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보건학 석사학위논문

An Exploratory Study on the Internal Communication  
for the Quarantine Management in a Public Health Emergency:

Focusing on the Case of G District in Seoul Using the Naver Band

During the Outbreak of Middle East Respiratory Syndrome Coronavirus in 2015

공중보건 위기상황에서의 자가격리자 관리를 위한

내부소통에 관한 탐색적 연구:

2015년 중동호흡기증후군 유행 시 네이버 밴드를 활용한

서울특별시 G구 사례를 중심으로

2017년 2월

서울대학교 보건대학원

보건학과 보건학 전공

김 미 희

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지도교수 조성일  
이 논문을 보건학 석사학위논문으로 제출함

2016년 11월

서울대학교 보건대학원  
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2016년 11월

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# ABSTRACT

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**Introduction:** In the outbreak of the Middle East respiratory syndrome coronavirus (MERS-CoV) in 2015, G district of Seoul established the Naver Band, a kind of closed-type social network service (SNS) for management of close contacts to a MERS-CoV patient (home quarantine). This is an academically valuable cases of a specific situation of internal communication within the response team during the public health emergency.

**Objectives:** The empirical case in G District allows exploration of several aspects of the internal communication using SNS at a public health emergency response. This study provides an overview of the SNS posts communicated for quarantine management, and attempts to describe these communication method's potential for influencing quarantine management.

**Method:** Qualitative and quantitative content analysis were conducted on 656 posts, from June 9, 2015, when the Band was created, until October 30, when the MERS-CoV epidemic was

temporarily ended. In addition, social network analysis was performed on 27 posts that monitoring staffs questioned about their problems occurred during the quarantine management.

**Results:** Closed-type SNS became common space for public health workers to internally interact and exchange information during public health emergency. In particular, it functioned as substitute internal communication channels when lack of coordination and internal information deficit to the response team were presented. As well as these roles, it was confirmed the achievement of SNS communication by efficient resolution of problems in quarantine management. Furthermore, most influential participants in communication network were identified, such as chief decision-maker and specialized functional managers (e.g., medical and livelihood management).

**Conclusion:** Local public health workers and professionals should actively utilize closed-type SNS, for the purpose of communicating effectively within a response team and manage efficiently the quarantines in a public health emergency.

.....  
**Keywords:** Closed-type SNS, Internal communication, Quarantine management, Public health Emergency, MERS-CoV, Content analysis, Social network analysis, mhealth

**Student Number:** 2015-24004

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# 1. INTRODUCTION

## 1.1 Background

The outbreak of Middle East respiratory syndrome coronavirus (MERS-CoV) in the South Korea in 2015 resulted in 186 confirmed cases, with 38 fatal cases (20.4%) in a two-month [1, 2]. The total number of close contacts was 16,693 in this outbreak, and they conducted a self-quarantine at their home for 14 days after the last contact with a MERS-CoV patient [3]. Especially in G District of Seoul, 7 patients have been confirmed, including 3 deaths (42.8%). It has been the largest contact management among the local government, with 4,479 people in contact monitoring (approximately 11.7% of the whole country), among them, 963 under home quarantine [4].

Closed-type social network service (SNS) has been utilized as a makeshift platform for the response team to communicate about their home quarantine management in G District. In order to manage these large-scale close contacts to a MERS-CoV patient, G District put in about 400 staffs to work on 1:1 monitoring activities by taking all the administrations of the local government [4]. However, lack of prepared guidelines for contact management or a social support system for close contacts, these measures for the massive number of contacts caused a considerable deal of confusion in the field [3, 5]. In particular, when an unexpected problem occurred during monitoring period, it was difficult for a monitoring staff to cope with him- or herself. To solve these problems, cooperation and communication with

various departments in the response team were urgently needed. In this situation, G District created the Naver Band, a kind of closed-type SNS, as a temporal internal communication channel within the response team for a specific problem or task and began to rely on SNS as an substitute source of information related to MERS-CoV. SNS has been broadly defined as “web-based services that support individuals to build knowledge and disseminate information within a confined system”[6]. Thus, in G District, this closed-type SNS became an ad-hoc avenue through which to communication with and learn from others about their problems, by being used for real-time Question & Answer and systematic information sharing related to the home quarantine management.

In general, the importance of communication has been emphasized in the public health emergency response. With advancing industrialization, increasing urbanization, and growing awareness of complicating factors, all nations have been challenged by public health emergencies that have the capacity to adversely influence the security of populations [7-9]. After the influenza pandemic, particularly, governments and health agencies worldwide has recognized the significance of public communication during an outbreak, and need for the emerging infectious disease communication was arisen [7, 10, 11].

Communication in public health emergency response has been largely divided into risk communication and crisis communication. One of the principal differences between crisis communication and risk

communication refers to their origins [12]. Crisis communication is generally related to public relations, and is based on efforts to strategically manage and build awareness of the framework to reduce harm to both organizations and stakeholders [13]. In contrast, risk communication involves identifying risks to public health and encouraging the public to adopt healthier, less risky behaviors [14]. Furthermore, there have also been efforts to combine the concepts of crisis communication and crisis communication into those depicted as crisis and emergency risk communication (CERC). [12]. Specifically, risk communication has been proven to be an important component of emergency operations plans, and is still another area in which positive existing relationships and cooperation enable more effective emergency response. To achieve this, it is crucial that an evidence-based and coordinated information is shared in a timely and accurate way [15]. Also, risk communication would be particularly effective by building on existing relationships and collaborations, not only with the media but also with other agencies and stakeholders [16].

In addition, it has been known to be important to plan for field-level group communication in preparedness for the emergency response [17, 18]. World Health Organization (WHO) 's Emergency Response Procedures [19] indicates that "the Global Emergency Management Team (GEMT) is responsible for ensuring the expedited clearance and dissemination of internal and external communications within 24 hours, including to establish mechanism for information sharing, such as web sites, share point, e-mail and contact lists. During an emergency, a

subset of the GEMT, known as the GEMT-Response (GEMT-R), comes together to grade and manage the response to a specific emergency. The GEMT-R is responsible for ensuring that communications are fast, reliable and unencumbered by extended clearance procedures. Where there is the potential for substantial risk to public health, the GEMT-R should ensure that available information is rapidly shared both internally and externally, and that on-going and regular communication occurs as new information becomes available”.

However, there is currently little analysis in the scholarly literature about the internal communication related to the infectious disease emergency response process, specifically at the field level using SNS [20]. Previous studies on communication in public health emergency response has largely concentrated on risk communication as a kind of external communication to the public [7, 10-14]. In addition, it has comprehensively targeted of all-hazards emergency risk management [19], including emerging infectious diseases epidemic as well as natural disasters, zoonosis, food safety, chemical, biological, radiological, nuclear and explosive hazards [17, 18].

It is widely believed that effective communication is critical for the containment of the spread of emerging infectious diseases [21]. In particular, an active internal communication within the response team is significant for management of contacts [3, 8]. Since MERS-CoV is an emerging infectious disease spreading person-to-person that does not have vaccines and antivirals, the only way to contain the epidemic

is to block the spread of new patients [1]. Contact management is a fundamental factor of the public health response to a MERS-CoV, and is needed for an effective quarantine to prevent the transmission of epidemics [22], that is, the ultimate goal of quarantine is to disconnect and restrict the movement of activities of persons who have been exposed to infection, in order to stop transmission of diseases [23]. Moreover, because persons who have been exposed to MERS-CoV may require to stay in quarantine for as long as 14 days, it is critical to make certain that home environment meets the ongoing medical, and mental/behavioral health needs of these impacted individual [23, 24]. For that reason, cooperation through group communication in the response process should be emphasized at the field level, in order to achieve the end of transmission through effective quarantine management [8].

The case of SNS communication in G District is the valuable experience suggesting a specific situation of internal communication for quarantine management in the public health emergency. As lack of coordination and internal information deficit can be a major source of internal confusion and embarrassment for a response team [20], establishing and accessing a stable communication infrastructure at emergency response is crucial in order to exchange information accurately and in real time [18].

Therefore, the purpose of this study is to conduct in-depth analysis of what aspect of internal communication using SNS contributes to

quarantine management; that is, it is to provide a general overview of the internal communication using SNS and its current capabilities for quarantine management.

Broadly speaking, an internal communication can be defined as “the process by which activities of an organization are collected and coordinated to reach the its goals, taken place within an organization” this is, “it is the information flow that takes place in an organization, and the flow of information has a structure, direction and process” [25, 26]. Accordingly, this study mainly explores the attributes of SNS posts in terms of structure and direction and attempts to find underlying process of communication.

Additionally, one of the most direct method to study organizational communication is to identify communication network that exist among organizational members. In communication network analysis, it allows a researcher to study the interactions of communication in an organization and discover its network, by identifying the relative relationship and the influence of others, based on the interest in the communication interaction of the members [27, 28]. Thus, this study performs the network visualization to emphasize the important information contained in the hidden SNS posts and identifies who played a significant role in the internal communication network.

Through it, the researcher discuss the benefits, limitations and prospects of the communication method using SNS for quarantine management.

The ultimate goal of this study is to impart evidence for developing appropriate SNS communication strategies within the response team for management of the close contacts in preparation for an emerging infectious disease emergency in the future.



## 1.2 Objectives

The empirical case in G District allows exploration of several aspects of the internal communication using SNS at a public health emergency response. This study provides an overview of the SNS posts communicated for quarantine management, and attempts to describe these communication method's potential for influencing quarantine management.

The specific objectives of this study are as follows.

First, confirming the need to communicate using SNS by examining the increased demand for communication within the response team for the management of rapidly increased quarantines

Hypothesis: The more persons in home quarantine, the greater the number of posts to the Band.

Second, describing the structural and directional attributes of communication, by analyzing both of the writer and contents of the SNS posts through qualitative content analysis

Hypothesis: The structure & direction of communication evolve over time in response to changing needs for quarantine management

Third, demonstrating the achievement of communication using SNS by measuring that the adapted communication process contributes to

the efficiency of problem solving through quantitative content analysis

Hypothesis: In the beginning, the question & answer of the problem situation is longer, but in the latter period, the discussion is relatively briefly finished by the quick solution based on the self-experiences

Forth, identifying who is influential participants in the SNS communication for problem solving among the response team through the social network analysis

Hypothesis: There is a difference of participant's role who is in a prominent position between levels, in the various levels of communication networks for quarantine management

## 2. METHODS

### 2.1 Materials

#### 2.1.1 Brief summary about the general aspect in Naver Band

The Naver Band is a leading closed-type social networking service (SNS) in Korea, which was first released by Camp Mobile on August 8, 2012, and operates as an invite-only platform for both iOS and Android. As of 2016, there are seven languages available, including English and Korean, and currently has 35 million users worldwide [29].

The main functions are as follows [30]. 1) Bulletin board: It is possible to post a message in the form of a timeline, and the latest article is posted at the top. Among the attached files, multimedia files and files in Microsoft Office format can be previewed. 2) Member: Users can invite specific members to the Band and manage the address book of the members who are members of the Band. Invitations can be easily invited by connecting with other Messenger friends such as Line, Kakao Talk, Facebook friends, etc., 3) Photo album: Users can post photos that can be shared by the Band members and upload up to 100 photos at a time.

### 2.1.2 “MERS Knowing correctly” (In Korean, “메르스 바로 알기”)

The Naver Band 'MERS Knowing correctly' was formed on June 9, 2015 by the G District, Seoul, and is being used as a real-time communication channel for quarantine management until now. This Band was established with the expectation that information obtained by 1:1 monitoring activity would be shared to enable better contact management.

The number of members who signed up is 397 persons, including monitoring staffs and all of the public health workers in G District community public health center, and it is with a total of 662 posts, as of August 3, 2016.

The main contents of this Band are about home quarantine case management and its database accumulation, or real-time information sharing related to MERS-CoV contact management [4].

The study proposal was submitted to the community public health center in G District for review and approval to use the research materials and the study was approved by Seoul National University Institutional Review Board (IRB No. E1609/003-009).

