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Needs for a Harmonized Vaccine Policy for Public Security Personnel

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Abstract

Public security personnel are frequently exposed to a variety of occupational hazards, including communicable disease pathogens. It is obvious that the current global environment necessitate multinational operations those include natural disaster relief, maritime rescue, joint military exercises, and peace keeping operations. As a result, risk of international transmission of communicable diseases is emerging through these multinational operations, therefore vaccination policy for public security personnel should be harmonized among the participating countries. This should help reduce the risk that troops or vessels are incapacitated by outbreaks of communicable diseases and should strengthen international alliance and competency of risk management across countries.

Keywords: *Harmonized Vaccine; Public security; Communicable diseases; Vaccination*

Introduction

Target cohorts for broad-range vaccination usually include infants, toddlers, adolescents, the elderly, healthcare professionals, and those having certain underlying conditions. Vaccination programs are designed to target the vaccine-preventable diseases specific to each of these cohorts. In addition, vaccination programs are designed according to the policies and funding mechanisms of each country, which is usually reflection of epidemiology, pharmacoeconomics, and budgetary allowance.

Public security personnel, such as police officers, firefighters, and members of the armed forces and coast guard, are generally considered healthier than the average population; nevertheless, they need to receive appropriate vaccination by the nature of their mission containing risks of exposure to pathogens of vaccine preventable diseases. To mitigate risk of incapacitation of these personnel, vaccination becomes more important in the current milieu where international cooperation is expected on a variety of facets and is covered by collective security regime. For instances, armed forces are deployed not only for traditional combat operations but also for joint military exercises, peacekeeping operations, natural disaster relief, and humanitarian rescue missions. Apart from military organizations, members of different coast guards play pivotal roles in international maritime rescue operations. Multinational disaster-relief teams often include rescue specialists from fire departments of multiple countries. International criminal investigations is conducted collectively between police officers of different countries.

Like vaccination programs for general population, vaccination programs for public security personnel differ between countries, which might hamper multinational operations. Moreover, if these people have an unsatisfactory immune status, their ability to complete missions can be compromised when they face communicable diseases. Therefore, vaccination programs should be harmonized with allied or neighboring countries to strengthen capabilities of multinational operations, national defense, and risk preparedness. The North Atlantic Treaty Organization (NATO) has issued a guideline for vaccination strategy (Table 1), but a unified vaccine policy has not been fully implemented by its member states [1]. However, broad coverage of vaccines classified into Standard category by NATO are in place across a few member states even today, which can be a launching platform to enrich harmonized vaccine policy with wider geographic and disease

coverage. In this article, needs for a harmonized vaccination strategy for public security personnel is discussed based on; 1) lessons learned from the past experience, and 2) prospects for the future in view of increasing multinational operations.

Standard vaccines	Diphtheria
	Measles
	Pertussis
	Polio live attenuated oral
	Polio inactivated
	Rubella
	Tetanus
Conditional vaccines	Hepatitis A
	Hepatitis B
	Japanese Encephalitis
	Meningococcal Menignitis
	Serogroup A,C
	Serogroup A, C, Y, W135
	Rabies
	Typhoid, live attenuated oral
	Typhoid, inactivated parenteral
	Yellow Fever
Other vaccines	Adenovirus (4 & 7)
	BCG (tuberculosis)
	Cholera
	Influenza (seasonal)
	Tick-borne Encephalitis
	Varicella-Zoster

Table 1: *Vaccination practice in NATO forces.*

Prevention of infectious diseases in group living situations

Individuals in public security services often have lifestyles and working environments are significantly different from those of ordinary civilians. In particular, public security personnel often live together at their workplace: on-duty firefighters reside together in readiness for dispatch; young police officers often live together in a dormitory; and armed forces and coast guard personnel are frequently housed together in small spaces or quarters. In such crowded environments, pathogens can be rapidly transmitted via airborne or droplets, meaning that these individuals are at increased risk of infection. Once outbreak is developed in these groups, it is easily understood that the infected individuals become ill, and more serious consequence is that the function of a group will be deteriorated depending on the extent and severity of the outbreak. This implies a particular garrison, vessel, fire stations or police stations might be incapacitated. To avoid such undesirable events, public security personnel should be immunized against communicable diseases. Important vaccine-preventable diseases in this category include influenza, meningococcal diseases, measles, rubella, varicella, mumps, diphtheria, and adenoviral infections. In addition to diseases transmitted by airborne or droplets, some water borne enteric infections should be considered [2,3], although these out break cases are not discussed here because vaccines against Norovirus is not available as of today.

