PRELIMINARY REPORT ON SUSPECTED MERCURY POISONING IN 3 ASGM HOTSPOTS OF INDONESIA:
CASE REPORTS BOMBANA-SOUTHEAST SULAWESI, SEKOTONG-WEST LOMBOK, AND CISITU-LEBAK

16 Feb - 6 March 2015

Prepared by

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1. Background

Mercury is an element and it cannot be created by people, nor can it be destroyed. Mercury is released into the environment by volcanic eruptions, and it naturally occurs in the earth's crust, often in the form of mercury salts such as mercury sulfide.[1] Mercury is widely used in products and industrial processes such as in dental restoration activity, medical devices (thermometers and sphygmomanometers), batteries, CFL lamps, cosmetics (whitening creams and mascara), pesticides and fungicides, Vinyl Chloride Monomer production (VCM), the chlor-alkali industry, by-products of oil and gas refineries processes, and in the artisanal and small-scale gold mining (ASGM) sector.

Globally, UNEP identified ASGM as the single largest source of mercury emission from intentional use (2013), and stated that it released approx. 1000 tonnes of mercury into the air.[2] In 2011, Indonesia had around 850 artisanal and small-scale gold mining hotspots all over the region.[3] In 2012, the ASGM sector in Indonesia contributed about 57% of the total national mercury released to the environment, or about 195 tonnes.[4]

When mercury enters the air, it moves with the wind and eventually falls back to earth. In the air, mercury may travel either a short or long distance before falling back or being re-deposited to earth; it may even fully circle the globe. A portion of the mercury that falls into the ocean or onto the land will re-volatilise; it will again travel with the wind and will again fall back to earth somewhere else. The mercury that falls on land and does not volatilise will likely bind to organic material. Some becomes trapped in peat or soils.

The remainder eventually drains to streams and rivers and then to lakes and oceans. In the aquatic environment, elemental mercury will likely become bound to sediment and then transported on ocean or river currents. Some mercury remains dissolved in the water column. In aquatic systems, naturally present microorganisms can transform mercury into methyl-mercury, an organometallic compound that is more toxic at low doses than pure mercury. Methyl-mercury becomes part of the aquatic food chain; it bioaccumulates and biomagnifies, and it can then be transported by migratory species (fish and shell-fish).[5]

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[1] *Bell, Lee, et.al. 2014. An NGO introduction to mercury pollution and the Minamata Convention on Mercury. IPEN.*

[2] *UNEP. 2013. Global Mercury Assessment.*

[3] *Ismawati, Yuyun. 2011. Opening the Pandora's Box of Poboya: the production of social and environmental suffering. Master dissertation. Environmental Change Management, School of Geography and the Environment, University of Oxford.*

[4] *Dewi, Kania, et.al. 2012. Mercury emissions and inventory in Indonesia. BaliFokus.*

[5] *Bell, Lee, et.al. 2014.*

2. ASGM in Indonesia and its impact

In Indonesia, in the last five years the number of artisanal and small-scale gold mining hotspots has almost doubled. Sites are located on public or private land that is managed together by groups of miners or a community. In 2010, there were about 900 hotspots with associated groups of more than 250,000 miners, including women and children, and over 1,000,000 people who relied on the sector for their livelihood.[6] From various studies, it was estimated that every miner could produce 5-10 grams of gold per week. The ASGM sector could produce about 65-130 tonnes of gold per year, bigger than the national gold production, which was 46 tonnes in 2013. There is a huge economic potential and there are benefits for the impoverished communities, but these need to be managed and controlled properly to prevent the irreversible negative impacts.