**16** **↗No.16 Monitoring staff** 2015년 6월 12일 오후 6:53 · 84읽음

↳ Read by 84 persons

연번 108번 환자 관련해서 문의 드립니다

보호자 어머니 얘기로는 경희대 병원 방문 이전에도 계속 열감기증세로 고생하였는데,  
(6월 6일 경희대 병원 응급실 방문시, 폐 엑스레이 결과 아무 이상 없었고 의사선생님께서도 그냥 조금 쉬면 나을거라고 진단하셨다고 합니다)  
그러나 현재 보호자는 이런 증세가 2~3주 지속된바 있어 진료를 받아야 할것같다고 불안해하십니다

↗No.11 Functional manager (medical support)

어제 11 의사선생님께서 직접 방문하셔서 아이의 검체를 채취하시고 봐주신 바 있는데(결과대기중)

격리대상자인 어머니와 108번환자가 병원에 가야하는지  
아니면 비격리대상자인 아버지와 108번환자가 가야하는지  
혼란이 있습니다  
답변을 부탁드립니다

↗ Expression by 0 persons / 5 comments in this post  
표정 0 · 댓글 5

☺ 표정짓기    ☰ 댓글쓰기

↗No.17 Functional manager (medical support) 6월 12일 오후 7:21

**17** 당연히 아버지와 가야합니다. 격리는 타인을 위한 조치이므로..  
☺ 1 · 좋아요

↗No.1 Functional manager (SNS management) 6월 12일 오후 7:51

**1** 환자 보호자분께서 꼭 진료가 필요한 지 담당의사와 상의 한 후, 진로 알정이 잡히면 저희가 구급차로 진료를 받도록 도와드리겠습니다. 검사결과는 나오는데로 개별 연락 드리겠습니다. 감사합니다.  
☺ 2 · 좋아요

↗No.18 Monitoring staff 6월 12일 오후 8:27

**18** 1 멋진일을 하고 계십니다..  
☺ 1 · 좋아요

↗No.10 Public health director 6월 12일 오후 8:44

**10** 11 선생님께서 병원과 통화하여 내일 아침에 병원으로 가도록 조치하였습니다 ... 담당자 분이 동행하여야 하나 내일 시험장에 간다고 하셔서 보건소에서 동반하여 가도록 하겠습니다... 가족분과도 이야기가 되었습니다.  
☺ 1 · 좋아요

**16** 6월 12일 오후 10:19

감사합니다 ^^.  
☺ 1 · 좋아요

+ ☺ 댓글을 남겨주세요    보내기

Figure 1 Example of the Post ID. 42

Footnote: The monitoring staff is asking for help to solve the problem for person quarantined at home, by writing post with the keyword ‘Question’

## 2.2 Content analysis

### 2.2.1. Description of the methodology

Content analysis as a study method is known to be “a systematic and objective means of describing and quantifying phenomena” [31]. Content analysis can be applied to either quantitative or qualitative data and in an inductive or deductive approach. Content analysis is an adjustable research method, which makes the researcher challenged now that there are no simple guidance for data analysis [32].

The application of inductive content analysis is recommended when there are no previous researches coping with the phenomenon or when knowledge is disintegrated. The categories are originated from the data in an inductive way [33]. An inductive approach is carried from the particular to the general situation, for the purpose that specific cases are observed and then integrated into a larger overall or general description [34].

In Figure 2, the qualitative content analysis processes in the inductive approach are illustrated as three main phases: preparation, organizing and reporting. In this study, the data of SNS posts is analyzed according to the inductive content analysis process proposed by Elo & Kyngäs (2008) [33].

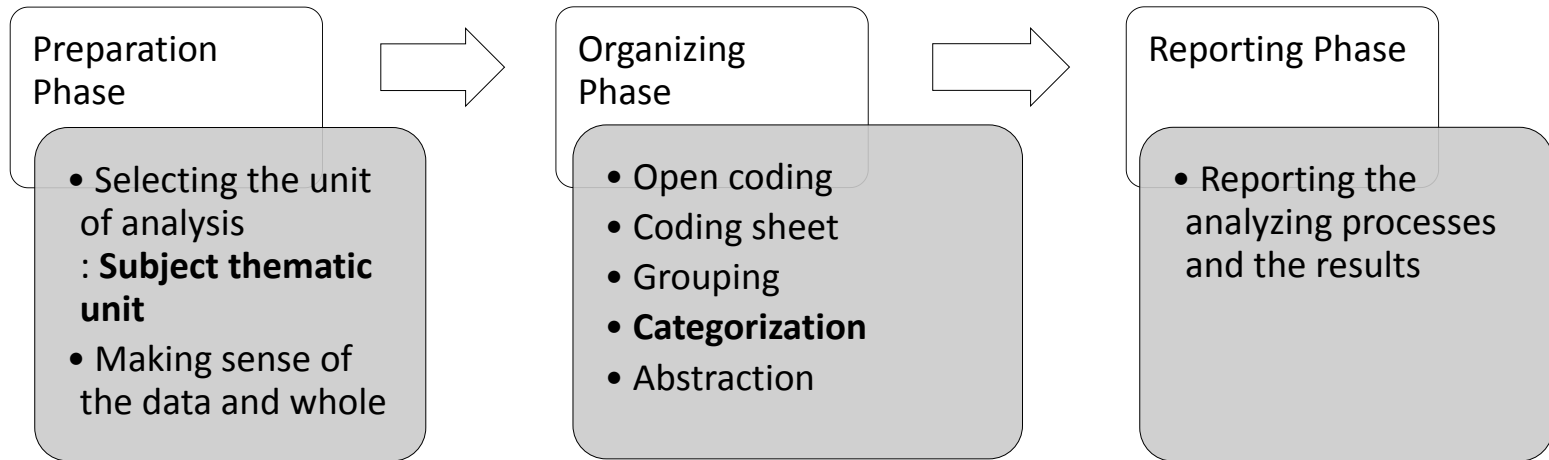


Figure 2 Qualitative Content Analysis Process in the Inductive Approach (Elo & Kyngäs, 2008)

A Unit of analysis in content analysis can be explained as “a discretely defined element of content” [35]. It refer to that unit which the researcher have selected for content analysis, each unit producing one text, and it can be selected among a word, sentence, paragraph, or other elements with a definable physical or temporal boundary [35].

There are two main types of analysis units used in content analysis.

One is the physical units. The most basic physical units are time and space measures of content. Measuring text and still visuals, for example, may involve counting the number of stories and photos, and these will occupy physical space in a content form measured by square inches or centimeters [35].

The other is the meaning units, which involves the syntactical unit, character unit and subject thematic units. First, syntactical units happen as discrete units within a language. The simplest syntactical unit in language is the word. In addition, sentence, paragraph, article, and book are also syntactical units naturally made in a language. Second, character units involve “some physical or temporal unit (e.g. event, people, objects, etc.) referred to within content” [35]. Character units involve measuring content about a person to whom the content refers. Finally, subject thematic units are best when the statements about objects take precedence over the objects themselves. A theme can be called as “an assertion about a subject matter” [36], or “a single assertion about some subject” [37].



### 2.2.2 Materials

The study object in the content analysis are 656 Naver Band posts, written from June 9, when the Band was opened, until October 30, when the epidemic was temporarily stopped. The study period is analyzed in 4 phases at intervals of 2 weeks as shown in Table 1.

The name of each phase was attached for the following reasons. Since the Band was established, communication started and became active during the first two weeks. Hence, this period of the name was set as the Introduction phase. The Expansion phase was set to the next two weeks, from June 23 to July 6, 2015, for it accounts for the need to manage an average of 271 home quarantine per day. The Decline phase was decided July 7 to 20, considering that July 20, 2015 was the day when all of them of G District were put out of home quarantine [4]. The Ending phase was set from July 21 to October 30, 2015, considering on October 29 at 24:00, in which was declared by the WHO as "the end of transmission" [38].

**Table 1 Study Object for Content Analysis (N=656)**

Phase	Introduction Phase	Expansion Phase	Decline Phase	Ending Phase
Period	6/9-6/22	6/23-7/6	7/7-7/20	7/21-10/30
The Number of Posts in Naver Band (posts)	326	208	40	82
The Mean of people who in Home Quarantine (persons)	298	271	29	0

### 2.2.3. Measurement

The content analysis process of this study is as follows:

Each post is coded for basic descriptive information, such as the post's writer, main content and comment. Based upon the preliminary review of posts during study design, the analysis unit is determined based on physical and meaning units [35].

Next, each post is coded and categorized according to the process of qualitative content analysis [33]. All of the coding protocol has been developed, based on 168 posts during the first week after the Band was opened. And then, this developed coding protocol is applied to the rest of the posts.

Specific coding protocols in this study are shown in Table 2 and 3.

In Table 2, coding protocol for the physical and meaning unit is presented. Post ID and Comment ID are coded by using a physical unit (place) [35]. As a single post could be divided into posts and comments, the Comment ID is assigned to each comment in each post, after giving the serial number on a post basis (Post ID). The creation date and time are coded by using a physical unit (time) [35]. They are recorded in date format (Year-Monty-Day) and time format (Hour:Min), respectively. The Participant ID is assigned to each writer in post and comment as a character unit [35]. The number of the Read by, the Expression and the Comment within each post is coded in numerical

form as a syntactical unit [35].

In Table 3, coding protocol for the subject thematic unit is shown. The open coding is conducted, focusing on the writer, main text and comment of posts as a subject thematic unit [35]; that is, notes and headings are recorded in the text while primarily reviewing these SNS posts. As many notes and headings as enough are written down in the margins to depict all aspects of the post's content. When this open coding is finished, the lists of categories are gathered under the parent heading [33]. Next, each category is given a title using content-characteristic words, and then a general description has been formulated finally for the writer in 3 levels, post in 8 types and comment in 7 types, respectively.

Table 4 shows an example of recording Post ID. 42 on a coding sheet.

**Table 2 Coding Protocol for Physical and Meaning Unit**

Observation Unit	Variable	Operational Definition	Recording Unit*
<b>Physical Unit</b>			
Place Unit	Post ID	Serial number of the posts	42
	Comment ID	Serial number of the comments within each post 0 = when it is an original post	1 0
Time Unit	Date	Creation date (Year-Month-Day)	2015-06-12
	Time	Creation time (Hour:Minute)	18:53
<b>Meaning Unit</b>			
Character Unit	Participant ID	Serial number of the writers	16
Syntactical Unit	#Read By	The number of the Read by within each post	84
	#Expression	The number of the Expression within each post	0
	#Comment	The number of the Comment within each post	5

\*Example of the recording unit in Post ID. 42

**Table 3 Coding Protocol for Subject Thematic Unit**

Variable	Operational Definition	Recording Unit
<b>Level of Writer</b>	- Monitoring staff	1
	- Functional manager	2
	- Public health director	3
<b>Type of Post</b>	- Monitoring staff ask a question on the problem situation	1
	- Manager provides a notification on changing instruction or action	2
	- Press release sharing (e.g., URL, attached pictures or files)	3
	- Feedback to monitoring staff about results of the consultation or treatment	4
	- Daily MERS statistics sharing in G District	5
	- Sharing the know-how or words of encouragement within monitoring staffs	6
	- Update response situation in G District	7
	- Monitoring staff suggests alternation to contact management	8
<b>Type of Comment</b>	- Answer to monitoring staff's questions	1
	- Words of comfort or encouragement	2
	- Thank you	3
	- Confirmation (e.g., copy that)	4
	- Get solved the problem situation in the Question post	5
	- Additional suggestions	6
	- Additional questions	7

Table 4 Coding Sheet as an Example of Post ID. 42

Post ID	Comm ent ID	#Read By	#Expre ssion	#Com mnet	Date	Time	Partici pant ID	Open Coding for Writer	Level of Writer	Open Coding for Post	Tyep of Post	Open Coding for Comment	Type of Comment	Note
42	0	84	0	5	2015-06-12	18:53	16	1:1 monitoring for home quarantine	1	Who should accompany when visiting a hospital	1		0	
42	1	.	1	.	2015-06-12	19:21	17	Medical Support	2		0	With father who was not quarantined	1	
42	2	.	2	.	2015-06-12	19:51	1	SNS management	2		0	Connect with medical team	1	
42	3	.	1	.	2015-06-12	20:27	18	1:1 monitoring for home quarantine	1		0	Good job	2	Mention 1
42	4	.	1	.	2015-06-12	20:44	10	Public health director	3		0	Will be given medical treatment tomorrow	5	
42	5	.	1	.	2015-06-12	22:19	16	1:1 monitoring for home quarantine	1		0	Thank you	3	

## 2.2.4. Analysis

### - Demand for internal communication in the response team

The ultimate goal of this analysis is to understand the demand for SNS communication in the response team for quarantine management. It could be confirmed by identifying the relationship between the number of posts and the number of people in home quarantine by date.

This analysis is performed, focusing on 41 days from June 9 to July 20, when from the date of the Band establishment to the date when all of the home quarantine was finished. Information on the daily number of people in home quarantine came from the 2015 G District MERS White Paper [4].

The variables are defined under the following assumptions. As the number of people under home quarantine increases, more efforts are needed to manage them [8]. Increased management requirements could be interpreted as demands for communication [21]. So, the demand for communication is operationally defined as the number of people in home quarantine and the number of SNS posts is considered as the amount of communication in reality.

