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EXPLORATION OF THE NEED FOR NURSING HUMAN RESOURCES INFORMATION SYSTEMS FOR GEOGRAPHICAL MAPPING OF NURSES: A QUALITATIVE STUDY

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ABSTRACT
The existence of data discrepancies related to nursing human resources requires an integrated Nursing HR Information System between interested parties (stakeholders). The purpose of this study is to explore the needs of nursing human resource management information systems. This qualitative research uses a phenomenological approach. Data collection uses in-depth interview techniques with open ended questions, which are carried out online and offline. The research was located at the Bogor Regency Health Office, Depok City Health Office, Cibinong Hospital Bogor Regency, Depok City Hospital, Karadenan Health Center and Bojonggede Health Center in Bogor Regency, Kemiri Muka Health Center and Sawangan Health Center in Depok City. Participants consisted of Health Human Resources Managers, Nursing Human Resources Managers, Nurses in Hospitals, Nurses at Puskesmas and Administrators of Nursing Profession organizations with a total of 28 participants. Data analysis uses a systematic coding process. The results of the study found three themes, namely the components of the information system, the features of the information system and the information produced. Participants expressed needs that would be basic input or data in the development of a geographic-based nursing human resource information system model.

Keywords: geographic information system; management information system; nurse; nursing human resources

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INTRODUCTION

Nurses are one of the professions in the health sector that contribute to the quality of health services, because they are the largest number of health human resources than other health human resources. Nursing services also play an important role in achieving health development targets in accordance with the mandate of the law on health. *Colorado Technical University* (2019) states that nursing services are not only *caring*, but also disease prevention and health promotion.

The Healthy Indonesia Program is in line with the *Sustainable Development Goals (SDGs)* set by 193 UN member states in 2015. The achievement of the SDGs targets in the health sector can be seen from the 2015-2019 RPJMN National Target as stated in Presidential Regulation number 59 of 2017, for example target 3.1 concerning Maternal Mortality. According to Statistics Indonesia (2016), the Maternal Mortality Rate (MMR) in Indonesia is still high even though from the results of the 2010 Population Census and 2015 SUPAS there was a decrease

from 346 per 100,000 live births to 305 per 100,000 live births. This figure is still far from the expectations of the Millennium Development Goals (MDGs) which targets the MMR in 2015 to be 102 per 100,000 live births, especially when compared to the Sustainable Development Goals (SDGs) which targets an MMR in 2030 of less than 70 per 100,000 live births.

Human Resources (HR) Nurses are the largest health workers. According to WHO (2016), almost 50% of health workers consist of nurses and midwives. Of the 43.6 million health workers in the world, 20.7 million are nurses and midwives. In Indonesia, of the 1,365,049 health workers including support workers utilized in health facilities, 410,064 (30%) are Human Resources Nurses. Of these, 263,362 Human Resources Nurses work in hospitals and 137,323 work in Public Health Center. According to the Health Human Resources Development and Empowerment Agency of the Ministry of Health of the Republic of Indonesia (2018), of the number of Human Resources utilized in hospitals, Nurses Human Resources are the largest Human Resources with a percentage of 49%.

Mukti, et al (2017), stated that "the ratio of Health Human Resources to population is the total number of Health Human Resources consisting of doctors, specialist doctors, dentists, nurses and midwives as many as 44.5 Health Human Resources per 10,000 population to achieve the SDGs target". Doctors consisting of doctors who are general practice and specialists are 1 per 1000 inhabitants. While dentists are 1 per 7,500 inhabitants; and nurses and midwives 1,365 per 100,000 inhabitants. Based on the Decree of the Coordinating Minister for People's Welfare Number 54 of 2013 concerning the plan for the development of health workers in 2011 – 2025, the target ratio of Nurse Human Resources is 180 per 100,000 population, and the ratio of midwives is 120 per 100,000 population.