The 2007 GEF-UNIDO-UNDP Global Mercury Project reported that mercury in fish in Central Kalimantan around the ASGM site ranged from 0.09 up to 1.6 ppm. Several studies conducted in Jambi (1997), West Kalimantan (2000), North Sulawesi (2002), West Java (2003) and Palu, Central Sulawesi (2008, 2010) found high mercury concentration in the river, soil and fish affecting community and miners' health.[7,8,9,10]

A study conducted by BaliFokus and others in several ASGM hotspots found mercury in the air also considerably high, ranging from 20 nanogram/cubic meter up to 55,000 nanogram/cubic meter.[11,12] It also found mercury in the food chain, especially rice and fish, risking the downstream population's health as well as the community that lives within the area.[13,14] Mercury in water and sediment in several ASGM sites ranged from 0.6 ppm up to 4 ppm which is 600-3000 times higher than the WHO standard (0,001 ppm).[15,16,17]

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[6] *Ismawati, Y. 2011.*

[7] *Subanri, 2008. Kajian Beban Pencemaran Merkuri (Hg) Terhadap Air Sungai Menyuke Dan Gangguan Kesehatan Pada Penambang Sebagai Akibat Penambangan Emas Tanpa Izin di Kecamatan Menyuke Kabupaten Landak Kalimantan Barat. Program Pasca Sarjana Magister Kesehatan Lingkungan Universitas Diponegoro. Semarang. Indonesia.*

[8] *Daniel Limbong et al, 2002. Emissions and environmental implications of mercury from artisanal gold mining in north Sulawesi, Indonesia*

[9] *Irwan Said, 2008. Tadulako University. Palu, Central Sulawesi.*

[10] *Halimah Syafrul, 2003. University of Indonesia. Pencemaran merkuri dan strategi penanganan penambangan emas tanpa izin (PETI) di Pongkor, Jawa Barat. Jakarta.*

[11] *BaliFokus, June 2011. Lumex sampling result in Palu and Poboya ASGM site.*

[12] *Yuka Serikawa, 2011. Joint research Toyohasi University of Technology, Toyama Prefecture University and Tadulako University.*

[13] *BaliFokus, 2013. Environmental monitoring in ASGM hotspot in Cisitu Village, Lebak Regency, Banten Province.*

[14] *Krisnayanti et al, 2012. Mercury assessment in a four-year old ASGM site.*

[15] *Gajah Mada University. 2010. Press release environmental monitoring study of Sekotong ASGM area.*

[16] *Prof. Mappiratu, Tadulako University. 2010. Laboratory result of Poboya ASGM site.*

[17] *Yayasan Tambuhak Sinta. 2010. Scoping Study Report of Poboya, Palu ASGM Site.*

3. Mercury intoxication

A guidance document prepared jointly by the World Health Organization (WHO) and the United Nations Environment Programme (UNEP) stated the following:

> *"The primary targets for toxicity of mercury and mercury compounds are the nervous system, the kidneys, and the cardiovascular system. It is generally accepted that developing organ systems (such as the fetal nervous system) are the most sensitive to toxic effects of mercury. Fetal brain mercury levels appear to be significantly higher than in maternal blood, and the developing central nervous system of the fetus is currently regarded as the main system of concern as it demonstrates the greatest sensitivity. Other systems that may be affected include the respiratory, gastrointestinal, hematologic, immune, and reproductive systems"*[18]

Mercury can cause direct or indirect intoxication, depending on personal sensitivity and susceptibility. Mercury can be present in three different forms that can affect our health, which are:

a. **Elemental mercury.**
   - This is mercury in the original form, and the most volatile form of mercury. It can contaminate the body via inhalation or by ingestion of mercury directly through the air (mercury that is burned evaporates into the air). We are directly exposed to mercury substances by the usage of mercury directly, such as in gold ore mining, or by thermometers that we use to measure our body temperature being broken (and thus the spilled mercury could have direct contact with our skin), or by ingestion of mercury-containing substances, such as dental fillings.
   - Inhaling elemental mercury vapors causes acute symptoms such as cough, chills, fever, and shortness of breath, and also gastro intestine complaints such as nausea, vomiting and diarrhea accompanied by a metallic taste, dysphagia, salivation, weakness, headaches and visual disorders.[19] This mercury can be excreted out of our body by our kidney and flows through the urine.[20]

