

Audit Report on the Prevention and Control of Quarantinable Infectious Diseases

I. Audit Overview

1. Background and Objectives

With the outbreak of emerging infectious diseases, such as the Middle East Respiratory Syndrome (MERS) and the Zika virus infection, added to the increase in international exchanges (37.07 million entrants in 2015 → 49.43 million entrants in 2018), there have been growing concerns over the possible importation of emerging infectious diseases to Korea. Accordingly, after the outbreak of MERS in 2015, the Korean government reinforced its system to prevent and respond to the importation of overseas infectious diseases by formulating the “Measures to Reform National Infection Prevention and Control System” in September 2015, revising the “Quarantine Act,” and increasing the budget related to “Quarantinable Infectious Diseases” (KRW 40.7 billion in 2015 → 349.4 billion in supplementary budget in 2015; KRW 95.5 billion between 2016 and 2018).

In 2016 and 2017, an additional 200 and 220 suspected MERS cases were reported, respectively, and in September 2018, a confirmed MERS patient passed thorough immigration and quarantine screenings without being detected, reigniting national concerns over emerging infectious diseases entering the country.

Due to these occurrences, it became mandatory to check for any possible blind spots that can occur during the monitoring and management by the national diseases prevention and control system, and to verify the proper operation of quarantine infrastructures (such as facilities and devices designed to respond to quarantinable infectious diseases), which were constructed using a hefty budget following the MERS outbreak.

Accordingly, the Board of Audit and Inspection (BAI) included the subject in its annual audit plan for 2018 and conducted the audit. The audit focused on collecting and analyzing relevant data on the government’s responses to quarantinable infectious diseases to identify the current status of preventive efforts and to check the proper use of quarantine infrastructure in order to devise necessary improvement measures.

2. Key Audit Matters

This audit focused on finding the obstacles in securing an effective management system during a national quarantine crisis, and to suggest measures for improvement. To do so, the audit concentrated on systematically examining the appropriateness of the infectious disease prevention system and the system's use, as well as eliminating blind spots in the management of quarantinable infectious diseases.

The audit was conducted on the overall response measures against quarantinable infectious diseases between 2016 and October 2018 taken by the Ministry of Health and Welfare (MOHW) and the Korea Centers for Diseases Control and Prevention (KCDC), now known as Korea Disease Control and Prevention Agency (KDCA). The audit also examined the efficacy of the measures in each phase of response against quarantinable infectious diseases (including entry screening) and against regional spread of diseases.

Also, the audit checked if the infrastructures for quarantine (including the Smart Quarantine Information System, negative pressure ambulances, isolation or quarantine facilities, remote diagnosis systems, and local testing centers operated by the National Quarantine Station), which were newly built after the MERS outbreak in 2015, were being operated effectively.

3. Audit Process

Prior to the field audit, the audit team collected and analyzed other relevant documents during the data collection period (Oct. 18 to Nov. 22, 2018), such as the BAI's 2015 "Audit on MERS-CoV Prevention and Response," "Measures to Reform National Infection Prevention and Control System," research papers, press releases, and National Assembly discussions related to quarantinable infectious diseases. The specific direction of the audit was determined after identifying expected problems through field checks on "immigration quarantine" systems of airports and ports, as well as medical institutions, including the National Medical Center. The field audit was conducted on the MOHW and KCDC with a team of 8 auditors, for 15 days from Nov. 28 to Dec. 18, 2018.

During the audit, the audit team analyzed the following data to seek reasonable improvement measures on quarantine and prevention: the data of the quarantine investigation for entry and departure between 2016 and 2018 stored in the KCDC's Quarantine Information System and

the Comprehensive Information System for Quarantinable Infectious Disease Control, reports from medical institutions on patients suspected of quarantinable infectious diseases, data on epidemiological investigations of local community health centers (Si, Gun, Gu), and data on medical care expenses for patients suspected of quarantinable infectious diseases held by the Health Insurance Review and Assessment Service (HIRA).

