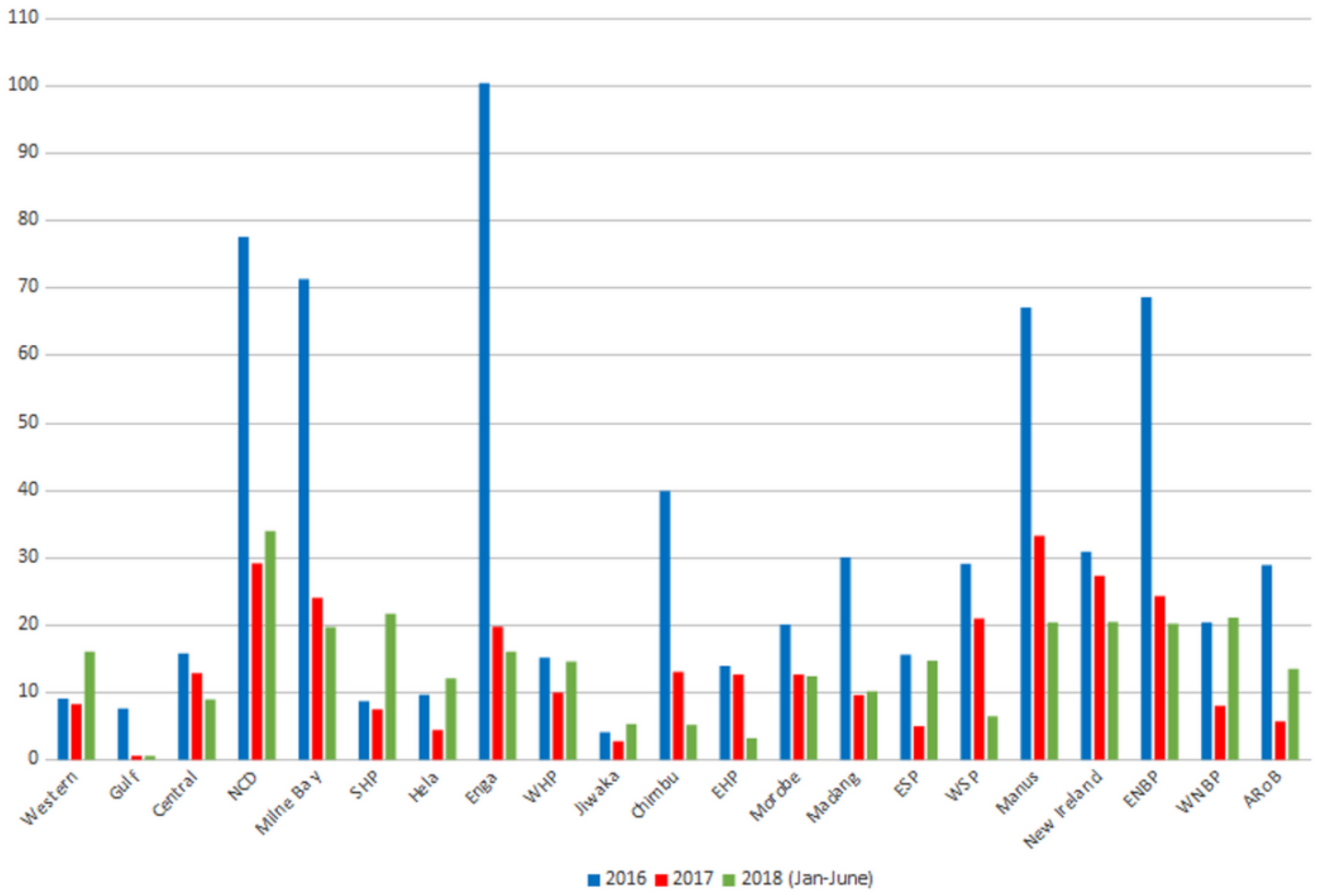

Figure 1

Percentage of measles coverage in children under 1 year of age in all provinces of PNG.