A search for published outbreaks of vaccine-preventable disease among public security personal (Table 2) reveals that both ground and maritime cohorts are at risk of incapacitating illness by group infections. The cases of communicable diseases in commercial cargo ships are analyzed, and quantitative risk analysis is provided [4]. Of course, naval or coast guard vessels carry more people in more

crowded conditions than commercial cargo ships, and the negative impact brought by outbreaks is even larger. Thus, vaccination policy targeting public security personnel must be distinguished from that of international traveler's vaccines for civilians. Furthermore, the published reports surely represent only the tip of the iceberg, it casts a reasonable doubt to presume countries not appeared on the table have not faced or will face similar outbreaks.

Illness	Affiliation	Year	Brief description	Ref
Influenza	US navy	1977-1978	Among 200 crewmen, 57 demonstrated influenza like illness and 36 were positive for virus isolation.	10
	US navy	1996	More than 60 out of > 500 crewman of a cruiser developed respiratory symptoms, and the ship was forced to dock in a naval port.	7
	US navy	2009	Among the samples of 489 sailors and marines, 142 persons (29.0%) had H1N1 virus infection.	8
	US military service base in Djibouti	2009	At the camp where approximately 25-75 service members are rotated every 2-3 wks, 25 cases of laboratory confirmed H3N2 were identified among 65 ILI cases	6
	Peruvian navy	2009	Febrile acute respiratory infection cases were reported in a training ship, and 78 out of 355 crews (22.0%) were positive for H1N1 influenza.	5
	South Korean army	2010-2011	Of 395 subjects investigated in three units, 77 (19.5%) was positive for H1N1 influenza	9
Meningococcal diseases	US armed forces	2006-2010	In US military including coast guard, 26 persons developed invasive meningococcal diseases, and 5 were turned out fatal outcome.	13
	South Korean armed forces	2000-2001	In Korean Armed Forces Capital Hospital, 12 cases of invasive meningococcal diseases were experienced and 4 were turned out fatal outcome.	14
	Israeli defense forces	1983-2007	During 25 years of observation period, 42 cases of lab confirmed invasive meningococcal diseases were identified. Incidence rate of vaccine-preventable meningococcal disease dropped from 1.31 cases per 100,000 person-years in 1983-1994, the period preceding the start of immunization, to 0 in 1995-2007.	15
Rubella	German navy	1996	Of the 330 crew members, 298 (90%) participated in the investigation. The outbreak was continuous without a peak and ended abruptly after the ship's return to a port. During the voyage, 20 cases were identified, and 11 of which were clinically symptomatic.	19
	British army	1996	Four helicopter ground crew deployed to Bosnia were infected with rubella. A female British soldier in pregnancy in the troop (belongs to a different unit) was repatriated to her base unit in Germany, considering a risk of congenital rubella syndrome (CRS).	17
	German army	1995	In German troop dispatched to a joint military exercise in US, rubella outbreak was occurred. Six out of 120 German soldiers developed clinical rubella.	18
Tuberculosis	US navy	1987	A sailor on a U.S. Navy ship had smear-positive, cavitary, pulmonary tuberculosis. Contact investigation of the entire ship's crew found 216 new reactors to tuberculin skin test (24.5%) among 881 previously tuberculin-negative sailors.	20
	US navy	1998-1999	A case of cavitary pulmonary tuberculosis was found in a large amphibious ship with a crew of approximately 1,350. Contact investigation revealed 21 persons developed active tuberculosis. New reactor for tuberculin test was 712 out of 3,338 (21.3%) investigated subjects.	21

Table 2: *Outbreak reports of communicable diseases transmitted by airborne and/or droplet among public security personnel in group life settings.*

Influenza

Influenza is a common communicable disease often affects people in general population not only in group life settings. The disease is highly contagious and spread rapidly, and clinical symptoms include headaches, pyrexia, general malaise, respiratory symptoms, and rarely encephalopathy. These symptoms tend to incapacitate those in group life settings both in ground and maritime cohorts (Table 1) [5-10]. The largest and worst influenza pandemic in recorded history is believed to be originated from military camps in the US, from which it spread through the migration of troops during World War I [11]. Although Influenza vaccination is not categorized in standard vaccines in Military Strategy for Vaccination in NATO Forces, universal vaccination is implemented in a few military organizations [1].