4. Review and Approval of Audit Results

The audit closing meeting was held on Dec. 21, 2018, with the participation of the Head of the Center for Infectious Disease Control (under KCDC), to exchange opinions on the audit results and key findings. The audited organizations also shared necessary details and follow-up measures through their written responses to the BAI’s questionnaires.

Afterward, the BAI reflected the opinions suggested in the closing meeting and conducted an internal review on the findings and recommendations to finalize the audit results through the Council of Commissioners on Apr. 25, 2019.

II. Current State of Response Efforts Toward Quarantinable Infectious Diseases¹

1. Overview

In accordance with Article 2 of the Infectious Disease Control and Prevention Act, the MOHW designated a total of 80 legal infectious diseases into 5 classes (along with other designated infectious diseases), based on the following characteristics described in Table 1.

[Table 1] List of Legal Infectious Diseases

Category	Characteristics	Types
Class 1	Transmitted by water or food; high risk of mass outbreak	Cholera, typhoid, shigellosis, etc.
Class 2	Preventable and controllable by vaccination	Measles, rubella, Japanese encephalitis, etc.
Class 3	Sporadic disease; surveillance required	Malaria, tuberculosis, AIDS, etc.

¹ This section is designed for the purposes of delivering a comprehensive understanding of the problems found in the audit, and is based on the data submitted by auditees or open data. The information has not been verified by field audits, audit methodology, etc.

Class 4	Overseas epidemic diseases that can be transmitted into Korea	Pest, yellow fever, SARS, MERS, etc.
Class 5	Infection by parasites	Ascariasis, trichuriasis, enterobiasis, etc.
Designated infectious diseases	Requires government surveillance	Hand, foot and mouth disease, gonorrhoea, etc.

Source: Restructuring of diagnosis and report criteria for legal infectious diseases (2017)

Among the aforementioned 80 infectious diseases, the MOHW designated 9 (including MERS) as quarantinable infectious diseases (in accordance with Article 2 of the “Quarantine Act”) that can occur overseas and be imported into Korea. The designation was made to ensure the prevention of inflow and transmission of such epidemics into the country. Table 2 shows the confirmed cases of quarantinable infectious diseases by type between 2015 and 2018.

[Table 2] Confirmed Cases of Quarantinable Infectious Diseases by Type

(Unit: persons)

Category	Cholera	Pest	Yellow Fever	SARS*	AI**	Novel Influenza	MERS	Emerging Infectious Disease Syndrome	Poliomyelitis	Zika Virus Infection
2018	2	-	-	-	-	-	1	-	-	6
2017	5	-	-	-	-	-	-	-	-	11
y2016	4	-	-	-	-	-	-	-	-	16
2015	-	-	-	-	-	-	186	-	-	-
Total	11	-	-	-	-	-	187	-	-	33

*SARS: Severe Acute Respiratory Syndrome ** AI: Animal Influenza Infection in Humans

Note: Though the Zika virus infection was designated as an infectious disease in February 2016, it was removed from the Quarantinable Infectious Disease list in November of the same year, but was still subject to quarantine in 2017.

Source: Restructuring of KCDC data

In accordance with Article 5.1 of the “Quarantine Act” and Article 2 of the Enforcement Rules of the same Act, the KCDC designated the areas that witnessed infectious disease outbreaks within one year or areas designated by the World Health Organization (WHO) to need public health crisis management, as “infected areas.” As can be seen in Table 3, 60 countries were designated as being “infected areas” by Sept.9, 2018, for 6 types of quarantinable infectious diseases, including MERS.

[Table 3] List of Areas Infected With Quarantinable Infectious Diseases

(as of Sept. 9, 2018)

Cholera	Pest	Yellow fever	Zoonotic influenza	MERS	Poliomyelitis
15 countries (Yemen)	Madagascar	42 countries (Cameroon)	China (11 provinces, cities)	5 countries (Saudi Arabia)	7 countries (Pakistan)

Note: As for MERS, Qatar was included in the list, as it is adjacent to the infected areas.

