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Progress and Challenges of Polio Environmental Surveillance in Indonesia

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ABSTRACT
As the gold standard to monitor poliovirus transmission in population, Acute Flaccid Paralysis (AFP) surveillance that we conducted found only about <1% poliovirus circulation appeared as paralysis cases. Therefore, we need Polio Environmental Surveillance as supplemental surveillance that can detect poliovirus in the environment to stop the poliovirus transmission. Polio Environmental Surveillance has been established in several countries and Indonesia started since 2016. This study aimed to analyze the Environmental Surveillance in monitoring poliovirus circulation in Indonesia. One Liter wastewater sample from wastewater treatment plant (WWTP), communal septic tank and open canal collected by grab method and send to the National Polio Laboratory Network. Samples were concentrated using the Two-Phase Separation Method and inoculated in both RD and L20B cell lines. Poliovirus identification using PCR and sequencing was carried out on positive isolates. Data analysis was performed on the 2016-2018 results. Two-point six percent (4) poliovirus and 39.5 % (60) Non-Polio Enterovirus (NPEV) were isolated from 152 samples were received at National Polio Laboratory Network. Three out of 152 samples were positive both poliovirus and NPEV. All Positive results were only found on the sample collected from wastewater treatment plants and communal septic tanks. Polio Environmental Surveillance in Indonesia has been giving information on the poliovirus circulation in the environment. A proper selection of the sampling site is needed to provide valuable information.
Keywords: *environmental surveillance, poliovirus, sewage sample*

1. INTRODUCTION

The polio eradication program has succeeded in reducing more than 99% of cases of paralytic paralysis caused by the wild poliovirus. Through the Expansion Program of immunization (EPI) that has been started since 1995 in Indonesia, wild poliovirus is no longer found by laboratory evidence through virological examination of stool specimens from acute flaccid paralysis (AFP) surveillance [1-4]. AFP Surveillance is the gold standard for monitor the poliovirus transmission in the polio erdication program. All paralysis cases according to AFP criteria were collected the specimens and examined in the laboratory to ensure the paralysis was not caused by the poliovirus. An active and sensitive surveillance system is needed to minimize undetected AFP cases [5-7]. The poliovirus infection rate is much higher than the AFP cases because only a small portion of the population infected with the poliovirus appears paralyzed. All populations infected with the poliovirus whether presenting paralysis symptoms or not excrete the poliovirus through their stools within a few weeks and cause the environment contamination. Silent circulation of the poliovirus from excretion of feces in asymptomatic populations to be serious concern because it can infect the susceptible populations and cause paralysis. For this reason, additional surveillance is needed to monitor the poliovirus circulation in the environment and provide valuable data for polio eradication program [7-11].

Polio environmental surveillance (ES) has established in several countries. The implementation of this program has provided evidence of the elimination of wild poliovirus in Egypt and India and detected the wild poliovirus circulation in free polio status areas such as Israel. Environmental Surveillance can detect wild polioviruses in endemic areas such as Nigeria.12-16 Based on The Polio Eradication & Endgame Strategic Plan 2013-2018, the ES will be established in priority countries or additional the number of sampling sites other than the existing sites in in countries that have started ES including Indonesia. Indonesia has the risk of importing wild polio virus from endemic countries and circulated Vaccine Derived Polio Virus (cVDPV) as happened in 2005 [4,17-18].

Environmental surveillance in Indonesia started in the province of DI Yogyakarta as part of the IPV pilot project in 2004 - 2014 then continued with a research about environmental polio characterization in 2015 in DI Yogyakarta and DKI Jakarta.19-20 At the end of 2016 Indonesia started environmental surveillance as part of eradication program in two province DI Yogyakarta and DKI Jakarta and in 2018 the sampling site expanded into 9 Provinces. Environmental surveillance with proper location provides valuable information of poliovirus circulation, especially when AFP surveillance performance is not optimal. The combination of AFP and

environmental surveillance can be used to identify high risk areas and specific target for vaccination. There are several point should be considered in environmental surveillance including proper sampling site, collection method, samples transportation and laboratory ability. This paper describes the environmental surveillance progress in Indonesia and the challenges throughout this program.

2. METHOD

Sampling Site

The sampling site is determined by directorate surveillance and health quarantine, sub-directorate surveillance, Indonesian Environmental Health and Disease Control Bureau (BTKL) and provincial/district Health Office. Sampling site selection determine by high risk for poliovirus transmission based on population characteristics, density, immunization coverage, and household wastewater system. Site selection also considers the time and feasibility of samples transportation to the laboratory. The recommended sampling site is inlet to integrated wastewater treatment plant (WWTP). Communal septic tanks or open canal can be an alternative sampling site if integrated sewage treatment plants are not available. Sample collected at the WWTP inlet was done in the DKI Jakarta province (PD Pal Jaya), DI Yogyakarta province (sewon Bantul), and South Kalimantan province (Pekapuran Raya, Banjar baru) while samples from the open canal were collected in the East Java provinces, Papua, North Sulawesi (Bitung), Maluku (Ambon), and South Sumatra Province (Palembang city) were taken from communal septic tank.