b. Inorganic mercury compound.
   - Inorganic mercuric compounds include mercuric sulphide (HgS), mercuric oxide (HgO) and mercuric chloride (HgCl2). These mercury compounds are also called mercury salts. The water solubility and chemical reactivity of these inorganic (ionic) mercury gases lead to much more rapid deposition from the atmosphere than for elemental mercury. This results in significantly shorter atmospheric lifetimes for these ionic (e.g. divalent) mercury gases than for the elemental mercury gas.[21]
   - In acute cases, ingestion of inorganic mercury salts cause gastroenteritis. The color of mucous membranes changes rapidly along with development of a metallic taste, local oropharyngeal pain, nausea, vomiting, bloody diarrhea, colic abdominal pain and renal dysfunction. Subsequently, stomatitis, hematemesis, and hematochezia may be seen, and chronic inorganic mercury salts intoxication may lead to development of a tremor of the lips and tongue, severe salivation, losing teeth, anorexia, and weight loss. This form of mercury

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[18] *UNEP. 2008. Guidance for Identifying Populations at Risk from Mercury Exposure. DTIE. Chemicals Branch and WHO Department of Food Safety, Zoonosis, and Foodborne Diseases,*

[19] *Mehrdad Rafati-Rahimzadeh et.al. 2014. Current approaches of the management of mercury poisoning: need of the hour. Daru. 2014; 22(1): 46. Published online 2014 Jun 2. doi: 10.1186/2008-2231-22-46.*

[20] *WHO. 2003. Elemental Mercury and Inorganic Mercury Compounds: Human Health Aspects.*

[21] *UNEP Mercury Programme.*

can also be excreted out of our body through our kidney through our urine, and will be cleansed from our body within a 3-month period.[22]

c. Organic mercury or methyl-mercury.

- This kind of mercury bonds with a living being, such as fish, shell-fish, or other living things. The danger of this kind of mercury is that it will accumulate in the body of the living being, and increase via the food chain hierarchy. Methyl-mercury is the most dangerous type of mercury to our body, because once deposited in our body, it can cause a lot of neural disturbance and neural as well as physical deformities.
- Depending on the susceptibility and the sensitivity of a person, the deformity usually manifests around 5 to 10 years after exposure; a person does not immediately show the disturbance or immediately become ill. In cases of mild exposure, organic mercury compounds, especially methyl-mercury, do not produce severe symptoms. However, high exposures to organic mercury compounds lead to acute GIT symptoms, delayed neurotoxicity, and regional destruction of neurons. This organic mercury can also cause many health problems, mimicking any disease, so can be describe as the greatest imitator.

The map of diseases that may possibly result as an outcome of mercury intoxication can be seen in the malacard below.

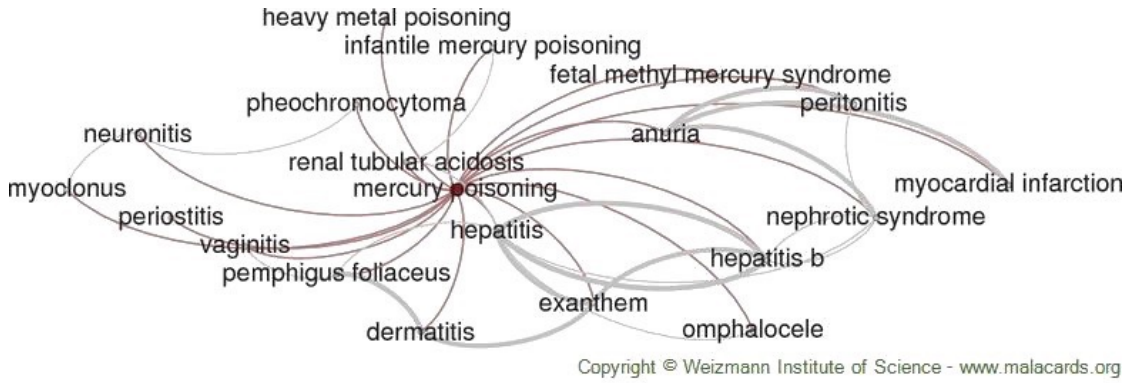


Figure 1. Possible diseases related to mercury intoxication.

Many of the diseases that occur due to mercury intoxication are neural deficient-related diseases. If mercury has been deposited in the body of a pregnant woman, the child that is being carried is at a risk for birth defects and malformation. If a child was being exposed to mercury at birth, it will create neural deformity in the child later in life. This deformity shall come gradually and increase with the age of the child.