Source: Restructuring of KCDC data

Meanwhile, the KCDC conducted quarantine for a total of 49,430,077 entrants in 2018, and has continuously expanded its quarantine every year, as shown in Table 4. As of 2018, the number of entrants by air reached 46,456,532 (96%) while entrants by sea was at 2,973,545 (6%). Among them, those from “infected areas” recorded at 9,842,474, accounting for 19.9% of the total 49,430,077 entrants.

[Table 4] Quarantine for Entrants

(Unit: persons, %)

Category		Total		Airplane		Ship	
		Entrants	Rate	Entrants	Rate	Entrants	Rate
2018	Total	49,430,077	100	46,456,532	94.0	2,973,545	6.0
	Infected	9,842,474	100	9,060,634	92.1	781,840	7.9
	Not infected	39,587,603	100	37,395,898	94.5	2,191,705	5.5
2017	Total	44,772,560	100	41,585,507	92.9	3,187,053	7.1
	Infected	10,755,258	100	9,436,866	87.7	1,318,392	12.3
	Not infected	34,017,302	100	32,148,641	94.5	1,868,661	5.5
2016	Total	44,475,279	100	39,523,792	88.9	4,951,487	11.1
	Infected	13,423,719	100	10,817,279	80.6	2,606,440	19.4
	Not infected	31,051,560	100	28,706,513	92.4	2,345,047	7.6
2015	Total	37,069,482	100	33,484,336	90.3	3,585,146	9.7
	Infected	15,917,411	100	13,815,978	86.8	2,101,433	13.2
	Not infected	21,152,071	100	19,668,358	93.0	1,483,713	7.0

Source: Restructuring of KCDC data

2. Management System for Quarantinable Infectious Diseases

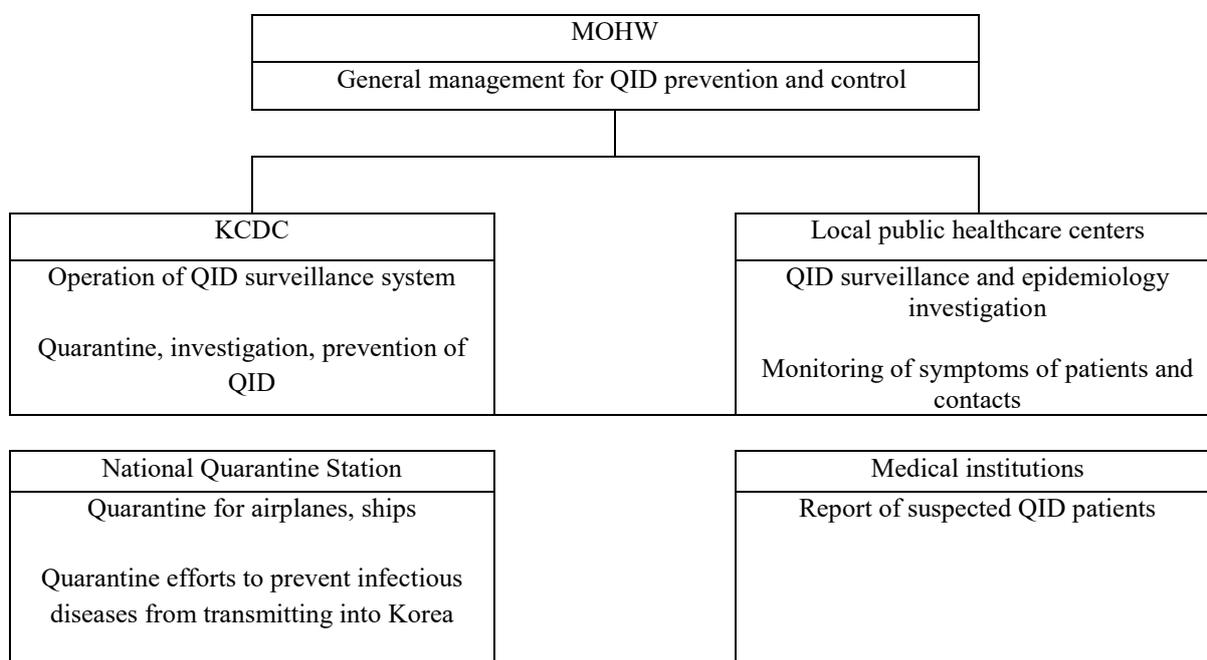
As seen in Figure 1, the MOHW is responsible for the prevention and control of quarantinable infectious diseases, including legislation and revision of quarantine-related laws.