Sampling Technique

One liter wastewater sample is collected using grab complied with the World Health Organization (WHO) guidelines. Samples are collected at peak time (6 - 9 am) where defecation activity is higher. Samples are not recommended to be collected after 9 am to avoid the sunlight. Samples are collected. by trained staff from BTKL every 2 weeks for DKI Jakarta province and every month for other sampling site. Samples are sent to Polio Laboratory Network using a reverse cold chain.

Processing sample and Isolation

Samples are concentrated immediately within 24 hours after received in laboratory using two separation method. The sample extracts are inoculated in 5 TC Flask L20B and 1 TC Flask RD cell lines. Sample are examined in the same way as stool specimens from AFP cases. The guideline was established by WHO.

Identification

All positive isolates from L20B arm should be performed Intratipyc Differentiation (ITD) test for poliovirus identification using Real-time Poly Chain Reaction method. Isolate with Sabin result should be followed by VDPV assay. The isolate showing contradiction between ITD and VDPV assay should be sequenced for further characterization.

3. RESULTS AND DISCUSSION

Polio environmental surveillance for programmatically to supplement AFP surveillance has been used since August 2016 in 2 province and was expanded to 9 province with 12 sampling site. The samples are collected at inlet of WWTP, communal septic tank and open canal 1 time per month except WWTP DKI Jakarta. Samples are collected from WWTP in DKI Jakarta collected 2 times per month. The total number sampling site and samples are collected in 2016-2018 are shown in figure 1 and 2.

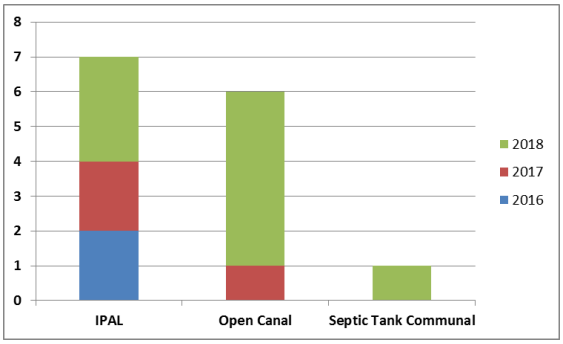

Figure 1. Sampling site of Polio Environmental Surveillance in Indonesia 2016 – 2019

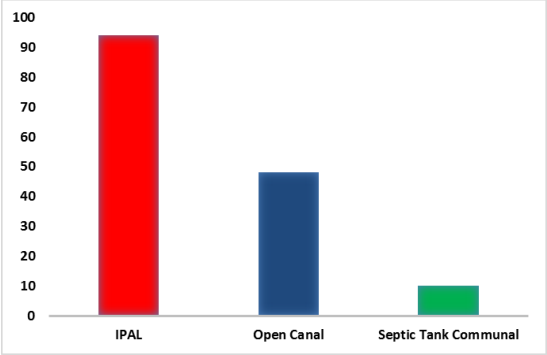

Figure 2. No of Sample were Received in Laboratory

Virus examination result shown there is no wild poliovirus at wastewater samples, vaccine poliovirus are found in 2,6% wastewater samples are collected from WWTP and Non Polio Enterovirus (NPEV) find in 39,5% samples are received in the laboratory. The laboratory result of 152 wastewater samples are shown in figure 3 and 4.