This neural deformity can also affect an adult that has direct contact to mercury and those that consume food or water that has been contaminated with mercury. Additionally, one of the worst things about diseases related to mercury is that, except for some skin disorders on people that have a hypersensitivity to mercury, some can take 10 years before clinical symptoms appear, and will worsen as the time elapses. This also relates to the linear relationship with the exposure to the mercury, especially to organic mercury, where food is an entry point.

[22] *Mehrdad Rafati-Rahimzadeh et.al. 2014.*

4. Findings from the 3 hotspots: Bombana, Sekotong and Cisitu

In early 2014, BaliFokus identified a significant number of people in the community poisoned by mercury from ASGM hotspots and already in a dire stage. The exposure from gold processing activities in most villages affected not only workers and people that are directly involved in the business, but also innocent people, from babies to elder people, from housewives to gold shop owners.

Between mid February until early March 2015, BaliFokus and the Medicuss Foundation conducted preliminary health assessments and observations in 3 ASGM hotspots: Cisitu, Lebak Regency, Sekotong in West Lombok Regency, and Bombana, Southeast Sulawesi Regency. Below is the map of the three hotspots (Figure 2).

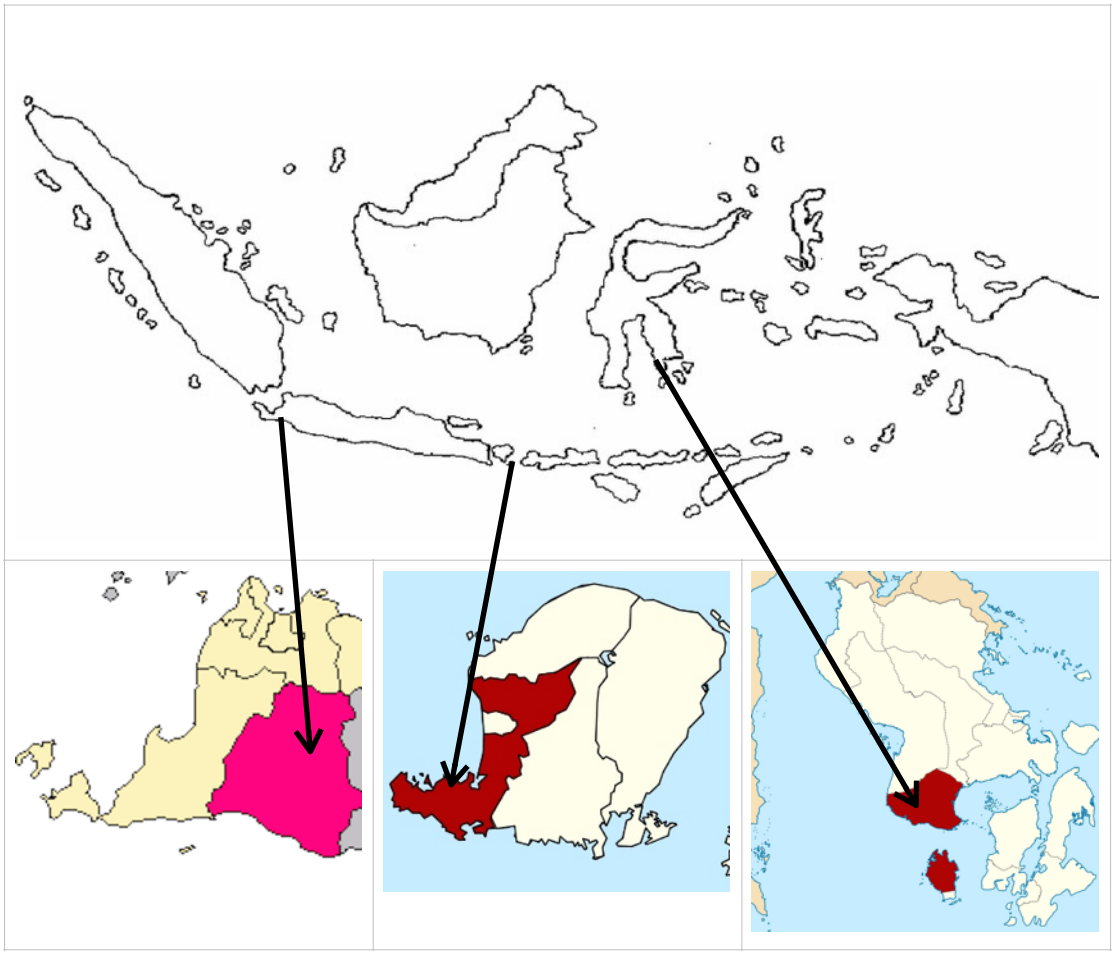


Figure 2. Maps of 3 locations: Lebak Regency, West Lombok Regency and Bombana Regency

Below is a brief description of the three hotspots:

a. ***Cisitu, Lebak Regency, Banten Province.*** The main economic activities in this area are wet-system rice farming, fish ponds, forest-based products, and gold mining. The site is an indigenous peoples' territory, located inside a national park, and had history and conflict with a state-owned gold mining company (PT. Aneka Tambang). The site is an old site. The mining and processing activities have already been taking place there for more than 15 years and have used more than 25 tonnes of mercury per year. In the last 10 years, the gold extraction process has moved to the village and is mushrooming in the residential areas. The total population of the

Cisitu community is about 7000 people, consisting of about 1460 households. Almost 50% of the population is involved in gold mining and processing and relevant activities.

b. ***Sekotong, West Lombok Regency, West Nusa Tenggara Province.*** The main economic activities in this area are dry-land rice farming, fisheries and gold mining. The mining sites are spread out in about 10 sites and have a history/conflict with a private gold mining company (PT. Indotan Lombok Barat Bangkit). The site is not a young hotspot, but not too old (about 10 years old) and has used more than 70 tonnes of mercury per year. In the last 10 years, the gold extraction process has moved to the village and is also mushrooming in the residential areas. The total population of Sekotong areas where the ASGM practices are spread out is about 40,000 people. Almost 50% of the population is involved in gold mining and processing and relevant activities.