The statistical analyses mainly used are ANOVA and were performed using statistical software SAS, version 9.4 [39]. One-way ANOVA was conducted to determine whether the daily number of people who in home quarantine affects the number of posts. As a factor, the daily number of person quarantined was divided into 3 levels of



150 persons—Small size was less than 150, medium was more than 150 and less than 299, and large was more than 300 people. Boxplots was drawn according to the sizes of population under quarantine to find the differences of response variable, which is the number of SNS posts. Two-way ANOVA was performed to find-out if the sizes of population under home quarantine and the written date affects the number of SNS posts. As another factor, the written date of posts was divided into 3 levels of 14 days.

3X3 factorial design was set and following model was fitted,

$$E(y_{ij}) = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij}, i=1,2,3, j=1,2,3$$

Using reference cell model.

	$j=1$	$j=2$	$j=3$
$i=1)$	$\mu + \alpha_1 + \beta_1 + (\alpha\beta)_{11}$	$\mu + \alpha_1 + \beta_2 + (\alpha\beta)_{12}$	$\mu + \alpha_1$
$i=2)$	$\mu + \alpha_2 + \beta_1 + (\alpha\beta)_{21}$	$\mu + \alpha_2 + \beta_2 + (\alpha\beta)_{22}$	$\mu + \alpha_2$
$i=3)$	$\mu + \beta_1$	$\mu + \beta_2$	$\mu$

(Reference cell;  $\mu = E(y_{33})$ : *Mean of  $i = 3, J = 3$* ).

## - Structural attribute of SNS communication

The purpose of this analysis is to observe the role differentiation over time and to identify the relationship between roles of the participants in SNS communication within the response team.

The analysis processes is as follows. First, posts are separated by the creation date. Next, I check the role of the writers who participated in SNS communication on that day. When a non-existing writer appears, a new role is assumed to have occurred on that date. Finally, the frequencies of participants' roles are computed according to each date and the communication process is illustrated in the figure.

More specifically speaking on above analytic process, the writer can be set as a character unit [35] and be given a serial number as the Participant ID in each of the posts and comments. Open coding for writers is conducted, using the content of the post and comment as a context unit. Context units are the content elements that should be examined to appropriately assign content to recording units [35]. After grouping the results of open coding for writers, roles of the writers were largely categorized into 3 level as followed: 1) monitoring staff who takes a role to monitor the close contact to maintain a home quarantine, 2) functional manager who plays a role to support of contact management in different functions, 3) control tower that is a public health director in G District community health center. The abstraction could be performed focusing on the functional manager, because there were various roles observed only in level 2. Sub-

categories with similar roles are grouped together as the components [33]. It is conducted by gathering similar roles together in functional managers. The process of abstraction continued as far as is attainable and reasonable. Finally, frequencies of persons who participants in SNS communication are computed according to each of the levels and roles that accumulated over time [35] and I draw the communication process by focusing on showing the relationship between roles among the response team [40].

The statistical analyses of this study were performed using statistical software SAS, version 9.4.

### - Directional attribute of SNS communication

The purpose of this analysis is to understand the content of the post in terms of information flow within levels and to confirm the change of direction of information flow according to the phase previously considered in Table 1.

The analysis processes is as follows. First of all, the keywords is assigned to the type of post previously recorded in 8 types and it summarizes the operational definition of post type as shown in Table 5. For example, when a type of the post is recording unit 1, it is given a keyword as the Question and recording unit 2 is labeled as the Notice. Next, I try to find-out an information flow in each keyword according to the level of writer as shown in Figure 3. It is the information flow that happens within the response team, and the flow of information has got a structure, direction and process [41]. Ultimately, the keywords of the post could be grouped into three directions-upward, downward and horizontal communication.

The name of each direction was attached for the following reasons. Upward communication has got an information flow from the lower levels of a hierarchy to the upper levels [25], so the Question and Suggestion of keyword are assigned to the upward communication. On the other hand, downward communication is introduced by the upper level and then filters downward by way of “chain of command” [25], so the Notice and Feedback of keyword are set to the downward communication. Finally, horizontal communication is the exchanges

within and among writers on the identical level of the response team [25], so the Know-how, Report, Statistics, Situation keyword are assigned to the horizontal communication.

The statistical analyses mainly used in this study were frequency test [35] and were performed using SAS, version 9.4. First, frequencies of keywords are computed according to each of the phases and the Fisher exact test is conducted to check whether there is a relationship between frequencies of the keywords and phase. Additionally, the frequencies of directions are computed according to the phases, and it is intended to understand how three directions of the information flow changes by phase. The Fisher exact test is also performed to analysis whether there is a relationship between frequencies of the directions and phase.

**Table 5 Direction of Information Flow by Keyword of the Posts**

Recoding Unit	Operational Definition	Keyword	Information flow	Direction
1	Monitoring staff ask a question on the problem situation for person quarantined at home	Question	1->2/3	<b>Upward</b>
8	Monitoring staff suggests alternation to contact management	Suggestion	1->2	
2	Manager provides a notification on changing instruction or action	Notice	2->1	<b>Downward</b>
4	Feedback to monitoring staff about results of the consultation or treatment from medical support manager	Feedback	2->1	
6	Sharing the know-how or words of encouragement within monitoring staffs	Know-how	1->1	<b>Horizontal</b>
3	Press release sharing (e.g., URL, attached pictures or files)	Report	2->1/2	
5	Daily MERS statistics sharing in G District	Statistics	2->1/2	
7	Update response situation in G District	Situation	2/3->1/2	

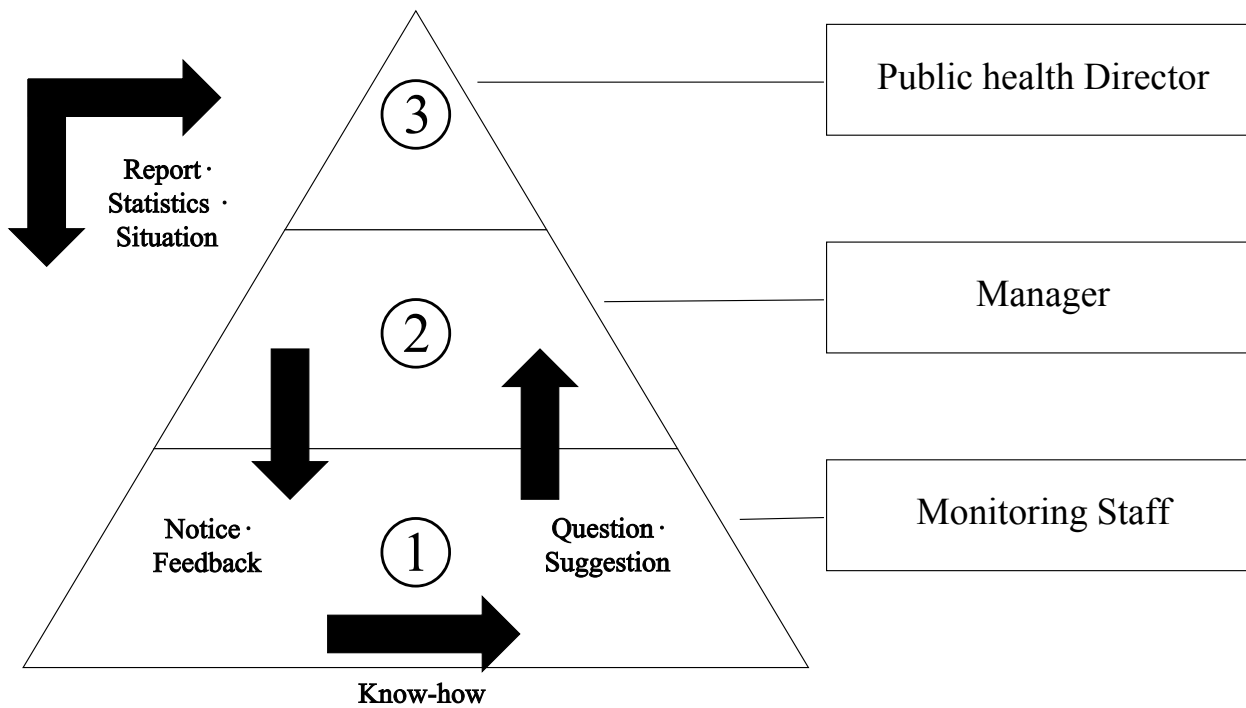


Figure 3 Direction of Information Flow in level of participants

### **- Achievement of internal communication in the response team**

The purpose of this analysis is to identify the change of the times spent solving problems over time, and to confirm the efficiency of problem solving.

The object of this analysis is 105 posts with creation time among 114 posts with the keyword 'Question'. The analysis period is from June 9, when the Band was opened, to July 4, when the last post was written.

The specific analysis processes is as follows.

First, the creation time of posts and comments could be recoded in a physical unit (time) [35]. This was possible because the Naver Band provides a function to display the creation date and time whenever members write post or comment on a post [30].

Next, the first comment time and the time spent solving problems are computed, respectively. The time spent on solving the problem is calculated as the difference between the posting time and the time, at which the comment suggests that the problem situation has been solved, was made. And it is recorded in the form of 'hour: minute'. Here, the comment suggesting that the problem situation has been solved, is operationally defined the case where the monitoring staff wrote the comment that their problem was solved, or the comment of the functional manager was sufficient and no further comments were made. The time spent on reply the first comment is computed by



subtracting the first comment time from the posting time, and also recorded in the form of 'hour: minute'.

Finally, using the median value, the first comment time and the time required to resolve the problem are calculated on each time period. Reasons for using median as a value presenting each time period are as follows. If midnight is posted at a late hour, or if it is time-consuming to resolve a problem (for example, the cost of living is related to banking hours), the time required would inevitably increase. These cases make it meaningless to calculate the average time by acting as an outlier. Since the mean is particularly sensitive to outliers, the median is presented as “an alternative and more robust measure of dispersion that is easy to implement [42]”.

The statistical analyses were performed using SAS, version 9.4.

## 2.3 Social network analysis

### 2.3.1. Description of the methodology

One of the most direct methods to study organizational communication is to identify communication networks that exist among organizational members. In communication network analysis, it allows us to research the interactions of communication in an organization and discover its network, by identifying the relative relationship and the influence of others, based on the interest in the communication interaction of the members [27].

Social network analysis is the process of identifying the communication roles of the individuals in the network and measuring the indicators of the communication structure. Through this, it is an approach to understand the patterns of relationships among members of society and to explain their impact on individual social behavior [28].

Communication networks can be presented by a vertex representing the member of a specific group participating in communication and an edge representing the connection relationship between the vertices. The vertex is an individual who is engaged in an interactive activity, but may also mean the group or groups that is a higher concept. The edge, which represents the connection relationship between vertices, means a communication relation such as information exchange between organizations [43].

Through network analysis, we can find which members played

an important role by calculating the centrality and the underlined communication structure.

Among the various centrality, the degree centrality is simply stated as the degree of each vertex, that is, “the degree of a vertex is the number of ties it has with other vertexes” [28].

Following the notation [44], degree centrality is defined as :

$$C_D(n_i) = d(n_i)$$

It is intuitive to understand that a participant of network who is associated with many other network participants is in a prominent position. For non-directed networks, this type of actor can be said to have high centrality, or that to be centrally located [44].

### 2.3.2 Materials

The study object in social network analysis is 27 posts with the keyword 'Question', written during the first week after the band was opened.

The reasons for selecting the study object as the Question post and the first week are as follows. First, since the purpose of this analysis is to find out which participants has had a great influence on problem solving in quarantine management process [44], the researcher focus on the posts with the keyword 'Question', which is a request for help on the problem situation related to their quarantine management. Second, since the first week after opening was the most dynamic period and became stable after then, the researcher determined that the first week is sufficient as a saturated point of the problem situations. This could be explained by the fact that during the previous content analysis, the first week's post was sufficient to develop the coding protocol and there was no difficulty in coding the rest of the postings [35].

### 2.3.3. Measurement

Using the results of the previous content analysis, the researcher coded vertexes, edges and their attributes, which are data of social network analysis [28]. The vertex is coded the participants in SNS communication as a Participant ID, and the edge is coded by source and target as a kind of relationship, appears when someone replied in the post as a kind of relationship. Also, the level of writer is coded as a vertex attribute, which means a level of role in response team. And vertexes are labelled as a Participant ID so that a network graph is easier to interpret who makes up the network [45].

### 2.3.4. Analysis

#### - Magnitude of the influence of participants in communication network

The vertex and edge data are transformed to the network object. Adjacency matrix without direction is constructed by date and for 7days, respectively.

The degree centrality, which is an indicator of how influential a vertex in a network [44], is calculated to determine which vertex plays a key role and the degree of role of the hub vertex [27]. The network visualization is performed to capture the essential information held in the concealed data, by plotting a network graph [28].

The statistical analyses of this study were conducted using statistical software R, version 3.2.4 [46]. The statnet and igraph package is a user-friendly software, which easily enable to control network object and conduct network visualization & description [45].