The KCDC handles practical tasks in terms of quarantine, investigation, and prevention, such as quarantine upon arrival and departure and prevention of diseases spreading at the regional level.

Accordingly, the KCDC requires entrants from “infected areas”² either by air or sea to submit health survey questionnaires and takes their temperature using thermal imaging cameras from 13 quarantine stations installed in nationwide airports (including Incheon International Airport Quarantine Station) and ports. In cases where entrants are identified with a fever (above 37.5°C), a medical test is conducted, or the KCDC requests local public healthcare centers where the suspected patients live to keep them under surveillance.

After the entry procedure, if there is a confirmed case found in the local community, the medical institution that diagnosed the patient is required to report the case, and the local public healthcare centers will conduct an epidemiological investigation of the confirmed patient (as well as on those suspected of quarantinable infectious diseases) to contact trace the transmission of the disease.

[Figure 1] Quarantinable Infectious Disease (QID) Management System



Source: Restructuring of KCDC data

3. Reshaping the National Disease Prevention System Post MERS Outbreak

² Entrants from non-infected areas are only subject to a fever test.

As shown in Table 5, the Korean government (Office for Government Policy Coordination and the MOHW) developed “Measures to Reform National Infection Prevention and Control System” in September 2015 following the MERS outbreak. The measures were to significantly improve the quarantine system to prevent the risk factors related to emerging infectious diseases.

[Table 5] Key Tasks to Reform National Infection Prevention and Management System

Category	Key tasks
1. Preventing importation of emerging infectious diseases	1-1. Establishing an international surveillance system for emerging infectious diseases
	1-2. Reinforcing entry procedures
	1-3. Expanding quarantine facilities including isolation and testing facilities
2. Making initial onsite responses	2-1. Operating 24-7 emergency rooms for infectious disease control
	2-2. Dispatch emergency response team for onsite response
	2-3. Securing and fostering excellent epidemiological investigators
3. Mobilizing medical and healthcare resources upon spread of epidemic	3-1. Establishing a prompt and accurate diagnosis system
	3-2. Securing isolation/quarantine facilities in advance and reinforcing monitoring of isolated people
	3-3. Constructing an infectious disease specialty treatment system
	3-4. Strengthening R&D for emerging infectious diseases
4. Restructuring governance of emerging infectious diseases	4-1. Reshaping the control tower with consideration to characteristics of prevention efforts
	4-2. Defining clear roles of central and local governments and establishing a central command and control authority
	4-3. Enhancing status of KCDC and promoting expertise
	4-4. Building capacities for emergency management and communication, securing transparency in information
5. Improving medical environment to prevent infections within hospitals	5-1. Strengthening infection control within Emergency Room (ER)
	5-2. Expanding isolation beds within hospitals and improving caregiving system
	5-3. Increasing infectious disease specialist in hospitals and reinforcing prevention efforts
	5-4. Improving medical service delivery system and hospital culture

Source: Restructuring of MOHW data

Conventional quarantine consisted mainly of fever tests for entrants coming into airports and ports. However, as emerging infectious diseases appeared with longer incubation periods and faster spreadability, such as the Ebola virus disease (incubation period of 21 days) in 2014 and MERS (incubation period of 14 days) in 2015, there were limits to checking suspected cases during the quarantine stage.

Therefore, the KCDC established the Smart Quarantine Information System, connecting the

information of entrants among related organizations, including the Ministry of Foreign Affairs (MOFA), Ministry of Justice (MOJ), and the HIRA. From April 2016, by using the connected system, a text message could be sent with instructions on how to self-report, and overseas travel records were made accessible to general medical institutions for all entrants from “infected areas” to facilitate the process of locating confirmed cases. The MOHW also revised the “Quarantine Act” in 2016, requiring entrants from a third country via an infected area to submit a health survey questionnaire like the entrants from infected areas. Failure to submit the questionnaire can lead to the imposition of administrative fines. From April 2017, the KCDC used data on overseas roaming to identify such entrants who visited infected areas and entered Korea via a third country.