Meningococcal diseases

Unlike influenza, meningococcal diseases are relatively rare, with only sporadic cases occurring in industrialized countries. By contrast, their clinical impact is apparently more serious than common communicable diseases like influenza. Invasive meningococcal diseases begin with non-specific respiratory symptoms, after which they can progress rapidly. Infected individuals can develop septicemia or meningitis, which require urgent treatment with antibiotics to prevent irreversible complications, such as neurological deficits, amputation, or even death. Thus, vaccination against invasive meningococcal diseases should be considered for personnel living in group settings. A study of a Polish military unit found that quadrivalent meningococcal conjugate vaccine suppresses nasopharyngeal carriage of *Neisseria meningitides* [12], which is a prerequisite for this disease. Universal vaccination with meningococcal vaccines has been implemented by the armed forces of the US [13], South Korea [14], and Israel [15]. Other nations employ a conditional vaccination policy targeting personnel dispatched to countries where the disease is endemic, the so-called "meningitis belt" [16]. Meningococcal vaccines should be considered both for people in group living situations and for those traveling to areas where meningococcal diseases is endemic.

Measles, rubella, varicella and mumps

Controlling measles, rubella, varicella, and mumps in children and adolescents is one of the most important challenges in global public health. Public security personnel should also be targeted for vaccination against these viral infections because of their clinical potential to incapacitate groups. Unlike meningococcal infections, infection with these pathogens usually does not cause irreversible damage, with the exception of male sterility due to mumps orchitis, sub acute sclerosing panencephalitis following measles, and congenital rubella syndrome. Because modern public security organizations often include female soldiers or officers in reproductive age, concern of congenital rubella syndrome is noteworthy. Outbreak of rubella in visiting foreign troops as reported in British troops stationed in Bosnia, promptly evokes worries of infection to troops from other countries or even civilians in the area of operation, a major concern was congenital rubella syndrome for personnel in pregnancy [17]. It is easily understood that any congenital rubella syndrome cases as a result of contact with stationed foreign troops ignites international dispute regardless of the aim of an operation or origin of a troop. Because rubella outbreaks have been reported in in both ground and maritime military cohorts [17-19], harmonization of vaccination policy in allied nations or neighboring countries is in need of consideration.

Tuberculosis

Apart from above-discussed illness infected via respiratory tract, tuberculosis is located in a different place in the context of preventative strategy in group life settings. The disease does transmit via droplets, and outbreak cases in naval vessels are reported indeed [20,21]. Nevertheless, vaccine against tuberculosis is *M. bovis* bacille Calmette-Guérin (also known as BCG), which appears effective in prevention of children from the disease but not adolescents and adults [22]. Although no vaccination is usually considered for controlling tuberculosis in adults, outbreak cases in naval vessels indicate that individuals in crowded conditions are vulnerable to tuberculosis even if they are in good health. An interpretation is that as far as effective vaccines are available, vaccination might be the most pertinent tool in protecting these individuals from illnesses transmitted via airborne and droplets.

Prevention of infectious diseases during disaster relief operations

Armed forces personnel as well as firefighters and police officers are frequently dispatched to rescue operations following natural disasters. These individuals may be infected with tetanus, Hepatitis B, and some bacterial pneumonia due to exposure to contaminated

soil, blood, or even airborne dust. Vaccines against these diseases are essential gears for protecting public security personnel in these hazardous circumstances, in addition to personal protective equipment.

Tetanus

Following natural disasters like earthquakes, tsunamis, landslides, or flooding, rescue teams often needs to excavate and handle muddy debris during which they may receive wounds. This can expose them to *Clostridium tetani,* a spore-forming bacillus that normally lives in soil. If an unvaccinated individual in a rescue team is infected with tetanus, it is an unfair trade-off for a person being committed to rescue missions in difficulties. After the Great East Japan Earthquake in 2011, tetanus cases are reported to be increased in the residents of areas washed out by tsunami [23], but no cases are reported in rescue teams to the best of my knowledge. This may be a reflection of universal tetanus vaccination in Japanese Self Defense Forces. NATO also recommends tetanus vaccine as a standard vaccine [1].