Information about nurses HR is still inconsistent. The *World Health Organization (WHO)* reported that the number of Indonesian nurses in 2017 was 345,276 with a ratio of 132 per 100,000 (WHO, 2019). The Indonesian Ministry of Health recorded that the number of nurses nationally in 2018 was 410,064 with a ratio of 155 per 100,000 population (BPPSDMK, 2019). Meanwhile, in the Indonesian Health Profile in 2018, the number of Nurse Human Resources is 354,218 with a ratio of 135 per 100,000 population. The Directorate General of Science and Technology Resources and Higher Education of the Ministry of Research, Technology and Higher Education recorded that the number of nursing workers in 2016 was 439,907 with a ratio to the total population of 170 per 100,000 population (Mukti, et al, 2017). BPS – Statistics Indonesia recorded the number of nursing workers in 2019 as many as 354,218 with a ratio of 134 per 100,000 population (BPS, 2019). Meanwhile, the Indonesian National Nurses Association (INNA) recorded the number of Indonesian nurses in 2017 as many as 359,339 with a ratio of 140 per 100,000 population. This difference in the number and ratio of nurses may be due to differences in the tools, methods and/or data sources used.

According to the *International Council of Nurses-ICN* (2009), nursing has always been on the WHO agenda for more than 40 years. In The World Health Assembly resolution WHA 59.27 on *'Strengthening Nursing and Midwifery*' shows serious attention to the shortage of nurse and midwife workers globally. This has a serious negative impact on health services. In many countries, nurses deal with the following problems: imbalances in numbers, both geographically, occupationally, specialties and institutions; unethical recruitment and abusive management practices; differences in the type and quality of nursing services provided; qualification errors (including excess and under qualification); incorrect utilization (including overuse/underuse); unfair access to occupational health protection or professional education;

demotivation; absence; high friction; unemployment and slow response to nursing trends such as new technologies and procedures, etc.
According to Mukti, et al (2017), the current condition of Indonesian Health Human Resources in terms of the total number of doctors, specialists, dentists, specialist dentists, nurses and midwives has reached a ratio of 40.1 per 10,000. Meanwhile, the target ratio of Health Human Resources set by WHO is 44.5 per 10,000 population. This figure shows that the target ratio of Health Human Resources has not been achieved. Judging from the density per region of health workers, namely from each province, it appears that the distribution in each province varies greatly. The largest ratio of density of Health Human Resources per square-kilometer is in the province of DKI Jakarta (126 per square-kilometer). There are five provinces with a ratio range of 8 to 3 health workers per square-kilometer and five provinces with densities of less than 3 per-square-kilometer. The province with the lowest density of Human Resources per square-kilometer is the province of North Kalimantan with a density of less than 1 per square-kilometer. The density of Health Human Resources in each district/city also varies greatly, including the density of Nurse Human Resources. This is supported by data from the Stastistics Indonesia (BPS - Stastistics Indonesia) which is processed by researchers from the Stastistics Indonesia report in the form of Provinces in Figures from each province. The Administrative City of Central Jakarta has a density of nurse human resources per square-kilometer of 140.95 while Malinau Regency in North Kalimantan province has a density of 0.01 per square kilometer. With this discrepancy in data, an integrated Nursing HR Information System is needed between *interested parties (stakeholders*) in the management of Nursing Human Resources, namely the Ministry of Health, The Health Office, Nursing Professional Organizations (INNA) and the Nursing Council that will be formed.

The results of a preliminary study conducted by the author in the 3T area (lagging, outermost, foremost) in Batang Gansal District and Rakit Kulim District, Indragiri Hulu Regency, Riau Province, showed that the ratio of Nursing Human Resources to the total population was 1: 2,233 with a density of 0.017 per km^2. This ratio is very small when compared to the ratio according to WHO of 1 nurse : 225 inhabitants; based on the global needs of 1 nurse : 230 inhabitants; based on the standards of the International Council of Nurses (ICN) and the country of Thailand of 1: 250 inhabitants. In fact, it is still lower than the Indonesian standard of 1 nurse: 555 residents. According to NHS (2012), "The Health Information System (HIS) is part of the sixth sub-system of NHS, namely in the sub-system of health management, information and regulation. which manages the functions of health policy, health administration, health information and health law that are adequate and able to support the implementation of national health efforts to be successful, effective, and support the implementation of the six other subsystems in the NHS as an integrated unit". The importance of the existence of HIS is regulated in PP Number 46 of 2014 concerning Health Information Systems (HIS). According to PP 46 of 2014, "HIS is a set of orders that include data, information, indicators, procedures, devices, technology, and human resources that are interrelated and managed in an integrated manner to direct actions or decisions that are useful in supporting health development". One of the health information is health human resource information (article 8 PP 46 of 2014). As an integral part of health care, the nursing information system is an integral part of the health information system.