Moreover, the KCDC installed negative pressure isolation rooms at the Incheon International Airport Quarantine Station, and increased isolation facilities of both Busan and Jeju Quarantine Stations, respectively, to promptly respond to patients suspected of quarantinable infectious diseases found during entry procedures. Infrastructures to diagnose infectious diseases were also established, including expanding diagnosis and testing rooms in three national quarantine stations so that medical testing can be promptly conducted for suspected infectious disease patients. The MOHW also increased the number of isolation beds in the ER to adopt an emergency treatment system for patients suspected of infectious diseases, and to transport them safely, 30 negative pressure ambulances have been allocated to medical clinics nationwide.

4. Related Budget and Projects

In 2018, a budget of KRW 81.8 billion for quarantinable infectious diseases was allocated to the KCDC (as shown in Table 6) and a total 15 projects were pushed forward: 8 projects (including quarantine management) through the general account budget, 5 projects under the Public Health Promotion Fund (including responses to emerging infectious diseases), and 2 projects through the Emergency Medical Service Fund (including expansion and maintenance of hospital beds for inpatient care of patients with infectious diseases).

Meanwhile, after the MERS outbreak, an additional KRW 343.8 billion was subsidized as a supplementary budget in 2015, including KRW 164.5 billion to increase facilities and devices for infectious diseases control, KRW 76.3 billion for prevention and management of infectious diseases, and KRW 100 billion to assist medical institutions.

[Table 6] Budget Details for Quarantinable Infectious Diseases (KCDC)

(Unit: KRW million)

Account/ Fund	Project details	2015	2015 Supplementary budget	2016	2017	2018
General account	Quarantine control	5,478	-	12,327	8,152	8,662
	Infectious disease prevention and development; operation of comprehensive information system	3,280	-	4,275	1,952	1,415
	International contributions for infectious disease control (ODA)	1,822	-	2,500	3,525	2,335
	Operation of infectious disease sample testing laboratory	2,868	-	5,811	5,292	5,629
	Infectious disease prevention and control	5,160	76,365	12,569	7,787	8,539
	Comprehensive management of emerging infectious disease emergencies	-	-	-	13,299	12,938
	Establishment of regional infectious disease specialty hospitals	-	-	-	1,400	2,822
	System operations of quarantine stations (informatization)	87	-	457	358	353
	Expansion of facilities and devices for infectious disease control	-	164,515	-	-	-
	Assistance for medical institutions	-	100,000	-	-	-
Public health promotion fund	Response measures to emerging infectious diseases	3,403	-	55,937	4,089	4,651
	R&D of infectious diseases management technology	8,955	3,000	14,793	22,661	20,395
	Management of epidemic investigations and operation of laboratory surveillance network	4,037	-	2,959	3,509	3,539
	Support and management in the prevention of infectious diseases	-	-	1,175	1,062	1,068
	Development of infrastructure for regional medical treatment	3,157	-	5,371	5,387	6,510
Emergency medical service fund	Expansion and maintenance of hospital beds for inpatient treatment (emerging infectious diseases)	1,520	-	2,470	4,080	2,320
	Operation of isolation facilities for emerging	912	-	756	696	678

	infectious diseases					
	Total	40,679	343,880	121,400	83,249	81,854

Source: Restructuring of KCDC data

III. Audit Results

1. Overall Audit Results

In an effort to improve measures on quarantinable infectious diseases after the MERS outbreak in 2015, this audit examined: 1) if the importation of quarantinable infectious diseases have been effectively prevented at the quarantine stage; 2) if there was efficient cooperation among the KCDC, local public healthcare centers, and private medical clinics; and 3) if quarantinable infectious disease-related infrastructures (Smart Quarantine Information System, isolation/quarantine facilities for suspected quarantinable infectious disease patients, and negative pressure ambulances) were being efficiently operated. Based on its findings, the audit also focused on developing measures to improve the prevention and control of quarantinable infectious diseases, thereby securing an effective control mechanism for the nation's quarantine system. The audit identified a total of 9 inappropriate or ineffective cases, and suggested the MOHW and the KCDC to develop complementary measures, as well as to improve the policy systems.