## 3. RESULTS

### 3.1 Demand for internal communication in the response team

In Figure 4, the distribution of the number of SNS posts and the number of people in home quarantine by date has been presented, from May 20 to October 30, 2015. It was evident that the number of person quarantined and the number of SNS posts were concentrated at the same time.

In Figure 5, the results of one-way ANOVA test are presented in forms of boxplots. There was statistically significance in differences of the number of SNS posts according to the sizes of population under home quarantine (F-value=19.09, degree of freedom=2, 38, P-value<.0001). It could be interpreted that the more persons in home quarantine, the greater the number of posts to the Band.

In Figure 6, the results of two-way ANOVA test is shown in forms of interaction plot. The sizes of population under home quarantine and the written date of SNS posts were found to have a statistically significant impact on the number of SNS posts (F-value=9.94, degree of freedom=5, 35, P-value<.0001). Larger size of quarantines were more likely to have much SNS posts regardless of time period.

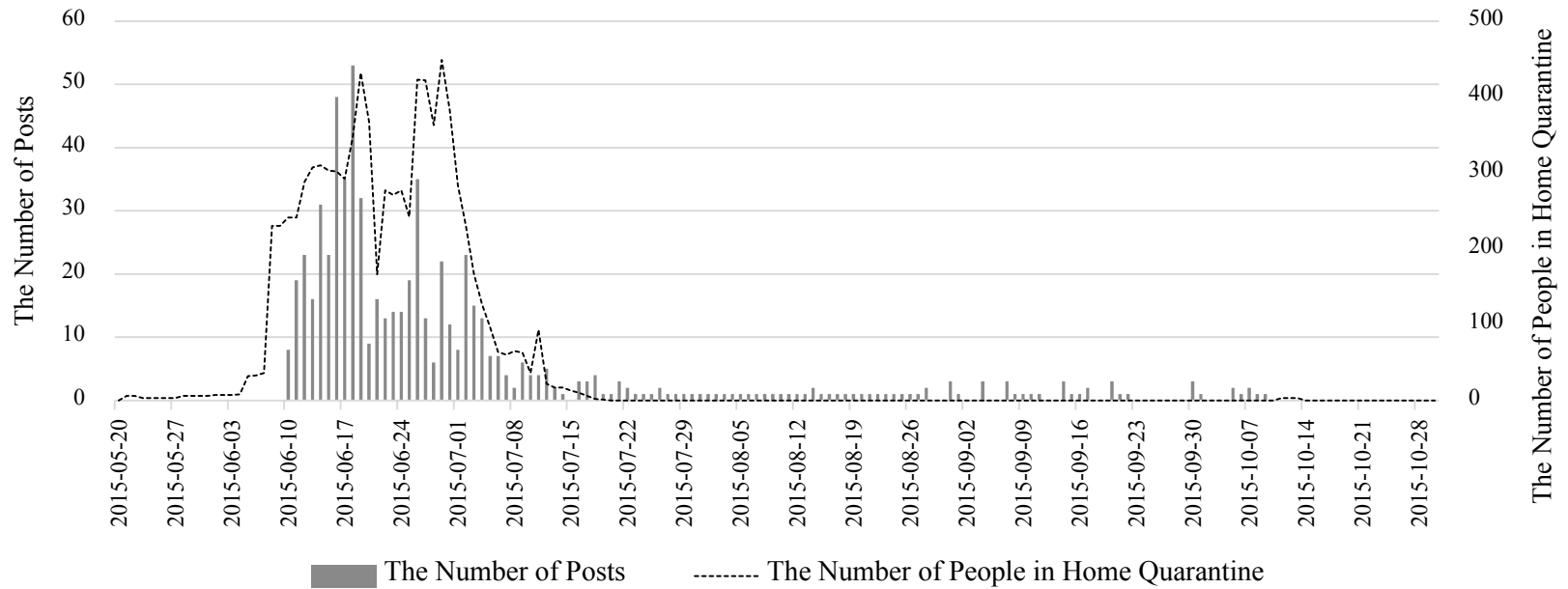
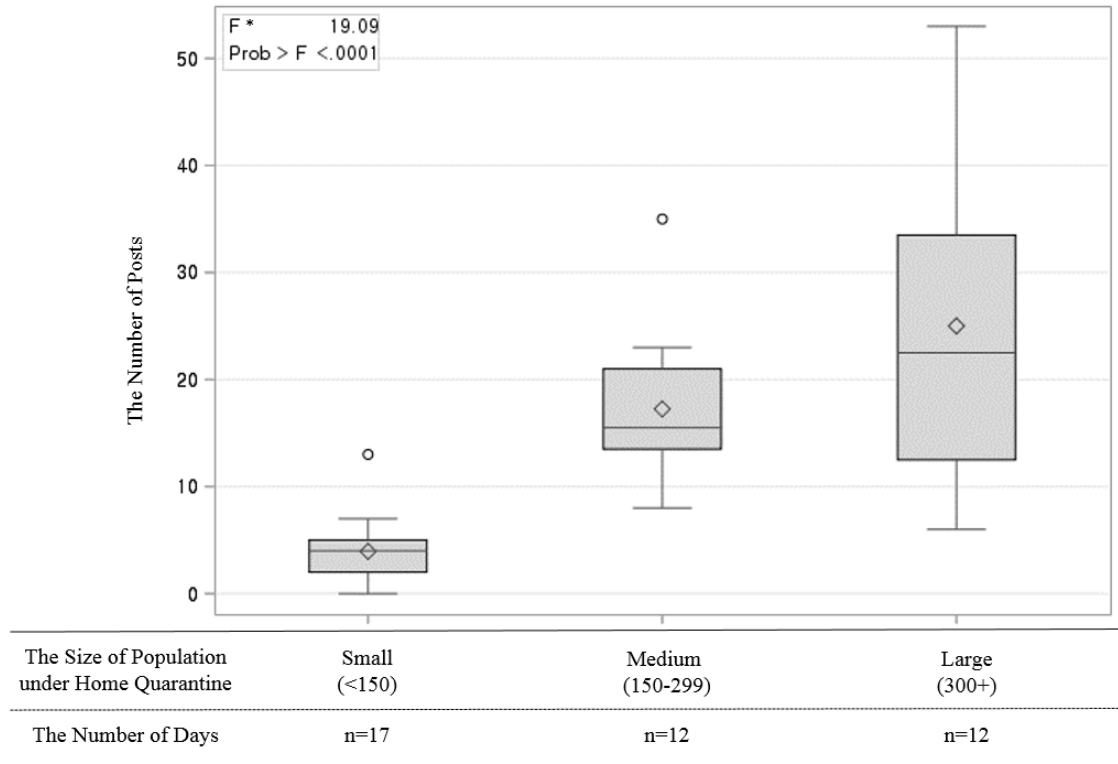


Figure 4 Distribution of the Number of SNS Posts and the Number of People in Home Quarantine by Date





\* Calculated using the One-way ANOVA test.

Figure 5 Differences of the Number of SNS Posts between the Sizes of Population under Home Quarantine, during 41 days from June 9 to July 20, 2015

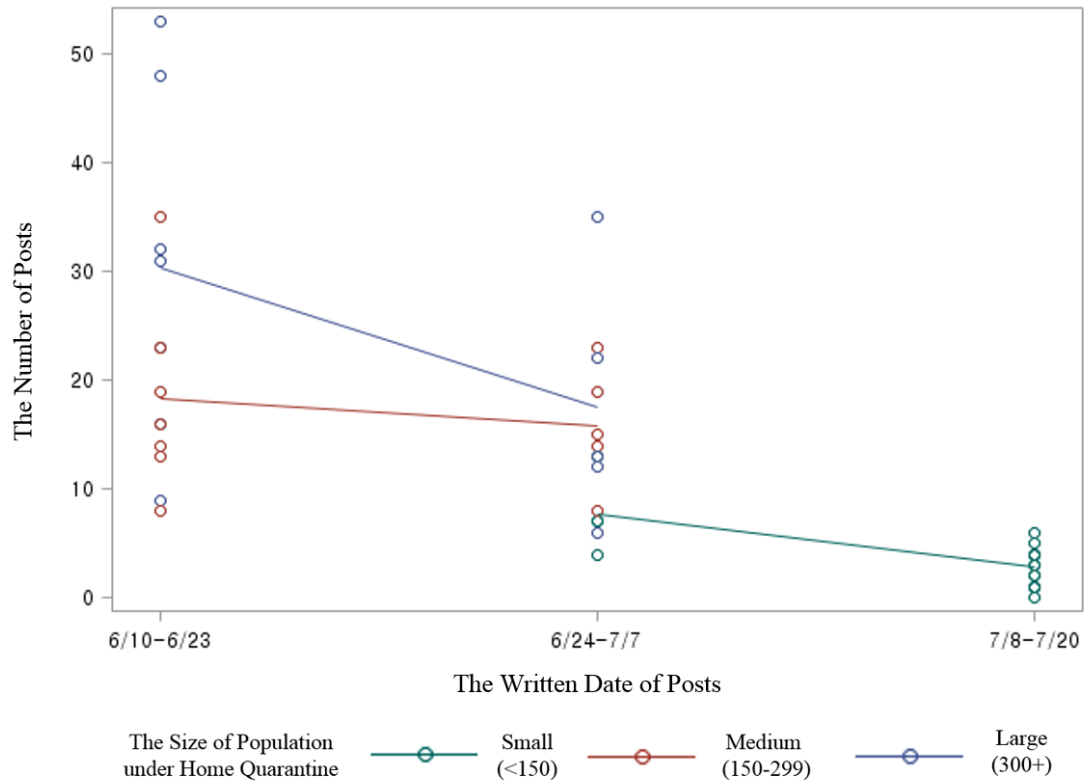


Figure 6 Interaction Plot of the Number of SNS Posts with the Sizes of Population under Home Quarantine, during 41 days from June 9 to July 20, 2015

## 3.2 Structural and directional attribute of SNS communication

### 3.2.1 Structural attribute of SNS communication

In Figure 7, it shows the role of the participants in SNS communication within the response team appearing over time, from the date of Naver Band establishment, June 9, 2015. Public health director in G District participated in SNS communication at the next day of SNS establishment, June 10, 2015. In functional manager, the first role that appeared is in charge of the coordination with school. The next day, June 11, 2015, functional managers had been emerged in 'Daily necessity support' and 'Medication use support'. Functional manager in reporting daily MERS statistics in G District was appeared on June 16, 2015.

In Table 6, total 129 persons were ultimately participated in SNS communication. The role of the participants could be largely divided into 3 levels. In level 3, public health director in G District community health center played a role as the control tower (0.8%). 34 persons played a role as the functional manager (26.4%) in level 2 and they could be separated with 5 components and 14 roles in detail. In particular, the Medical management was the largest component of level 2, including 13 persons (38.2%). 94 persons participant in monitoring activity for close contact management (72.8%) in level 1.

In Figure 8, communication process has been presented, focusing on showing the relationship between roles among the response team.