c. ***Bombana Regency, Southeast Sulawesi Province***. The main economic activities in this area are irrigated rice farming, fisheries and gold mining. The mining sites are spread out in more than 10 sites, mostly alluvial type, and have had conflicts or overlap within the concession areas of several medium-sized gold mining companies. The site is more than 10 years old and has used mercury intensively (more than 80 tonnes per year during the panning process and through the sluice box). In the last 10 years, the gold extraction process has moved to the village and is mushrooming in the residential areas. Like in other sites, some processing activities involving mercury and the burning os the amalgam are handled by women. The total population of the ASGM sites in Bombana is about 50,000 people spread out in several sub-districts.

While in the field, we also measured the mercury concentration in the ambient air around the houses of the people suspected to be ill by using a portable mercury vapour analyser RA-915+. The results are varied from place to place. In Bombana, the lowest mercury reading was 28.07 nanogram/m3 in one of the houses of a child suspected to be afflicted with mercury poisoning and 41,000.00 nanogram/m3 t a gold shop. The safe level and reference guidance of WHO and the US Department Health and Human Services are below 1,000 nanogram/m3. Guidance for mercury concentration between 1,000 to 10,000 nanogram/m3 - should be prepare for evacuation while in the condition where concentration of mercury vapour > 10,000 nanogram/m3, people should be evacuated.

The highest mercury level in the air was 54,931.84 nanogram/m3 at a gold shop in Sekotong, Lombok, and the lowest one was 121.77 nanogram/m3. In front of a community's house where a ball-mills unit was in operation, the level was about 20,891.93 nanogram/m3, next to a suspected patient's house. In Cisitu, Banten, the lowest reading was 122.25 nanogram/m3 at a community's house and a gold shop was 50,549.91 nanogram/m3 near a fish pond.

The results of this survey to three ASGM hotspots indicated several severe mercury intoxication suspects in adults and children. Some adults showed severe tremors and already experienced them for more than 7 years. Some babies and children, from 40-day-old babies to 15-year-old teenagers, showed severe symptoms of mercury intoxication and need further proper medical assessments.