According to Setyawan (2014), in line with the development of information technology, the Health Information System has developed towards the use of Geographic Information Systems (GIS). According to Burrough (1986), "GIS is a tool/medium for entering, storing, retrieving, manipulating, analyzing, and displaying geographical data (geospatial data) that is

useful for supporting decision-making processes in planning and management of natural resources, environment, transportation, urban and administrative issues". Meanwhile, according to ESRI (1996), "spatial data is data that has a geographic coordinate system. In other words, GIS is a database system that has a specific ability to perform certain operations on data". By utilizing GIS, it is hoped that the quality of health information system information will increase.

The information system that produces health information including information on Nursing Human Resources in Indonesia at this time is managed by the Ministry of Health, Provincial/Regency/City Health Offices and Health Service Facilities on a tiered basis, in accordance with laws and regulations on Health Information Systems, and membership management information systems of Nursing Professional Organizations. Nursing HR information generated by the Health Information System (HIS) is limited to information on Nursing Human Resources who work in health service facilities, does not accommodate Nursing Human Resources who have not worked or worked in other sectors outside the health sector, including Nursing Human Resources who have just graduated from college, so it is less than optimal for the implementation of the development and empowerment of health human resources in accordance with the mandate of laws and regulations. The data elements owned also do not include "spatial data" or data that has "geographical references" to find out the ratio and density of nurses in a particular area. The Nursing Professional Organization, namely the Indonesian National Nurses Association (INNA), has a Membership Management Information System (MMIS) that only manages the data of Nurses Human Resources who are members of INNA and without having spatial data elements so that they also cannot produce information that has "georeference". To develop a geographic-based HR management information system model, it is necessary to know the need about nursing resource management information systems. Therefore, researchers are interested in conducting qualitative studies with the aim of exploring the needs of nursing human resource management information systems.

METHOD

This study is a qualitative study that uses a phenomenological approach to explore the needs of nursing human resource management information systems. The population of this study is HR managers at the Regency/City Health Office, HR managers in Hospitals and Public Health Center and Administrators of Nursing Professional Organizations (PPNI). The research participants were the Head of Health Resources Division and Staff at the District/City Health Office, the Nursing HR Manager and Staff at the Hospital, the Head of Administration and Staff at the Public Health Center, and INNA Central Board of Directors through *purposive sampling* techniques. The number of participants is determined based on data saturation, which is a situation where the addition of research participants no longer provides additional new information about the phenomenon under study (Streubert & Carpenter, 2011)

This study is located at the Bogor Regency Health Office, Depok City Health Office, Cibinong Hospital Bogor Regency, Depok City Hospital, Karadenan Public Health Center and Bojonggede Public Health Center in Bogor Regency, Kemiri Muka Public Health Center and Sawangan Public Health Center in Depok City. Data collection was carried out using in-depth interview techniques by asking seven *open ended questions*, namely: how to manage nursing personnel at this time, the use of information systems in the management of nursing personnel, how to find out the number, ratio and density of Nursing Human Resources in a certain area, availability of resources (HR, funds, hardware, software, procedures) for system

management information on nursing personnel, constraints in the management of human resources and information systems carried out, plans for the development of nursing personnel information systems, and what kind of nursing personnel information systems are expected.