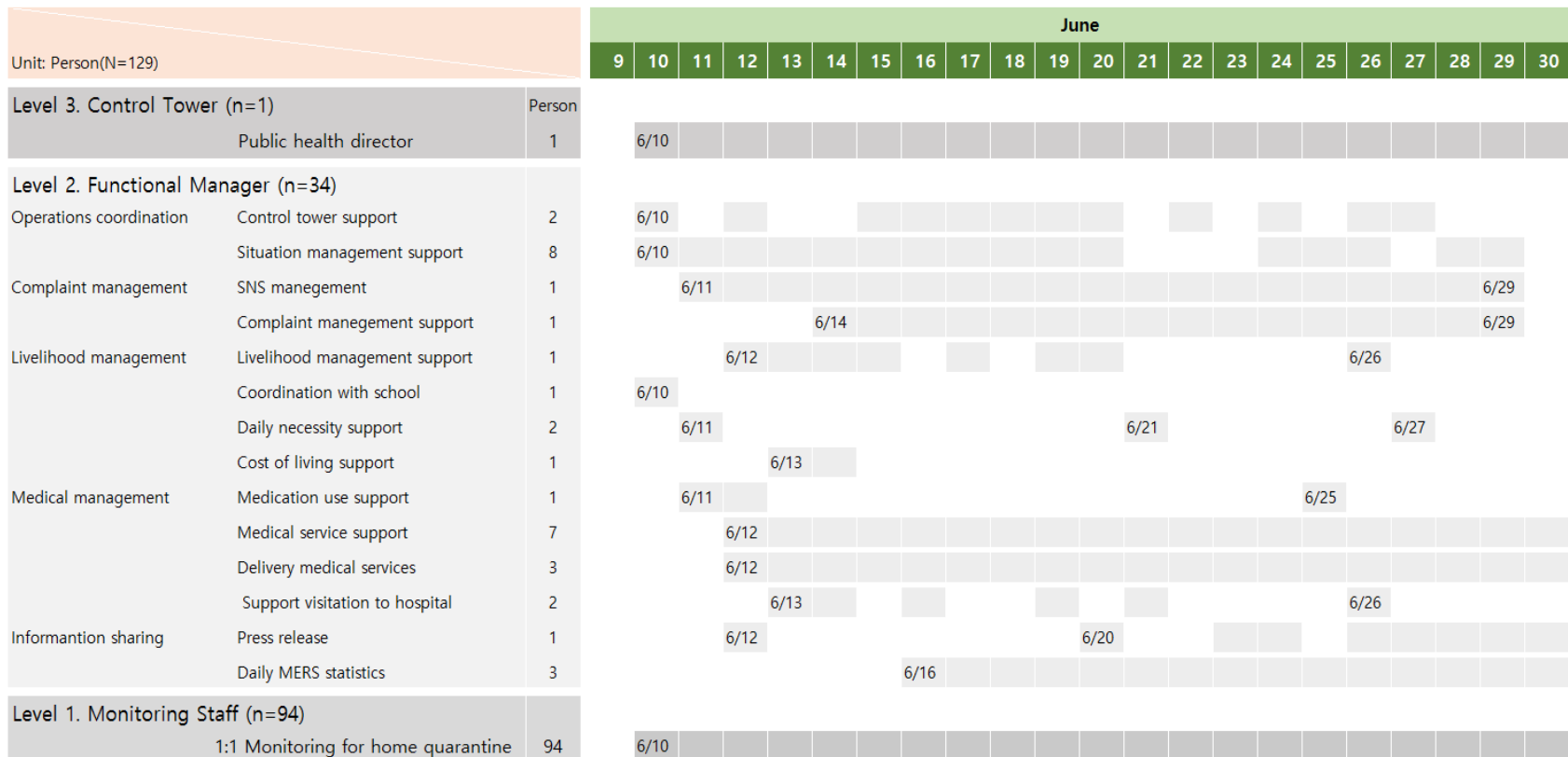


Figure 7 Role of the Participants in SNS Communication within the Response Team by Date



**Table 6 Frequencies of Roles in SNS Internal Communication**

Level	Role	Persons
<b>Level 3. Control Tower (n=1, 0.8%)</b>		
	Public health director	1
<b>Level 2. Functional Managers (n=34, 26.4%)</b>		
Operation coordination	Control tower support	2
	Situation management support	8
	Subtotal=10 (29.4%*)	
Complaint management	SNS management	1
	Complaint management support	1
	Subtotal=2 (5.8%*)	
Livelihood management	Livelihood management support	1
	Cost of living support	1
	Daily necessity support	2
	Coordination with school	1
	Subtotal=5 (14.7%*)	
Medical management	Medical care service support	7
	Delivery medical services (Doctor)	3
	Support Visitation to hospital	2
	Medication use support	1
	Subtotal=13 (38.2%*)	
Information sharing	Press release (e.g., URL, attached files)	1
	Daily MERS Statistics	3
	Subtotal=4 (11.8%*)	
<b>Level 1. Monitoring Staff (n=94, 72.8%)</b>		
	1:1 Monitoring for home quarantine	94
<b>Total</b>		<b>129</b>

\*Percentage of persons in each part within level 2.

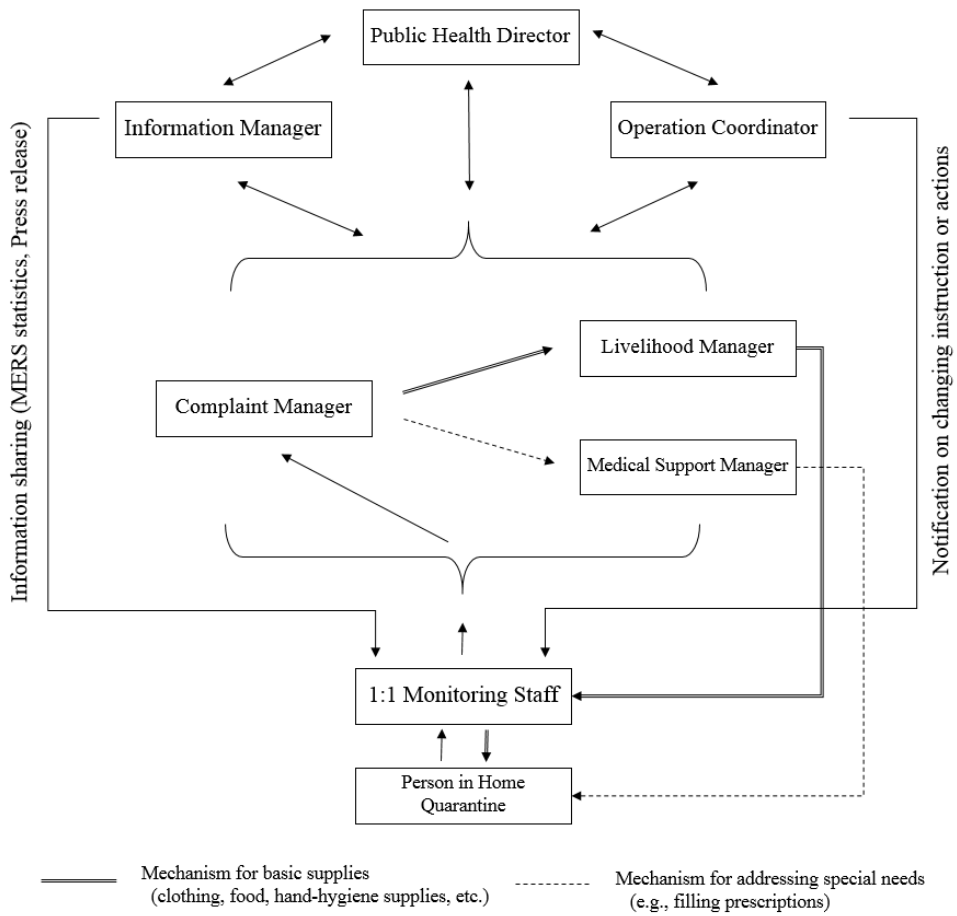


Figure 8 SNS Internal Communication Process within the response team

### 3.2.2 Directional attribute of SNS communication

In table 7, frequencies of keywords by phase period had been presented. As a whole, the Feedback post has the largest number (288/656, 43.9%), among all of the keyword, followed by the Statistics (116/656, 17.7%), and the Question post (114/656, 17.4%), respectively.

In terms of the phase, the Introduction phase accounted for more than half of the total posts (326/656, 52.1%). Then, the Notice and the Question post were most often written in the Introduction phase, (53/326, 16.3%), (41/326, 12.6%), respectively. Most of the keywords were coded as either the Repot or the Question in the Expansion phase. These two keywords combined to account for just over 75% (158/208, 75.9%). The Statistics post includeed most of the ending phase (72/82, 87.8%).

Table 8 shows the frequencies of communication directions according to the phase. Most of communication directions in the Introduction phase were coded as downward communication (253/326, 77.6%). In the Expansion phase, downward communication comprised the largest subgroup, followed by upward and horizontal communication. Horizontal communication was the most common under the Decline (37/40, 92.5%) and Ending phase (80/82, 97.5%).

In Figure 9, the distribution of how three directions of communication changed according to four phases has been examined,



compared to the mean number of person quarantined. It was mainly downward directions in the Introduction phase, but the trend had been changed into the upward and horizontal direction in the latter phase.

Table 7 Frequencies of Keywords by Phase, n (%)

Recording Unit	Total	Phase and Period				P-value <sup>a</sup>
		Introduction	Expansion	Decline	Ending	
		6/9-6/22	6/23-7/6	7/7-7/20	7/21-10/30	
<b>Upward Communication</b>						
Question	114 (17.4)	41 (12.6)	72 (34.6)	1 (2.5)	0 (0.0)	<.0001*
Suggestion	5 (0.8)	2 (0.6)	1 (0.5)	0 (0.0)	2 (2.4)	
<b>Downward Communication</b>						
Notice	59 (9.0)	53 (16.3)	6 (2.9)	0 (0.0)	0 (0.0)	<.0001*
Feedback	288 (43.9)	200 (61.3)	86 (41.3)	2 (5.0)	0 (0.0)	
<b>Horizontal Communication</b>						
Know-how	20 (3.0)	4 (1.2)	3 (1.4)	10 (25.0)	3 (3.7)	<.0001*
Report	36 (5.5)	3 (0.9)	16 (7.7)	13 (32.5)	4 (4.9)	
Statistics	116 (17.7)	16 (4.9)	17 (8.2)	11 (27.5)	72 (87.8)	
Situation	18 (2.7)	7 (2.1)	7 (3.4)	3 (7.5)	1 (1.2)	
Total	326 (100.0)	208 (100.0)	40 (100.0)	82 (100.0)	656 (100)	

<sup>a</sup> Calculated using the Fisher exact test, \*Significant at p<0.05

Table 8 Frequencies of Directions by Phase, n (%)

Direction	Total	Phase and Period, n (%)				P-value <sup>a</sup>
		Introduction	Expansion	Decline	Ending	
		6/9-6/22	6/23-7/6	7/7-7/20	7/21-10/30	
Upward	119 (18.1)	43 (13.2)	73 (35.1)	1 (2.5)	2 (2.4)	<.0001*
Downward	347 (52.9)	253 (77.6)	92 (44.2)	2 (5.0)	0 (0.0)	
Horizontal	190 (29.0)	30 (9.2)	43 (20.7)	37 (92.5)	80 (97.6)	
Total	656 (100.0)	326 (100.0)	208 (100.0)	40 (100.0)	82 (100.0)	

<sup>a</sup> Calculated using the Fisher exact test, \*Significant at p<0.05

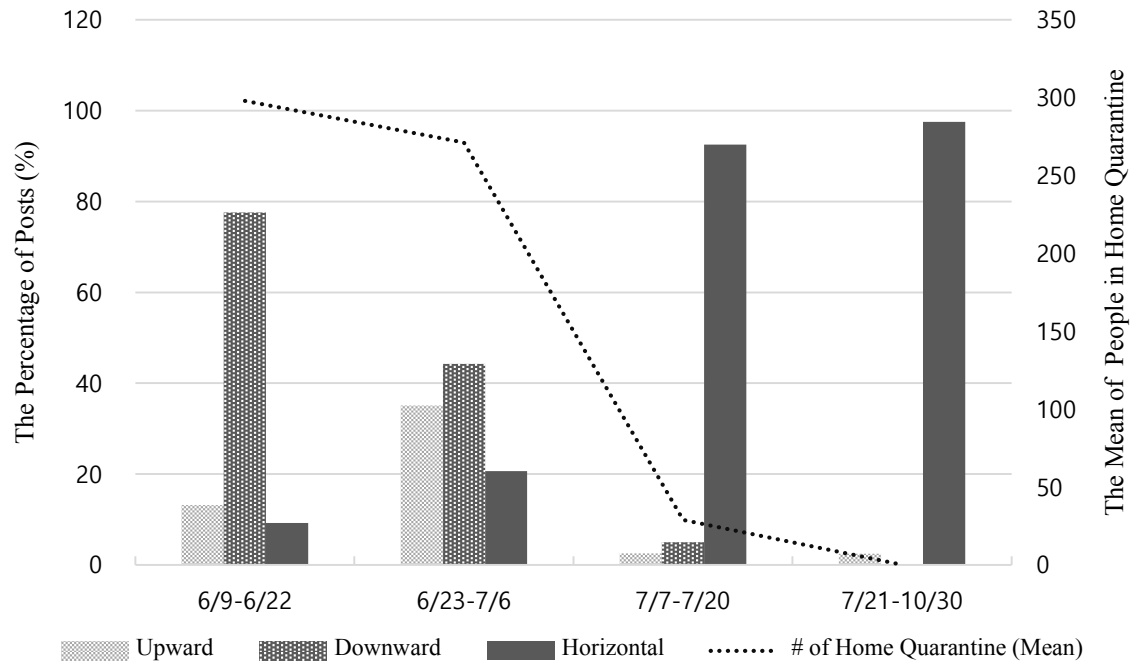


Figure 9 Distribution of Directions by Phase

### 3.3 Achievement of internal communication in the response team

The results of measuring the time required to post the first comment and solve the problem among the 105 Question posts with creation time are as follows in Table 9 and Figure 10.

In Table 9, the median of the first comment time required was 54 minutes and that of spent solving the problem was 1 hour and 27 minutes among the 105 Question posts which created from June 9, when Naver Band was opened, to July 4, when the last Question post was made. At the details by time period, the median of the time spent on posting the first comment was 30 minutes and that of solving the problem was 1 hours and 7 minutes for 5 days from the onset date, among the 15 Question post with creation time. The median of the time spent on posting the first comment was 1hour and 14 minutes and that of solving the problem was 2 hours and 26 minutes for 5 days from June 20 to 24, among the 18 Question post with creation time.