The impact of mercury poisoning is not only an additional burden to the family of the victims, but also to the society in general. Lack of knowledge about mercury intoxication symptoms lead to misleading diagnoses of symptoms, and ineffective drugs and medical treatments. There is an urgent need to develop solid and systematic health measures to assess the mercury intoxication suspects, especially mothers and children, epidemiology, and the etiology. Additionally, follow-up plans to monitor the mortality and morbidity are necessary, as well as proper medical treatment/ medication.

Preliminary findings from 3 weeks survey to 3 ASGM hotspots:

Bombana, Sekotong and Cisitu, 16 February - 6 March 2015

1	Name	Rifki	
	Age	2 y.o	
	Address	Tenjo Laut, Cisitu Village, Banten	
	Problem	Abnormality of head shape causes by sinostosis, had seizures since 2 month old, hyper-salivation.	
	Need	Neuropediatrician, full medical assessment	
2	Name	Agung	
	Age	5 mo	
	Address	Poleang, Boepinang, Bombana, Kendari	
	Problem	Agung has problem with superior extremity, Os.Humerus of both of his hand are short, skin eruption all over his body, congenital cataract, undesensus testis or kriptorkidismus (the medical condition with no testis inside the scrotum when the baby born). This condition could happen with one or two testicle and this condition mostly happen to premature baby or baby with low birth weight.	
	Need	Dermatologist, Ophthalmologists, Surgeon and Orthopedist.	

3	Name	Ahmad Gibran Khalfani	
	Age	5 mo	
	Address	Matirowali, Poleang, Bombana	
	Problem	Labiognatopalatoscisis is failure fusion between the processus palatines left/ right on the median line during embryonal stage	
	Need	Pediatrician , general surgeon	
4	Name	Zaskia	
	Age	3 y.o	
	Address	Mendorot, Sekotong	
	Problem	Clubfoot also called Congenital Talipes is congenital deformity involving one foot or both. The affected foot appears to have been rotated internally at the ankle.	
	Need	Orthopedist	
5	Name	Rizki	
	Age	7 y.o	
	Address	Jerenjeng, Sekotong	
	Problem	Cataract juvenile	
	Need	Opthalmologist	

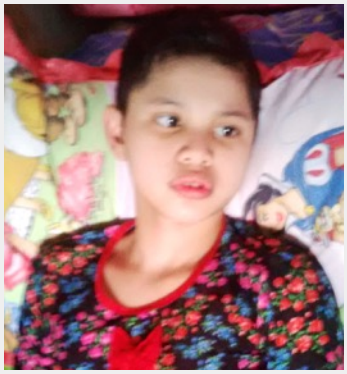
6	Name	An. Angel	
	Age	4 years old	
	Address	Watu – Watu, Bombana, Kendari	
	Problem	Deafness	
	Need	Neuropediatrician and, nose, ear and throat doctor	
7	Name	An. Supriatna / e`ok	
	Age	10 years old	
	Address	Babakan Simpang, Cisitu village, Banten	
	Problem	Labiognatopalatoscisis is failure fusion between the processus palatines left/ right on the median line during embryonal stage	
	Need	Surgeon	
		Ambient air mercury level: 49,632,05 ng/ m3	
8	Name	An. Rangga	
	Age	10 years old	
	Address	Babakan simpang, Cisitu village, Banten	
	Problem	Deafness	
	Need	Neuropediatrician, And doctor ear, nose, and throat	
		Ambient air mercury level: 2,068.85 ng/ m3	

9	Name	An. Arga	
	Age	8 years old	
	Address	Tenjolaut, Cisitu village, Banten	
	Problem	Deafness	
	Need	Neuropediatrician, And doctor ear, nose and throat	
10	Name	An. Suci	
	Age	6 years old	
	Address	Wumbu Bangka, Bombana	
	Problem	Deafnesss, vision disorder, and suspected impaired renal function	
	Need	Internist or pediatrician, and ear, nose and throat doctor	
11	Name	An. Fauzan	
	Age	9 years old	
	Address	SP 2, Bombana, Kendari	
	Problem	Anokuli, high Myopia	
	Need	Opthalmologist	