The in-depth interviews conducted are *offline* and *online*. This method was chosen as a solution to overcome various limitations during the pandemic. The equipment used is *voice* and *video recorders*, cameras, *cellphones*, as well as recording verbal, nonverbal responses and important events during in-depth interviews taking place in *the notes field*. This research has applied the principles of research ethics by obtaining approval from the Ethics Committee of the Faculty of Nursing, University of Indonesia. Researchers have also received written consent from participants to participate in this study. The data analysis process is carried out *simultaneously* with the data collection process. Data analysis activities carried out by researchers in general have five stages, namely (Creswell, 2013): 1) preparing data; 2) organize data e.g. data text in the form of transcripts or data in the form of photographs, paintings or photographic forms; 3) reducing data into the form of interconnected themes through the process of coding; 4) make a summary/condensation of the codes that have been generated.

RESULTS

Participant Characteristics

The research was carried out at the Bogor Regency Health Office; Depok City Health Office; Cibinong Hospital, Bogor Regency; Depok City Hospital; Karadenan Public Health Center and Bojonggede Public Health Center in Bogor Regency; Kemiri Muka Public Health Center and Sawangan Public Health Center in the City. There were 6 participants from the Health Office, 3 from Bogor Regency and 3 from Depok City, namely the Head of Health Resources (HHR), Head of The Health Human Resources Section (HHRS) and Manager of the Health Human Resources Information System (IS HHR). Participants from the Hospital as many as 10 people from 2 Hospitals consisted of the Head of the Personnel Sub-Section, the Head of the Nursing Section or the Chairman of the Nursing Committee, the Head of the Room and the Implementing Nurse. Participants from Public Health Center as many as 11 people from 4 Public Health Center consisted of the Head of Public Health Center, Head of Administration or Manager of IS HHR and Implementing Nurses. One participant of the INNA Central Board is the Chairman of the INNA Central Board for Information Systems. The details of the participants are found in table 1.

Table 1.
Characteristics of Research Participants

Participants	Position	Education	Age	Gender
P01	Head of Health Resources Health Office	Master of Public Health	49	F
P02	Head of The Health Human Resources Section Health Office	Master of Public Health	48	F
P03	Manager of IS HHR Health Office	Bachelor of Public Health	43	M
P04	Head of Health Resources Health Office	Master of Public Health	48	M
P05	Head of The Health Human Resources Section Health Office	Master of Public Health	46	F

Participants	Position	Education	Age	Gender
P06	Manager of IS HHR Health Office	Diploma of Nursing	36	F
P07	Head of Personnel Section	Bachelor of Law	46	M
P08	Head of Nursing Quality Assurance Section	Bachelor of Nursing	45	F
P09	Chairman of the Nursing Committee	Bachelor of Nursing	44	F
P10	Head of Nursing Room 1	Bachelor of Nursing	38	F
P11	Implementing Nurse 2	Bachelor of Nursing	33	F
P12	Staffing Department	Bachelor of Psychologist	32	F
P13	Head of Nursing Care	Master of Nursing	48	F
P14	Head of Inpatient & Outpatient	Master of Public Health	40	M
P15	Implementing Nurse 1	Bachelor of Nursing	40	F
P16	Implementing Nurse 2	Bachelor of Nursing	36	F
P17	Head of Karadenan Public Health Center	Medical Doctor	45	F
P18	Manager of IS HHR Karadenan Public Health Center	Diploma of Midwife	38	F
P19	Karadenan Public Health Center Implementing Nurse	Diploma of Nursing	53	F
P20	Head of Bojong Gede Public Health Center	Medical Doctor	46	M
P21	Manager of IS HHR Bojong Gede Public Health Center	Bachelor of Public Health	44	M
P22	Bojong Gede Public Health Center Implementing Nurse	Bachelor of Nursing	42	F
P23	Manager of IS HHR Kemiri Muka Public Health Center Implementing Nurse	Diploma of Nursing	39	F
P24	Kemiri Muka Public Health Center Implementing Nurse	Diploma of Nursing	52	F
P25	Head of Administration Sawangan Public Health Center	Diploma of Nursing	48	F
P26	Manager of IS HHR Sawangan Public Health Center	Bachelor of Health	32	F
P27	Sawangan Public Health Center Implementing Nurse	Diploma of Nursing	34	F
Q28	Chairman of INNA Central Board	Master of Nursing	51	M