Figure 10 summarizes the time trend from June 9 July 4. In June 9 to 19, the median of the first comment time and the time spent solving the problem was on a decreasing trend, but increases in the third time period (June 20 to 24). After then, the median value of them had been decreased over time until the last interval.

The whole period could be divided as of June 18, considering MERS-CoV confirmation of hemodialysis patient (165th confirmed case). As the hemodialysis patient was confirmed as MERS-CoV infection, the

massive number of dialysis patients were exposed to MERS-CoV. A dialysis patient with high MERS-CoV exposure was given priority in proactive measure. Individuals under home quarantine were strictly monitored, and were transported by the designated ambulances if necessary [47].

Therefore, it would be seen that the problem solving time decreases with the later period, considering its difficulty in quantitative and qualitative aspects. That is, the later the response period, the less time was needed to resolve problems. It could be understood that effective internal communication within the response team has improved the efficiency of problem solving.

Table 9 Time Spent on Posting the First Comment and Solving Problem according to Time Period

	Time Period					Total
	6/9- 6/14	6/15- 6/19	6/20- 6/24	6/25- 6/29	6/30- 7/4	
The Time Spent on Posting the 1st Comment*	0:30	0:16	1:14	1:12	0:20	0:54
The Time Spent on Solving the Problem*	1:07	1:01	2:26	2:05	0:33	1:27
Frequencies of the Question Posts	20	11	18	53	12	114
Frequencies of the Question Posts with creation time	15	10	17	52	11	105

\* The median time using the unit=Hour:Min.

\*\* The hemodialysis patient (165th confirmed case) was confirmed as MERS-CoV infection in June 18

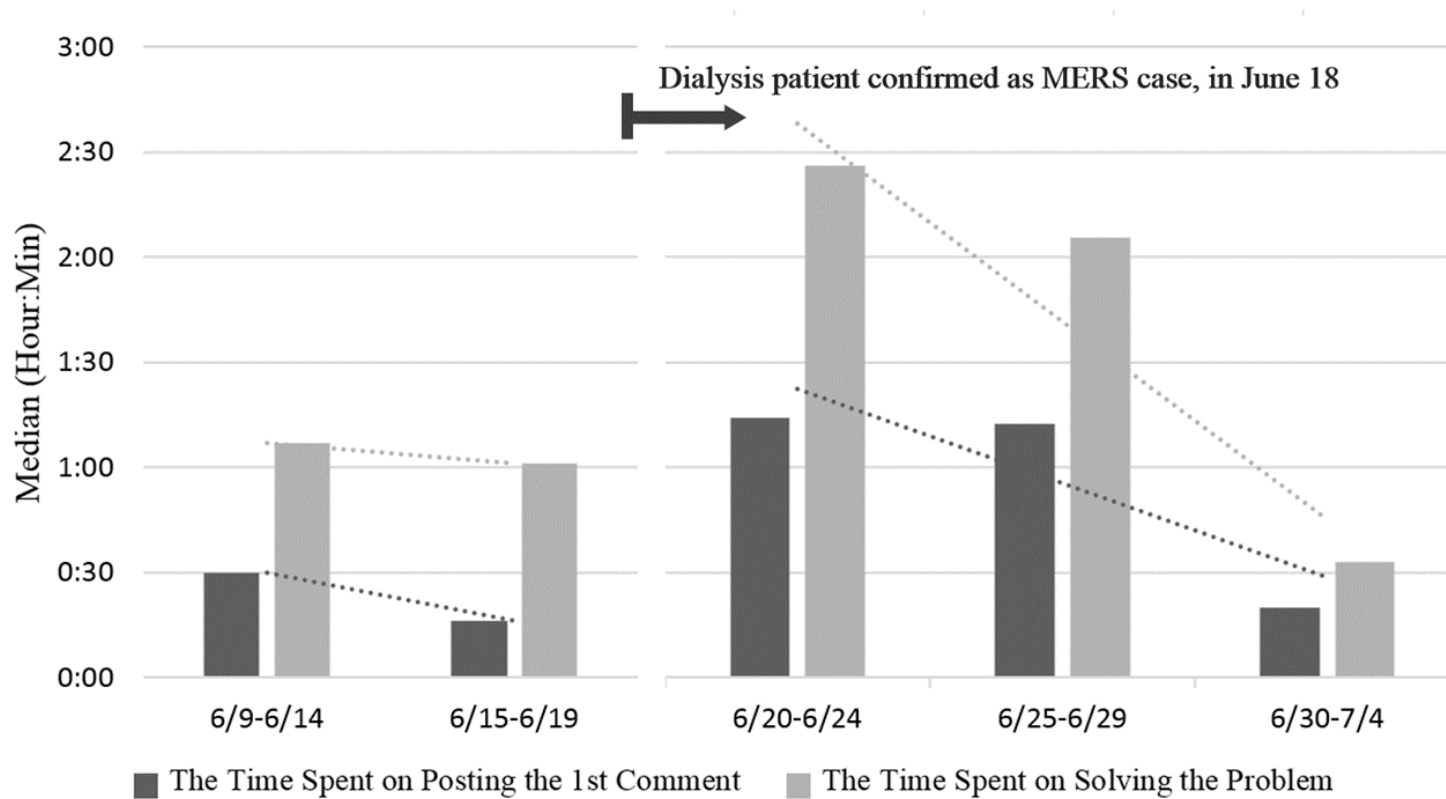


Figure 10 Time Spent on Posting First Comment and Solving Problem according to Time Period



### 3.4 Magnitude of influence of participants in communication network

Figure 11 summarizes the overall communication network structure by expressing all SNS posts of 7 days in one network. The larger the circle size, the larger the degree centrality, which was a hub vertex that played a key role [45]. The largest circle was the Participant ID. 10.

In Figure 12, the results of measuring the degree centrality for the first week of opening were shown. The public health director (Participant ID. 10) had the largest number of degree centrality among the participants, and it implied that role as a control tower was the most influential in SNS communication within the response team. In functional manager at level 2, role of SNS management (Participant ID. 9), role of support for cost of living (Participant ID. 20) and role to provide treatments or consultations (Participant ID. 4) were highly centralized, and it could be interpreted that they played an important role in response. In monitoring staff at level 1, the degree centrality of person who posted MERS suspected symptoms was high, and it could be seen that various functions within the response team need cooperation in the event related with MERS symptoms.

Figure 13 presents the SNS communication structure of the daily network of the first week after the band was opened. The most complicated day of the week was June 14. There were nine pink circles, which means that nine monitoring staffs had posted nine problem situations [45].

There are two main reasons why the network structure becomes complicated in terms of the degree centrality. One is that the degree centrality of a functional manager was large, which implied that the functional manager was highly specialized and was involved in solving a large number of problem situations. Participant ID. 20 was responsible for supporting the cost of living, in June 14. The other reason is that the degree centrality of a monitoring staff was large. This was when cooperation and communication of various functions were required to solve complex problem situations. Especially in June 12, the problem post written by the monitoring staff (Participant ID. 6) was that the person under home quarantine had suspected MERS symptoms and was transferred it to the isolation facility.

**SNS Communication Network in Response Team  
(During 7 days from June 9 to 16 , 2015)**

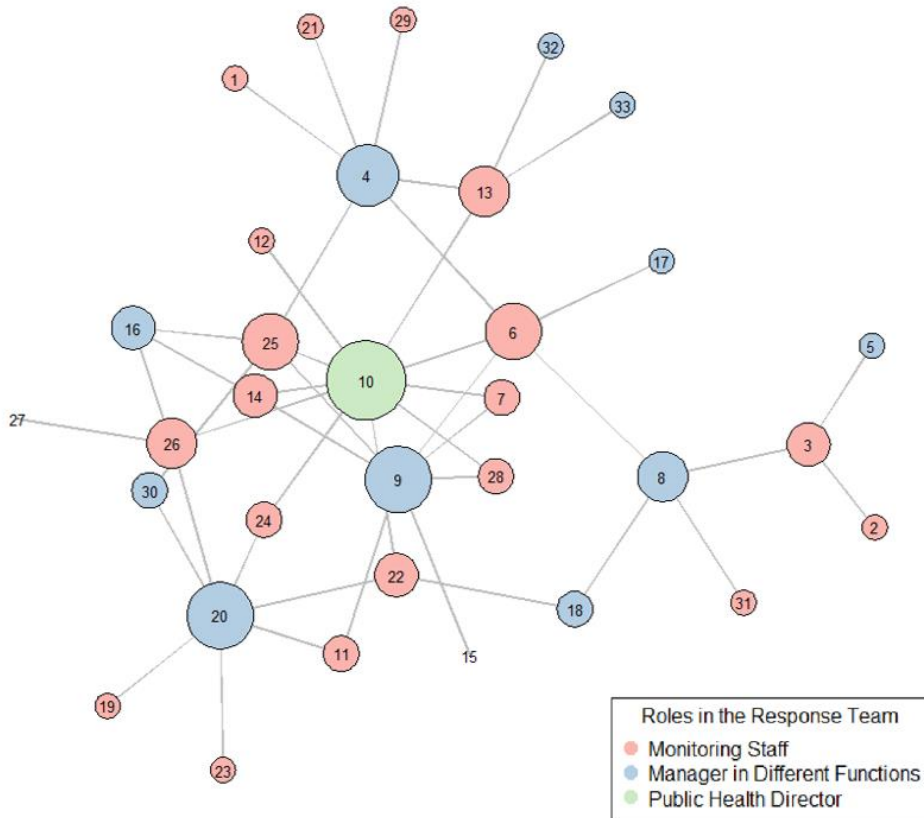
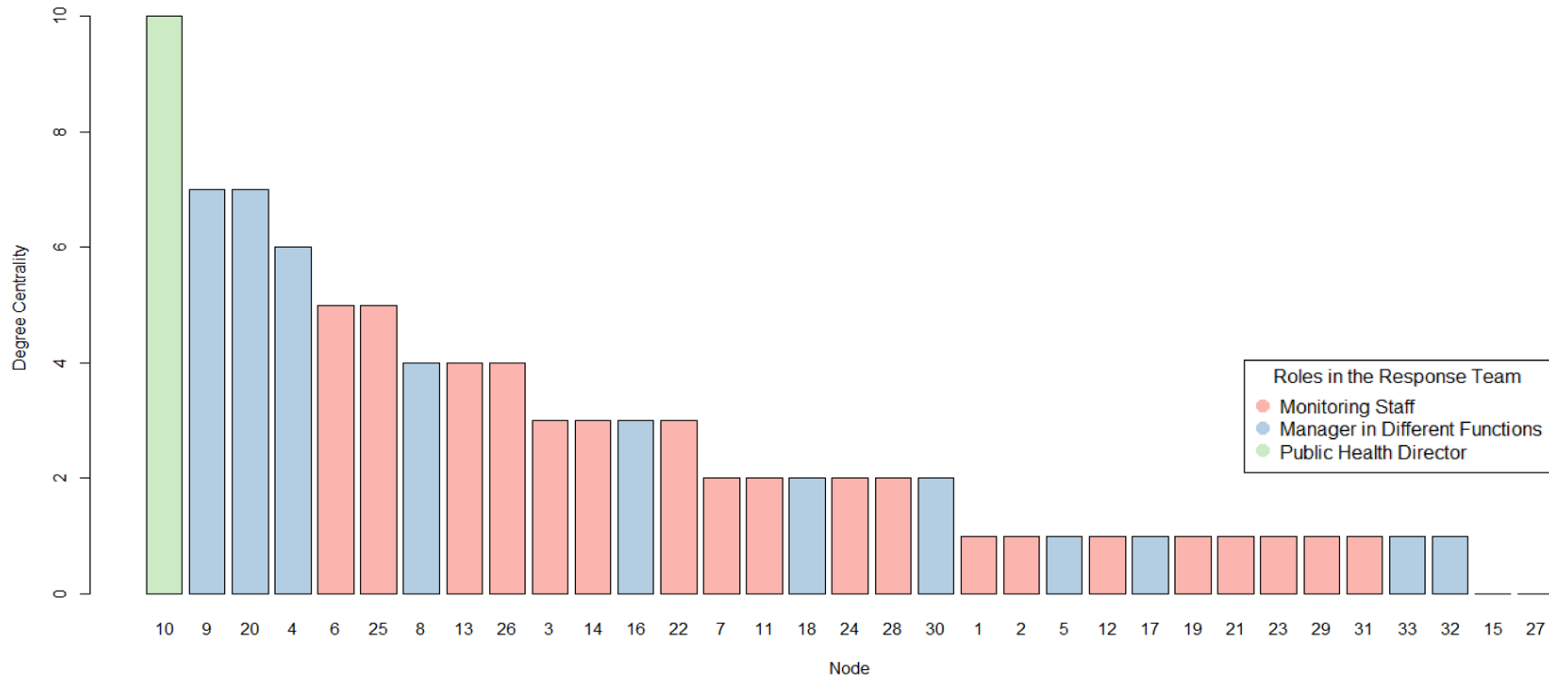