Hepatitis B

There is another risk of infection during disaster relief operations: hepatitis B, a blood borne viral disease. It can be easily anticipated that a rescue team contacts with bleeding survivors or the bodies of victims; if they are infected with hepatitis B, individuals in a rescue team are at risk of infection while providing first-aid treatment and or carrying them to a safer place. Broad-range of clinical manifestations can be developed after hepatitis B infection, for instance, transient acute hepatitis, fulminant hepatitis, chronic hepatitis, liver cirrhosis, and hepatic cancer are potential outcome. Regardless of the clinical syndrome developed in an individual, hepatitis B infection occurred in the field of disaster relief should be prevented by proper vaccination to protect health and life of rescue team members. Furthermore, the risk of infection transmitted via blood is not concerned only in the area of natural disaster. Firefighters, ambulance operators, police officers, and armed forces personnel are also at increased risk of hepatitis B due to the possibility of exposure to infected blood during operations or even during training during peacetime. Vaccination against hepatitis B is therefore desirable for public security personnel. Although the hepatitis B is classified as conditional vaccine by NATO, quite a few countries include it as part of their standard vaccine program [1]. In northern European countries, i.e., Denmark, Finland, Iceland, Ireland, Netherland, Norway, Sweden, and UK, where no universal hepatitis B vaccination is implemented, security and emergency service personnel are considered at occupational risk of the disease together with healthcare personnel or commercial sex workers [24]. These nations do implement selective hepatitis B vaccination targeting these cohorts.

Haemophilus influenza* and *Streptococcus pneumoniae

H. influenzae and *S. pneumonia* are encapsulated bacteria that are the main causes of invasive or mucosal diseases in younger children and the elderly. Following massive earthquakes, cases of hospitalized pneumonia due to these two pathogens can also increase in adolescents and young adults, and rates of pneumonia caused by *H. influenza* significantly increased after the Great East Japan Earthquake in March 2011, possibly due to crowded living conditions in evacuation shelters and cold temperatures [25]. Similarly, a rise of pneumococcal pneumonia cases was reported after the earthquake in New Zealand in 2010, and the etiology was sought by spatial/spatio-temporal epidemiological approach [26]. This report suggests that inhalation of liquefaction eject a (a source of air-borne dust) and short age of vital supplies might contribute increase of pneumococcal pneumonia. These tragic disasters teach us that, following massive earthquakes, vaccination against *H. influenza* and *S. pneumonia* should be considered for both evacuees and rescue teams. Also, outbreaks of pneumococcal pneumonia in military facilities in Israel [27] and the US [28] indicate that even healthy adults may be at elevated risk for pneumococcal diseases when exposed to crowded living conditions.

Prevention of endemic infectious diseases during deployment to high-risk areas

No matter what type of operation is conducted by what sort of organization, vaccines in this category are necessary for personnel of industrialized nations dispatched to the countries/areas where endemic diseases are prevalent, usually they are located in subtropical or tropical zones. In the same time, for the nations contain risks of those endemic diseases in domestic settings, preventative strategy against this class of illness should be in place of routine vaccination for public security personnel. Also, preventable measures other than vaccines are essential to protect personnel from the risk of endemic diseases [29], since some of them are not prevented by

vaccines and continuous efforts to develop effective vaccines against these tropical diseases, for example, malaria, dengue, and viral hemorrhagic fever such as Ebola, are still underway.

Food- and water-borne infections

Vaccine-preventable food and water-borne infections include poliomyelitis, cholera, typhoid fever, and hepatitis A. Polio was on the verge of eradication by virtue of the Strategic Advisory Group of Experts' Global Polio Eradication Initiative, which has been implemented by many supranational organizations [30]. Unfortunately, the volatile situation in Pakistan and Afghanistan and chaos in Syria and neighboring countries have hampered endgame towards polio eradication. These latest movements result in the disease still to be accounted in a serious travel health concern for endemic areas, considering irreversible neuromuscular damage occurred in affected individuals. Cholera is an enteric disease characterized with life-threatening diarrhea that requires prompt and sufficient parenteral hydration. A series of events full of lessons is the one observed in Haiti from 2010. The country was hit by a devastating earthquake in January 2010, and United Nations' peacekeeping troops of multinational origin were stationed there. A large scale cholera epidemic has been reported since October 2010, which was surprising as no cholera outbreak had been reported in Haiti for more than a century [31]. Possible explanations include an increase in the water temperature due to climate change and importation of cholera from an endemic country by personnel belongs to the United Nations and other non-governmental organizations. Genetic analysis of clinical isolates from victims confirmed that the bacterial strain was originated from Asia [32], not from South Africa, confirming the importation hypothesis. This is more than an irony that the personnel dispatched to rescue peoples suffering from the earthquake brought a deadly disease, and as a consequence, sorrow of Haitian was unintentionally amplified. This tragedy suggests us that vaccines are needed for public security personnel not only for protecting themselves but also protecting indigenous population in contact with the personnel.