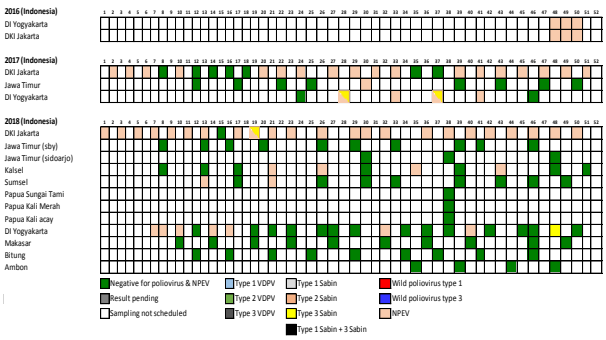

Figure 3. Environmental surveillance result 2016-2018

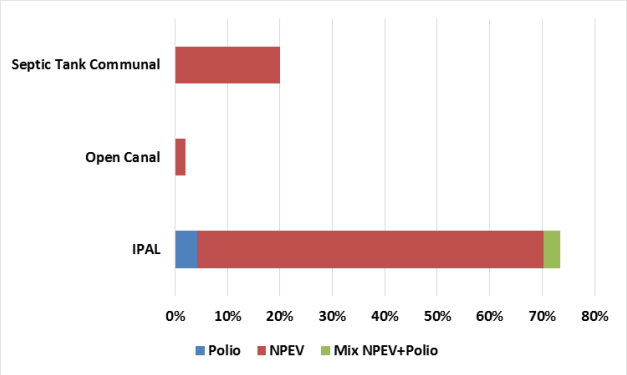

Figure 4. Proportion of Positive Result from sample source

Polio Environmental surveillance has succeeded in detecting poliovirus circulation among wild poliovirus, sabin poliovirus and VDPV [8,21-22]. Several countries was encouraged to implement envinvonmental surveillance in order to detect residual transmission of poliovirus and early detection for poliovirus transmission before AFP cases appear or without AFP cases. The countries with low vaccination coverage or reported wild poliovirus and cVDPV in the recent year should implement environmental surveillance or strengthen existing environmental surveillance by expanding the sampling site. Low immunization coverage in some areas in and have reported cVDPV outbreaks in 2005 lead Indonesia as high risk country for poliovirus transmission and environmental surveillance must be enhanced and expanded. Environmental surveillance is required to monitor the cessation of type 2 poliovirus after withdrawal Oral Polio Vaccine (OPV) type 2 from tOPV [18].

The WWTP only available in some areas in Indonesia and communal septic tanks accommodate limited amount of household waste, so open canal is an alternative as sampling site in most area. Poliovirus can be detected in wastewater samples from open canal if the requirements such as population density and household wastewater flow into canal. Wild poliovirus was successfully isolated from wastewater are collected from open canal in India and Nigeria. Since environmental surveillance are implemented, there is no wild poliovirus and VDPV found in samples are collected from all sampling site. Vaccine/sabin poliovirus are isolated from samples are collected from WWTP. Environmental surveillance should reveal the sabin poliovirus strain in population are immunized with OPV. The cessation of type 2 poliovirus also successfully documented through environmental surveillance after switching tOPV to bOPV was implemented [20]. Type 2 poliovirus with 1-5 nucleotida changes are inoculated from WWTP samples at DKI Jakarta in 2015 [20]. The worldwide switch trivalent to bivalent OPV in 2016, the risk of cVDPV2 has been reduced [23].

Environmental also can inoculate non polio enterovirus (NPEV) which was used as a criteria of satisfactory performance of environmental surveillance. At least 30% of concentrated wastewater from grab samples should reveal NPEV and in areas with Oral Polio Vaccine immunized populations, environmental surveillance should also reveal sabin like strains. NPEV found in > 30% wastewater samples are collected from WWTP but NPEV only found in 2% waste water are collected from open canal. Sabin poliovirus only detected in 4 wastewater samples (2.6%) were collected from WWTP and 3 of them also detected NPEV. Poliovirus and other enterovirus is difficulty to inoculate due to low concentration [24]. A low positive rate, especially in wastewater from the open canal, can be caused due to difficulty finding the ideal location for sampling sites for environmental surveillance in Indonesia. Limited numberof WWTP, Indonesian geography, household sewer systems by an individual septic tank, scattered residents with densely populated only in urban areas cause the preferable size of the source population is 100.000–300.000 are difficult to obtain. Furthermore, the difference time of defecation activity, water flow rate and the presence of chemical waste flow from the home industry, improper sampling time and handling sample transportation due to the distance of the sampling site is far from the laboratory lead the virus concentration decreased. A negative result on the sample cannot be interpreted as a lack of circulation of the poliovirus. Negative results can be caused by incorrect site selection, improper sampling, transportation to the laboratory and accuracy of laboratory tests. Need an assessment and evaluation if negative results are obtained for a long time. ES with the proper of the sampling site, sample collection, sample handling, sample transportation, and the laboratory examination could be supplementary surveillance to support AFP surveillance eradication program [6,25-26].

4. CONCLUSION

Polio Environmental surveillance is implemented in Indonesia although representing selected high-risk areas by following WHO's recommendations are not fully met. Environmental surveillance successfully detects poliovirus in the environment and provides valuable data in monitoring the poliovirus circulation in Indonesia. There are many challenges in implementing environmental surveillance in Indonesia including the characteristics of sewage systems, adequate population sizes, and geographical conditions. Proper assessment and review performance of sampling sites based on performance standards are needed to determine the continuation of the existing sampling site and for expansion to new Locations. A team work involving the related departments is needed to determine the sampling site is close to the WHO criteria.

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