Figure 11 SNS Communication Network Structure for the First Week of Band Opening, focusing on 27 Posts of the Question

**Results of the Degree Centrality Analysis  
(During 7 days from June 9 to 16, 2015)**



**Figure 12 Degree Centrality in SNS Communication Network for the First Week of Band Opening, focusing on 27 Posts of Question**

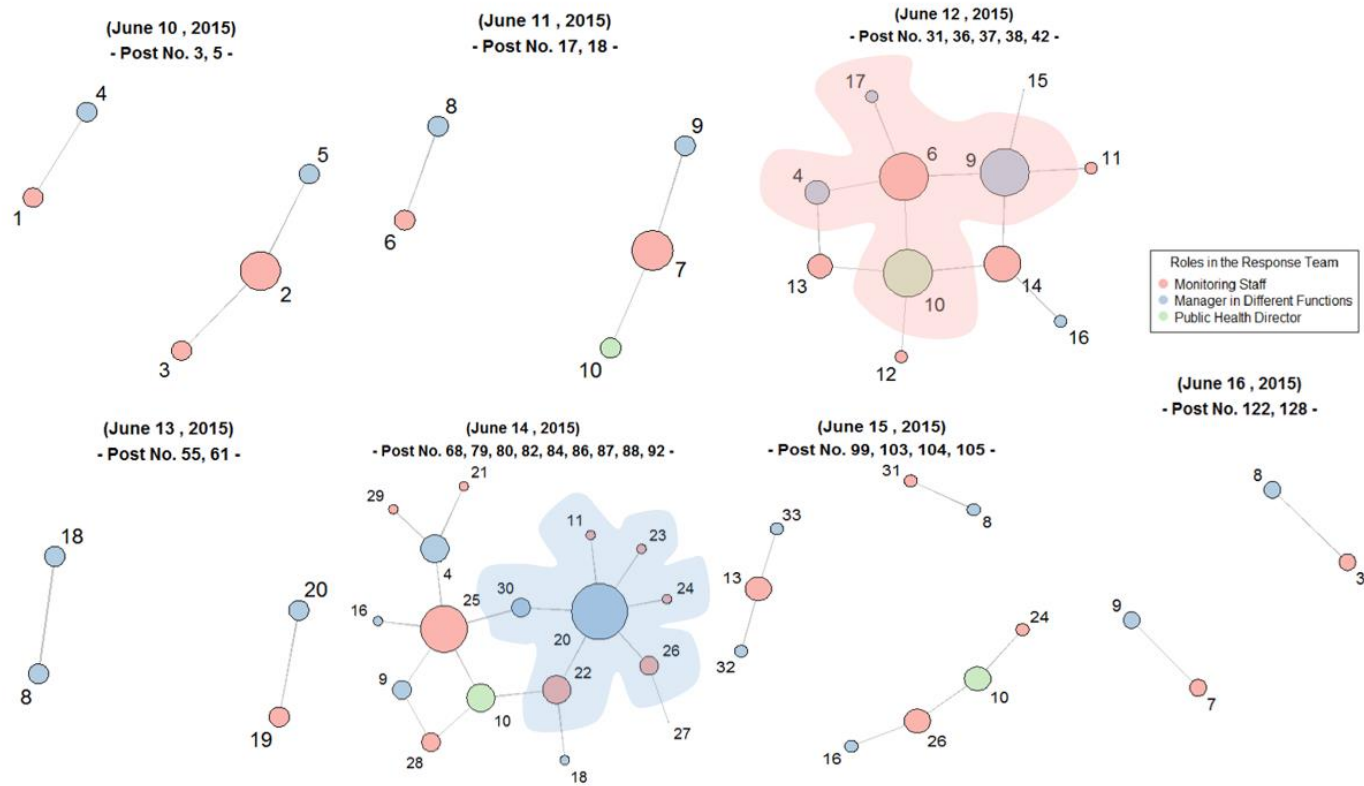


Figure 13 SNS Communication Network Structure by Date, focusing on 27 Posts of the Question

## 4. DISCUSSION

The current study explored what aspect of internal communication using SNS contributes to quarantine management. The number of people under quarantine increased the demand for communication within the response team and rapidly increased the number of SNS posts. This demand stimulated the response team to communicate more actively. The structure & direction of communication evolved over time in response to changing needs for quarantine management, such development contributed to more efficient problem solving. In the social network analysis, most influential participants were identified, such as chief decision maker and specialized functional manager in the SNS communication network.

The structural attributes of internal communication observed in this study is consistent with Miller (2014) finding about a learning organization; that is, the typical characteristics of the learning organization were evidently appeared in the SNS communication system [25]. That is the following, 1) learning from experience and experiment, 2) dissemination of the new knowledge throughout the organization for incorporation into day-to-day activities, 3) fast innovation in response to rapidly changing environment.

The SNS internal communication system in this study had been created increasingly through an adaptive process in which roles were progressively differentiated over time and relationships between these

separated roles were formed, and as the question & answer posts were shared and the quarantine management cases accumulated, the outline of the internal communication system became clearer towards the end of the response period. By visualizing the appeared roles by date, it could be observed the process of evolutionary differentiation of SNS communication participants [27] as shown in previous Figure 7, and relationships have emerged between these differentiated roles, which could be interpreted as an adaptive process. Particularly, in the early days of the current Band opened, in which needed to manage the suddenly increased quarantines, monitoring staffs and functional managers communicated urgently through the Band to solve the unexpected new problem situations related to their quarantine management. Consequently, any participants in the response team who need to collaborate and share information during their monitoring period have used this Band as an alternatives to communicate for helps, and as a result there has been appeared a new role person when someone hand answered and problems had solved [40]. The types of new roles for quarantine management have been increasing step-by-step over time, and the final SNS communication structure is shown in the following Figure 14. This is a sort of internal communication structure that takes place within the response team using closed-type SNS [40].

In Figure 15, the SNS communication process for providing medical services to person in home quarantine is a good example of the characteristics of a learning organization. When the person quarantined in their home called for the medical care service (e.g.,

filling prescriptions, stitch removal or dressing), monitoring staff reported this monitoring results to the complaint manager. Complaint manager allocated it to medical support manager after screening in an hour. In case of the medical need, consultation or treatment was conducted by doctors and the feedback was given to monitoring staff through SNS post. When it comes to other than medical needs, it was easily solved by the written answer in the Band. By repeatedly solving these similar problem situations, new knowledge was created at the organizational level and a communication process was established in the latter period as shown in previous Figure 8.

Broadly speaking, a learning Organization can be described as “the organization, which is developing new knowledge that changes behavior to improve future performance” [48]. The most distinctive feature of the communication in learning organization is the learning from experience and experiment, and dissemination of own knowledge and sharing interpretation of information. [40, 48, 49]. Therefore, the SNS communication process observed in this study could be understood as a kind of learning organization, that is, the SNS internal communication system has increased adaptability through constant learning at the organizational level [40]. As a result, through SNS communication, all members of the response team have participated in the creation, acquisition, and sharing of new knowledge on their own. Based on this, it could be indicated that the adaptability and the competitiveness of the environment increase as the latter period approaches.



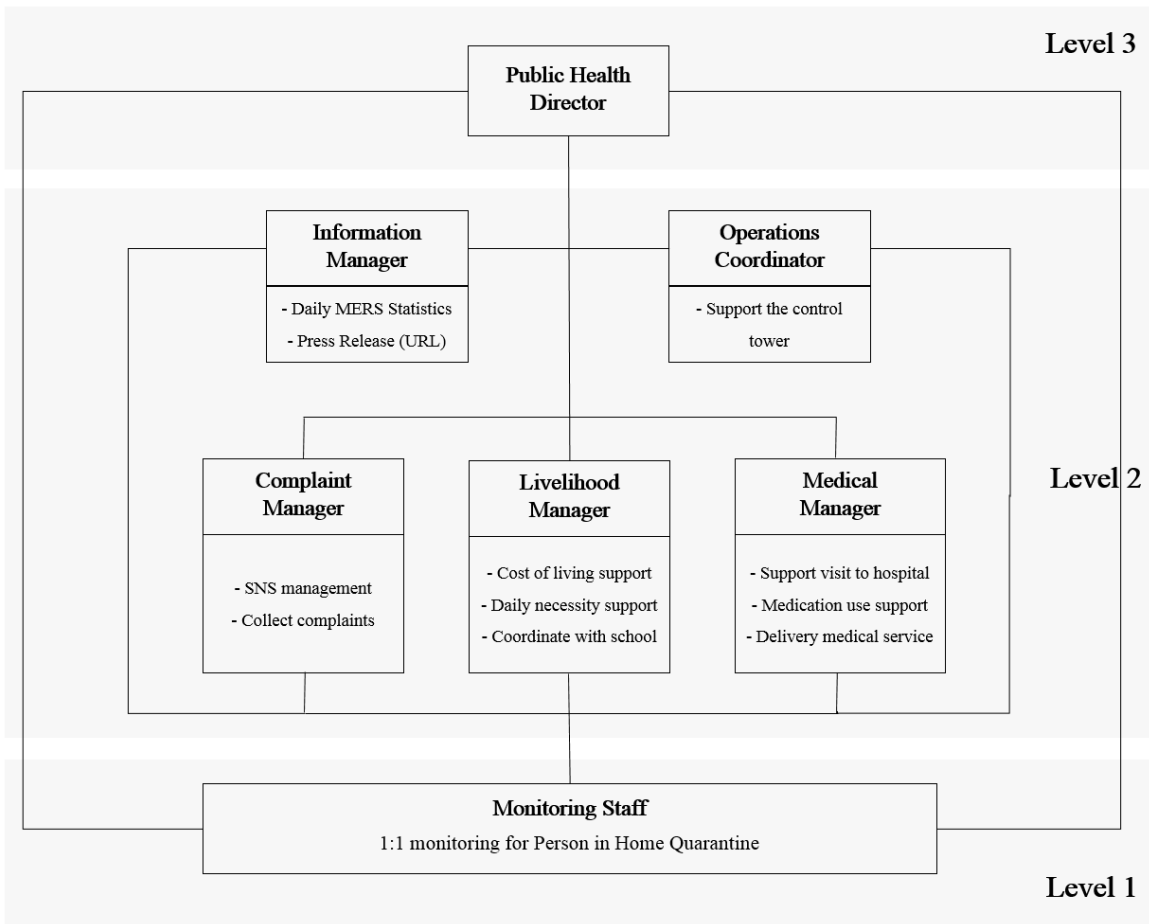


Figure 14  
 SNS Internal Communication  
 Structure within the response  
 team for Quarantine Management

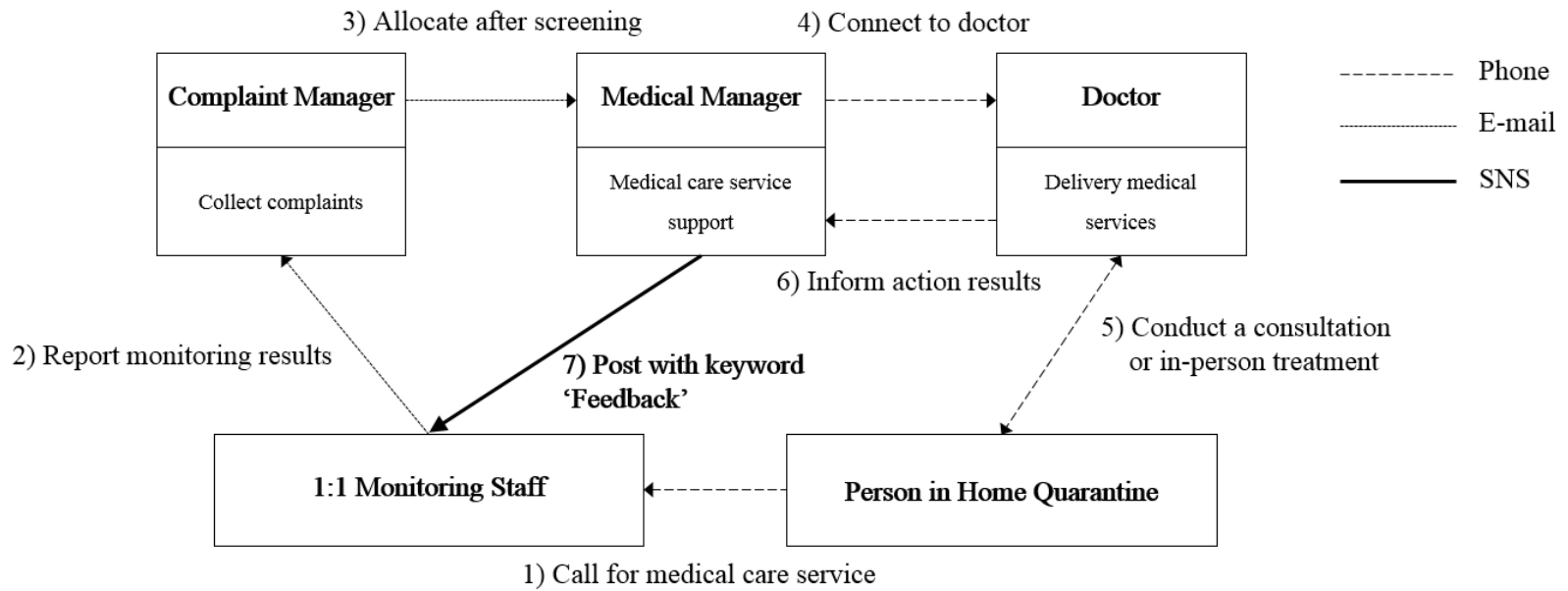


Figure 15 SNS Communication Process for Providing Medical Services in the Response Team

The directional attributes of SNS communication is constant with the previous studies of multidirectional communication in an organization in terms of information flow [40, 50].