Results of Theme Analysis

Information System Components

Themes related to inputs are components of information systems inferred by categories and keywords. The results of the study found that there are four categories of information system components, namely 1) hardware, 2) software, 3) internet networks, and 4) humans. The statements of some participants were as follows:

“..... hadware, software, internet network have....." (P01)

".... If the hardware and software we are available, sir, computers, laptops, internet/wifi networks in the office....." (P06)
".... The server is in the Hospital, the Hospital has a server...." (P07)
"... we already have an information system sir, HHRS Information System is called..." (P05)
".... we use HHRS from the Ministry of Health...." (P05)
".... We have 1 special health worker who manages IS-HHRS...." (P05)
"... Actually, she is not an expert, in the Public Health Center anyone can be anything, the administration is a midwife, basically a midwife, not a special admin..." (P17)
".... If it is for internet access, it depends on the room, the internet is not good in my room....." (P16)
".....Sometimes the internet is slow, sometimes it is difficult, sometimes the internet is intermittent...." (P18)
".. has limitations on the side of internet access, which varies from one to another.." (P28)

Information System Features

The results of an exploratory study of 28 participants through in-depth interviews obtained an overview of the expected features of the information system, namely 1) convenience in terms of use and access; 2) access speed, 3) completeness of functions and 4) interoperability (can share data) with other information systems. The statements of some participants were as follows:

".... Want to have one application that is from planning, spreading, to being able to assess the performance of the nurse...." (P05)
".... which is more systematic and accessible anywhere and anytime,.." (P12)
".. each health HR can access it so that they can update their own data" (P12)
".... which is just easy to access, it's easy...." (P15)
".... I want a fast information system...." (P22)
"... based in all regions..." (P28)
"..... I want a fast information system, from the registration department, you can directly link to the doctor or nurse....." (P22)
".... the registration data (registration certificate) of health workers is mainly for those workers who need it...." (P03)
".... later everything has a paperless system and has been integrated all in the hospital information system....." (P10)

Produced Information

In accordance with PP 46 of 2014 concerning Health Information Systems article 8 paragraph 5, it is stated that Health Human Resources information as referred to in paragraph (1) letter d contains at least information about: type, number, competence, authority, and equitable distribution of health human resources. However, the HR information system used in the Health Office and Public Health Center at this time only displays indicators of the type and number of personnel to see whether the minimum standards of personnel needs is met or not, does not include the competence, authority and equal distribution of Health Human Resources as measured by the ratio to population and density to the area; to get data on the ratio and density of Health Human Resources must be processed again. Meanwhile, at Hospital, it only uses indicators of the number of visits and *bed occupancy rate*. Several participants said this:

".... Can't, sir, if you apply this, we only talked about it earlier, sir, just talk about this, sir, the minimum standard...." (P02)
".... From IS H, you can't do it, sir, it's just the amount, the number of workers in each Public Health Center and the movement of workers only...."(P21)

".... we have to processby ourselves which means it is not made in the dasboard itself...." (P28)
".... must be very lacking, if we follow the population ratio, it takes a lot overall...." (P25)

DISCUSSION

Based on the results as contained in part 4, that there are three main needs to develop an information system for nursing human resources, namely the components of the information system, the features of the information system and the information produced. The main components of an information system consist of hardware, software, networks, procedures, people, and databases that will determine the success of an information system. This is in accordance with the theory of nursing informatics related to computer science as proposed by Sipes (2019), Sutabri (2016), Kadir (2014), Jogiyanto (1999) as well as the results of research on the application of information systems by Yusof (2008), Herbst, et.al (1999), Lian JW et.al (2013). Generally, health facilities such as the Health Office, Hospitals and Puskesmas already have all or part of the information system components.