12	Name	An. Amir	
	Age	8 years old	
	Address	Watu – Watu, Bombana	
	Problem	Inferior extremity dissability	
	Need	Orthopedist	
13	Name	An. Fikri	
	Age	2 years old	
	Address	Onggomate, Bombana	
	Problem	Nutrition problem, upper motor neuron disorders	
	Need	Physician nutrition, neuropediatri	
14	Name	An. M Iqbal	
	Age	2 years old	
	Address	Jerenjeng, Sekotong, West Lombok	
	Problem	Seizures, hypersalivasi, nutrition problem, and myelodistrofi	
	Need	Neuropediatrician	

15	Name	An. Nyimas	
	Age	8 years old	
	Address	Jerenjeng, Sekotong, Lombok	
	Problem	Hidrocephalus, medical condition In which there is an abnormal accumulation of cerebrospinal fluid in the ventricles of the brain, malnutrition	
	Need	Neuropediatrician, physician nutrition	
16	Name	An. Fikri	
	Age	7 years old	
	Address	Tawun, Sekotong, Lombok	
	Problem	Delay development, sinostosis, hypersalivasi, dan muscle weakness.	
	Need	Neuropediatrician	
17	Name	An. Dita	
	Age	10 years old	
	Address	Rau - rau, Bombana	
	Problem	Malnutrition, Seizures, atrophy otot, Contractures (same cases with Rini), hypersalivasi, delay development	
	Need	Physician nutrition, Neuropediatrician, Orthopedist	

18	Name	An. Rini	
	Age	15 years old	
	Address	Watu – Watu, Bombana	
	Problem	Contractures, medical condition with permanent shortening of a muscle or joint.usually in response to prolonged hypertonic spasticityin a concentrated muscle area, such as in seen in the tightest muscle of people with condition like cereberal palsy, athropy extremity muscle	
	Need	Orthopedist, neurologist	
19	Name	An. Hidayatullah	
	Age	8 years old	
	Address	Tawun, Sekotong, Lombok	
	Problem	Deformity of fingers, syndactile and club foot	
	Need	Orthopedist	
20	Name	An. Alpin	
	Age	10 month	
	Address	Padang Bila, Bombana, Kendari	
	Problem	Vitiligo	
	Need	Dermatologist	

21	Name	An. Wumbu Bangka	
	Age	4 year old	
	Address	Wumbu Bangka, Bombana, Kendari	
	Problem	Parsial paralise, and contractures, muscle weakness in neck	
	Need	Orthopedist, neurologist	
22	Name	An. Febri Romansyah	
	Age	2 year old	
	Address	Tenjo Laut, Kujang Sari, Cisitu village, Banten	
	Problem	Malformation of ear canal and the ear	
	Need	Ear nose and throat doctor, pediatrician	
23	Name	An. Kamelia	
	Age	5 years old	
	Address	Tenjo Laut, Cisitu village, Banten	
	Problem	Epilepsy	
	Need	Neuropediatrician	
		Ambient air mercury level at the back of her house: 21,985.02 ng/m3	
24	Name	An. Santi	
	Age	10 years old	
	Address	Ciater, Cisitu, Banten	
	Problem	Seizures, cereberal palsy	
	Need	Neuropediatrician	

25	Name	An. Angel	
	Age	4 years old	
	Address	Kujang Sari, Cisitu, Banten	
	Problem	Seizures	
	Need	Neuropediatrician	
		Ambient air mercury level in front of her house: 3,751.39 ng/m3	
26	Name	An. Angga	
	Age	3 years old	
	Address	Cisitu Village, Banten	
	Problem	Skin Rash	
	Need	Dermatologist and pediatrician	
27	Name	An. Atipah	
	Age	3 years old	
	Address	Situ Mulya, Cisitu, Banten	
	Problem	Syndactile	
	Need	Orthopedist and pediatrician	
28	Name	Baby Jasmine Parisa	
	Age	45 days	
	Address	Tenjo Laut, Cisitu village, Banten	
	Problem	Syndactile	
	Need	Orthopedist and pediatrician	
		Ambient air mercury level in front of her house: 14,750.52 ng/m3	

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Photos of the children available upon request

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