Two arguments can be put forward to explain the direction of information flow in SNS communication [40]. First, the internal experience of the organization is communicated vertically, for example, the post with the keyword 'Questions' created by the monitoring staff and the post with the keyword 'Feedback' made by the functional manager. This vertical communication, including upward and downward, could be interpreted as repetition and sharing of internal experience. Second, the external information sharing is communicated horizontally between levels, for instance, the reports of press release, the daily MERS statistics. Vertical communication could be seen as the diffusion and sharing of external resources.

The main benefit of each direction of communication is as follows. First, consistent and accurate information sharing is an achievement of downward communication. As an example of the 1:1 monitoring guidelines, an operation coordinator provided a notification on changing instruction or action and explained a task or operational procedures to the monitoring staffs through their Band. Downward communication is started from the organization's higher management and filters downward via "chain of command" [50]. As information moved downward in the SNS communication process, it had grown very quickly spread and influenced all over the participants at the same

time. It helped monitoring staffs more effectively to understand and pursue organizational objectives. Second, upward communication accomplishes that the monitoring staff asked for a help about their problem situations in real time, got the decision information, took a quick action, and the functional managers in different functions cooperated. The SNS communication process whereby the questions of lower-level monitoring staffs was communicated to those at upper levels in the response team, it provided a monitoring staff with needed information for decision making. It helped monitoring staffs reduce the pressure and confusions of the responding situation [41]. Third, clearly filtered external information sharing is attained by the horizontal communication, such as Daily MERS statistics, press release. Linking related URL of articles, pictures, and videos and attaching files were an effective way to provide quick and accurate information to individuals in the response team and to enhance the expertise of the quarantine management [51].

The direction of SNS communication multi-directionally evolved over time in response to changing needs for quarantine management. On the basis of multidirectional communication, where both vertical and horizontal communication occur at the same time, had increased the flexibility within the response team. Considering that a flexibility in an organization could be found where in decisions are to be made rapidly, or when the organization is facing problems, that is, by-pass communication made in urgent situations [41], SNS communication process had improved their capabilities of response team for

quarantine management. This means that when new information came up, they can change their decision and the content of the activity can be changed to suit their situation.

Eventually, the structural and directional developments of internal communication using SNS contributed to more efficient problem solving. The later the response period, the less time was needed to resolve problems. It was consistent with the characteristics of general organizational communication in terms of time savings as well as facilitated co-operation of the task [48, 49]; that is, better communication helps in better understanding, solving problems, better inter-personal relationships and less conflicts.

Additionally, in the social network analysis, most influential participants were identified in SNS communication network, and the magnitude of the influence of participants could be interpreted differently according to the level of the vertex. First, the role of the leader as a chief decision maker in the emergency of infectious disease was the most influential in the SNS communication process. It could be attributed to the SNS's possibility of diagonal communication between monitoring staff and public health director and it facilitates monitoring staffs relieve the pressure and frustrations of the responding situation [41, 50]. Second, in level 2, the more specialized functional manager had roles, the larger the influence they had in the SNS communication network, such as MERS suspected symptom consultation in the medical management and cost of living support in the livelihood

management. This could be explained that specialized roles could have been involved in resolving a large number of problem situations. Third, monitoring staff was most influential in coping with MERS suspected symptoms. In level 3, when the monitoring staff posted complex problems such as MERS suspicious symptoms in their Band, the influence in the SNS communication network was large. Monitoring staff contributed to contain the epidemic of MERS, by notifying the occurrence of suspicious symptoms through SNS, when considering the purpose of the home quarantine to block additional infections by isolating them before the onset of symptoms [3, 8].

In this study, it is shown that the Naver Band as an internal communication channel has several advantages in terms of the function of the closed-type SNS. The biggest feature of closed-type SNS is that users can block the range of groups that can share contents and communicate in advance because they are composed of only invited people, unlike open-type SNS, which can communicate with unspecified majority [29]. This implies that the main user of the closed-type SNS is a user with a specific purpose, in current study, this feature could be confirmed in the fact that it was used in a limited response team with a specific purpose of quarantine management. In addition, according to a previous study analyzing the motivation for using the Naver Band, 'acquisition of knowledge and information' was found to be the main motivation for using it [52], it is consistent with the fact that the Naver Band users of this study used their Band to obtain information related to the quarantine management, collect

knowledge about their interests and share knowledge of others. Therefore, in this study, it was found that the function of closed-type SNS is expanded as a means to exchange information and acquire knowledge among people who already have a relationship.

The SNS internal communication channel in the current study appear more practical than traditional approaches in the public health emergency response and are consistent with the effect of SNS communications studied in other disciplines. The biggest difference in SNS communication when compared to face-to-face communication is the rapid application and presentation of data [29]. In this study, linking related articles, pictures, and videos was also an effective way to provide immediate and accurate information to individuals in the response team and to enhance the expertise of the quarantine management. The use of the Expressions, which are graphic emoticons, also contributed to encouraging SNS communication participants, heightening mood, and creating emotional consensus. In addition, it can be seen that emotional functioning as an additional effect of emotional support is provided by exchanging messages of encouragement and comfort each other [53]. Furthermore, the one-to-many communication, not one-on-one communication, such as writing or telephone, allowed someone to reply immediately in a short period of time without knowing who could answer the question. And the impact of these replies went to many people at once, and the collected replies could accumulate and guide others in similar situations. According to a previous study of the use of SNS on soldiers' perceptions and

behaviors, the Naver Band played a role as a communication channel between acquaintances and those who form closer social relations, thereby increasing the sense of belonging but also positively influences the performance of individual tasks [54]. This is similar to the results of the present study, which suggests that the use of closed-type SNS positively contributes to the efficient resolution of problems caused by managing the quarantines.

The current exploratory study has many strengths. First, to the researchers' knowledge, this may be one of the first studies to consider the internal communication for quarantine management in a public health emergency, especially using closed-type SNS. In addition, the empirical case of internal communication in G District allowed in-depth exploration of attribute and advantages of communication method using SNS. Second, the temporal relationship between SNS communication and problem solving could be confirmed, using the creation date & time of SNS posts [29]. Lastly, the nature of social network analysis used in study allow researchers to capture the hidden influential roles among the response team more accurately [28].

It is acknowledged that this study has several limitations. First, the method of content analysis has been criticized in the quantitative field, by those who regarded it to be a simple technique, while others considered that content analysis was not inherently qualitative enough [33]. But, if the categories and rules are conceptually and theoretically sound and are reliable, the researcher increases the likelihood that



their study findings will be valid [35]. Second, the SNS posts represented in this study may not include all of the contents potentially relevant to quarantine management. Although this study was conducted on the entire SNS posts without sampling, it is possible that unmeasured / unknown situation or variables (e.g., e-mail, phone, in person communication, different types of SNS platforms) may explain the presenting finding. Therefore, future studies should make attempts to investigate the influences of different types of communication channel. Especially, there may be differences among SNSs, and various platforms of SNS can facilitate unique SNS communication types, and as a result, can have a unique effects on quarantine management during infectious disease outbreak. Finally, the SNS communication participants with emotional distress, fear and anxiety levels were not considered in current study. Since the emerging infectious disease outbreaks could have a significant psychological impact on public health workers largely [55, 56], and the psychological well-being of them who cope with the public health emergency must be recognized as a priority for the next future study.

## 5. CONCLUSION

Closed-type SNS has become common space for public health workers to internally interact and exchange information during public health emergency response. In particular, Closed-type SNS functions as alternative internal communication channels when lack of coordination and internal information deficit to the response team are presented. As well as these roles, this study emphasizes the achievement of SNS communication on efficiency of problem solving in quarantine management.

In light of these results, local public health workers and risk communication professionals need to utilize SNS, so that communicate actively within a response team and then manage effectively the quarantines caused by an infectious disease outbreak. Especially, SNS communication system, including various specialized functions in quarantine management (e.g., medical and livelihood management), can enable the response team to understand more about what monitoring staffs are asking for help about their quarantined person, to recognize accurately communication demands, and to solve their problems accordingly.

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## SUMMARY IN KOREAN

국문초록

공중보건 위기상황에서의 자가격리자 관리를 위한

내부소통에 관한 탐색적 연구:

2015년 중동호흡기증후군 유행 시 네이버 밴드를 활용한

서울특별시 G구 사례를 중심으로

김미희

보건학과 역학전공

서울대학교 보건대학원

**연구배경:** 2015년 중동호흡기증후군 (Middle East respiratory syndrome coronavirus, MERS-CoV, 이하 메르스) 유행 시 서울특별시 G구에서는 대규모 자가격리자를 효율적으로 관리하기 위해 폐쇄형 SNS인 네이버 밴드를 개설하여 대응팀 내부소통 창구를 마련하였다. 이는 공중보건 위기 시 대응팀 내 구체적인 내부소통 상황을 제시하는 학술적으로 가치 있는 사례이다.

**연구목적:** 따라서 본 연구에서는 G구의 내부소통 사례를 통해 폐쇄형 SNS를 활용한 소통 방식이 자가격리자 관리에 기여한 측면



에 대해 논의하고자 한다. 이를 위한 본 연구의 구체적인 목적은 SNS 소통 게시물의 속성을 구조와 방향 측면에서 탐색하고, 자가격리자 관리를 위한 내부소통의 필요성과 그 성과를 확인하며, 나아가 대응팀 내에서 어떤 참여자가 자가격리자 관리 중 발생한 문제 해결에서 중요한 역할을 했었는지 파악하는 데에 있다.

**연구방법:** 네이버 밴드가 개설된 2015년 6월 9일부터 메르스 유행이 잠정 종식된 10월 30일까지 작성된 게시물 656개를 대상으로 질적, 양적 내용분석을 실시하였다. 또한 1:1 모니터링 요원이 자가격리자 관리 중 발생한 문제 상황에 대해 질문한 27개의 게시물을 대상으로 사회 연결망 분석을 실시하였다.

**결과:** 폐쇄형 SNS는 메르스 유행과 같은 공중보건 위기상황에서 보건 요원들이 내부적으로 상호 작용하고 정보를 교환하는 소통 공간으로 자리잡았다. 특히, 대응팀 내 협력과 정보가 필요한 상황에서 폐쇄형 SNS는 대안적인 내부소통 채널로서 기능하였으며, 그 소통의 구조와 방향은 시간이 갈수록 점진적으로 발전하였다. 이러한 소통의 발전은 자가격리자 관리 과정에서 발생한 문제의 효율적인 해결에 기여했다. 또한, 소통 네트워크에서 보건소장과 같은 주요 의사결정자 및 전문적인 기능을 가진 관리자 (예: 의료 및 생활 관리)의 역할이 가장 영향력 있음이 확인되었다.

**결론:** 공중보건 위기상황에서 지역 보건 요원과 소통 전문가는 대응팀 내에서 효과적으로 소통하기 위하여, 폐쇄형 SNS를 적극 활용할 필요가 있다. 또한, 전문적인 기능을 가진 관리자를 포함한 SNS 내부소통 전략 개발 및 적용을 통하여 보다 조직적인 정보 공유와 효율적인 자가격리자 관리가 이루어져야 한다.

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**주요어 :** 폐쇄형 SNS, 내부소통, 자가격리자 관리, 공중보건 위기, 메르스, 내용 분석, 사회 연결망 분석, 모바일 헬스

**학 번 :** 2015-24004