Summary of Audit Results

1. Prevention and Management of Quarantinable Infectious Diseases

(Insufficient management in reporting patients suspected of quarantinable infectious diseases) Medical institutions should report any patients suspected of a Zika virus infection to the KCDC if the patients meet the reporting requirements. However, it was found that medical institutions failed to report 400 out of 681 people who met reporting requirements and claimed medical testing expenses. The KCDC was found to be insufficient in their management and oversight in this regard.

(Insufficient classification and management of suspected patients) The KCDC failed to notify local public healthcare centers on 639 out of 12,056 people who were subject to tracing

and management. The failure of the local public healthcare centers in proactively managing those requiring tracing led to a blind spot where a foreigner, who came in contact with a confirmed MERS patient left and re-entered Korea without being properly monitored for contact tracing.

(Inadequacies in designating areas affected with quarantinable infectious disease) The KCDC failed to designate the Southeast Asian region as an infected area though the confirmed cases for the Zika virus infection were growing in number. It also excluded India from being labeled as an infected area even though the country had 1,226 cholera patients according to the WHO, causing an incongruence between the infected areas and the quarantine investigation.

2. Use of quarantine infrastructures

(Inadequate operation of Smart Quarantine Information System) The Smart Quarantine Information System was established by the KCDC to secure the information of entrants who enter Korea via a third country after visiting an infected area. However, the actual use of the system proved ineffective, as the system performed poorly in properly notifying individual entrants with necessary information. The system also excluded the cabin crew (Korean) and foreign visitors staying for less than 90 days from the list of overseas travelers whose information should be provided to medical institutions. The quarantinable infectious diseases subject to the system were decided arbitrarily, which further enhanced the inefficiency of the system.

(Insufficient allocation and use of negative pressure ambulances) The MOHW expanded the number of negative pressure ambulances to prevent instances of disease transmission that can occur during patient transport. However, the ambulances were not properly allocated to quarantine stations where the actual patient transport takes place. In addition, the related guidelines were not properly developed, resulting in a significant decrease in the usage of negative pressure ambulances for the purpose of transporting patients with infectious diseases.

(Insufficient expansion and operation of quarantine station facilities) The KCDC prepared a remote diagnosis system, isolation/quarantine facilities, as well as testing and treatment

rooms to provide prompt responses to those identified as suspected patients of quarantinable infectious diseases during the quarantine stage, but such facilities were rarely used due to the lack of proper guidelines.

(Insufficient support in general devices for local public healthcare centers) The KCDC subsidized local public healthcare centers with expenses to purchase tablet PCs to help perform epidemiological investigations. However, since an operation system for the epidemiological investigation was not suggested as a standard feature, 58.5% of the subsidized tablet PCs went unused.

In this regard, the BAI notified the KCDC to strengthen their management and oversight of medical institutions by: 1) monitoring whether they are properly reporting patients suspected of quarantinable infectious diseases, 2) ensuring no entrants are left untracked (including any who come in contact with a MERS confirmed patient), and 3) overseeing and instructing local public healthcare centers to properly manage those requiring tracing and tracking. The BAI also recommended the KCDC to develop clear measures on how to designate areas infected with quarantinable infectious diseases in a timely manner by taking into consideration outbreak information, possibility of importation to Korea, and risks of the disease. The BAI recommended the KCDC to actively use the Smart Quarantine Information System to tighten quarantine investigations, and to include local cabin crew and short-term foreign visitors in the list for the System to send individual notifications. The KCDC was also advised to prepare measures to enhance the use of facilities for quarantinable infectious diseases, such as isolation/quarantine facilities and devices that were subsidized for local public healthcare centers.

In addition, the BAI notified the MOHW to promote the use of negative pressure ambulances by reallocating them to medical institutions that have actual transportation demands for infectious disease patients, as well as to revise related guidelines.