Vector-borne viral diseases

Yellow fever, Japanese encephalitis, and tick-borne encephalitis are vaccine preventable diseases placed in this group. Geographic distribution of these illnesses differ each other, endemicity of yellow fever is observed in Africa and Latin America, and Japanese encephalitis represents a risk in Asian countries, despite both are infected through mosquito bite. Tick-borne encephalitis cannot be classified into a tropical disease, as cases are reported from Russia and some European countries also from some regions of Asia. Other than these three viral infections, vaccines against other vector-borne diseases are not available, thus tools to prevent physical contact from these vectors, i.e., mosquito net or repellant, should be equipped depending on the risk of exposure.

Zoonosis

Rabies vaccine should be considered either as pre-exposure immunization or post-exposure prophylaxis. After the exposure of non-vaccinated individuals, passive immunization using immunoglobulin is also in the scope. It should be noted that no survival is anticipated once clinical symptoms, the most characteristic one is hydrophobia, are developed with a patient. Other zoonotic vaccine preventable diseases such as anthrax, plague, or tularemia occupy a central place in the context of biological warfare [33,34], are also of concern but are not discussed here because this review focuses on international harmonization but not on combat situations.

Conclusion and Future Prospect

Public security personnel face a broad range of occupational hazards. Vaccination is an important and pragmatic measure to protect them from infectious disease associated with: 1) group living in training facilities, vessels, or encampments; 2) unusual physical environments at disaster relief or accident sites; and 3) deployment to countries or areas where endemic diseases are prevalent. Because multinational teams often carry out joint natural disaster relief, maritime rescue, military exercise, and peacekeeping operations, another key purpose of vaccination strategy is to prevent the spread of infectious diseases from a deployed unit to another nation's personnel or to the local population. Communicable diseases are not able to be confined in a framework of a single nation in these settings, and no any nations welcome international exchange of such disease as a consequence of joint operations. In this regard, harmonizing vaccine policy for public security personnel across nations should be considered. In fact, NATO has published a vaccination guideline and recommended for its member states to follow the guideline that mentions that "vaccination against certain infectious diseases is

an essential precaution and a keystone of operational readiness" [1]. In the same time, the guideline also states that "each nation is responsible for establishing their mandatory and voluntary vaccination requirement". This means that adherence for the guideline is solely decision made by each member state, which could result in creating a gap between the policy and practice in each country. Multiple reasons can be suggested for some reluctance to fully adhere the recommendation, for example, limited budgetary allowance, lack of evidence supporting the needs of vaccines, lower budgeting priority compared with other equipment required to fulfill missions. Nevertheless, these hurdles should be cleared by all means considering critical role of vaccines in maintaining public security personnel be ready for their own missions with minimal risk of communicable diseases. Apart from an initiative by NATO, to the best of the author's knowledge, no similar harmonization activities are in place by other supranational organizations. In the future, development of vaccination guideline by other regional security networks is in need of consideration. As of today, it seems that the United States armed forces and coast guard implements one of the most enriched vaccination program in terms of type of vaccines in use [35]. An example of positive impact on disease prevention by a vaccine in public security personnel is also seen in US [13]. Subsequent to introduction of routine meningococcal vaccination program, overall incidence of invasive meningococcal diseases has dropped by > 90%. Not necessarily limits meningococcal diseases, this is a good lesson to learn for other nations where limited vaccination programs are currently in place towards improvement of nation's own program and internationally harmonized vaccination policy beyond.

Disclaimer

The view provided in this article is solely personal one of the author and does not necessarily reflect the position or policy of Sanofi Pasteur Japan, Yokohama City University, or the Ministry of Defense of Japan.

Conflict of interest

The author is a full-time employee at Sanofi Pasteur Japan, the vaccine division of Sanofi K. K. The author serves as Lieutenant Colonel (inactive reserve) of the Medical Service Corps of Japan Ground Self Defense Force and is a part-time employee of the Ministry of Defense of Japan. There is no conflict of interest with Yokohama City University.

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