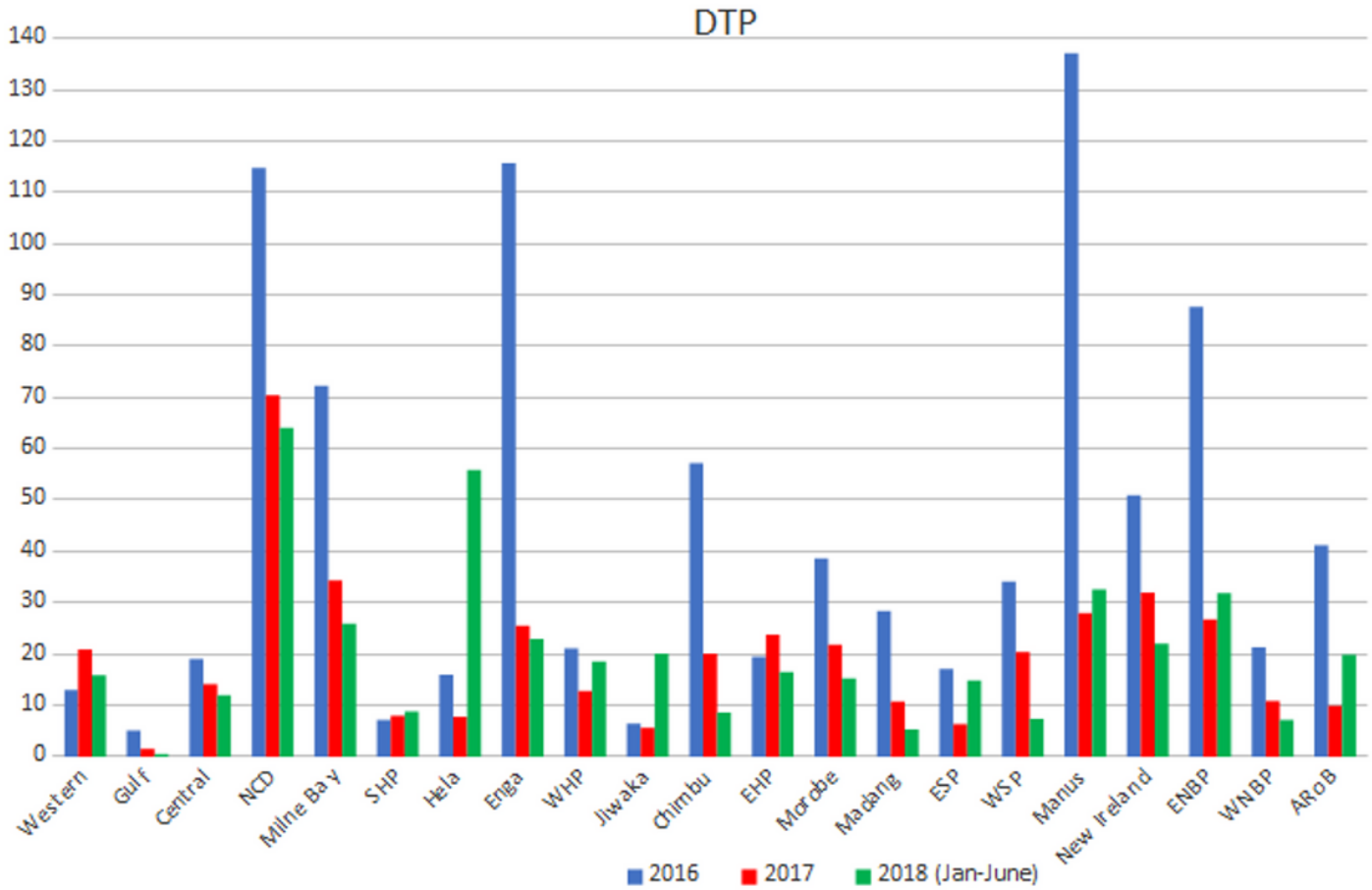

Figure 2

Percentage of 3 doses of pentavalent and measles coverage in children under 1 year of age in all provinces of PNG.