According to Kadir (2014), the information system contains the following components:
1) Hardware, which includes physical devices such as computers and printers
2) Software or program, which is a set of instructions that allows the hardware to process data
3) Procedure, which is a set of rules used to realize data processing and the generation of desired output
4) Persons, that is, all parties responsible for the development of information systems, processing and use of information system outputs
5) Databases, that is, collections of tables, relationships and others related to data storage
6) Computer networks and data communication, which are connecting systems that allow sources to be shared or accessed by a number of users

In practice, not all information systems cover all of these components. For example, a personal information system that only involves a user and a computer does not involve network and communication facilities. However, workgroup information systems involving a number of people and a number of computers require network and communication means

Hardware

Sutabri (2016), said that the main parts of hardware in computer systems are input tools, Central Processing Units (CPUs), storage tools (*secondary memory*), and output tools. Computers specifically CPU work digitally so that the equipment related to the CPU must work digitally anyway or at least the equipment has the function of changing from any form to digital anyway or vice versa. Input tools include keyboards, mice, digitizers, microphones, scanners. The processing tool is a central processing unit (CPU). Storage tools are hard drives, solid state drives (SSDs), flash disks and memory cards. Output tools are such as monitors, printers, plotters, speakers and projectors. In the study, it was found that all health facilities already have the hardware to use information systems.

Software

According to kadir (2014), a computer would be useless without the presence of software. The computer works on the basis of instructions. A set of instructions are given to control the computer hardware. This set of instructions is what is known as a computer program or programs. More generally, it is this program that is called hardware. Software is grouped into application programs and system programs. Meanwhile, Sutabri (2016), grouped software

into three: application programs, system programs and programming languages. The study found that in all health facilities there is software needed along with the available hardware.

Human

One of the components of information systems is human. According to Kadir (2014), human resources that are components of information systems are divided into two, namely end users and information technology specialists. An end user (also referred to as a client) is a person who uses an information system or information generated by an information system. In organizations, users can be grouped into staff, low-level managers, middle-level managers, high-level managers, and knowledge workers. In this study, generally the human components available were included in the end-user group. Information technology specialists were not obtained as participants. These final users are health workers such as nurses, midwives and public health workers. There are manpower who specialize in managing information systems, but there are also many manpower who hold multiple tasks. In the Health Office and Hospitals, there are personnel who specifically manage information systems. But in Puskesmas, information system managers are assembled by health workers such as nurses, midwives or public health workers.

Computer Networking and Data Communication

According to Kadir (2014), a computer network or often abbreviated as a network only, is a relationship of two pieces (generally in the form of a computer) or more whose main purpose is to carry out data exchange. In its paraktek, computer networks make it possible to share software, hardware, and even share processing power. Judging from the geographical range covered by a network, the network can be divided into three types: Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN).

Telecommunications is a long-distance communication that uses equipment such as telephone, television, radio, cable, telegraph and satellite. Telecommunications technology allows people to be able to send or receive information from somewhere far apart. Telecommunications is a broadly meaningful term, which includes both voice and data communication (text and images). So, data communication is only a part of telecommunications that is specifically related to the transfer of data or information in digital form from one device to another.

Computer networks and data communication are the basis of a wider network that connects a network with other networks globally around the world called the Interconnected Network or commonly called the Internet. According to Kadir (2014), by using this internet network, an organization can exchange information internally and externally with other organizations. With this internet, the information system can be accessed from anywhere and anytime. In this study, it was found that all health facilities already have an internet network even though it varies in bandwidth or internet speed and differs in connection stability due to differences in quality and availability of network devices.

Information System Features

The expected features of the nursing human resources information system include: complete; accessible from anywhere and anytime; can be accessed by all nursing staff and can update data independently; easily accessible and fast. It is also in accordance with the model of success of information systems as proposed by DeLone & McLean (2016) about system quality. In this study, it was found that the available human resource information system called SI SDMK, could only be accessed by data managers at the Health Office; Human

Resource Department at the Hospital; and Data managers at Puskesmas. Nurses cannot manage their own data in the sense that they cannot update the data independently.

Generated Information

About the information produced, there is a need to find out the number and ratio of nursing personnel to the number of residents reflecting the equitable distribution of personnel throughout the region as stipulated in the laws and regulations on the information system of health human resources. This is in accordance with the theory of success of information systems DeLone & McLean (2003) related to the quality of information and research on human, organizational and technological suitability as carried out by Handayani et.al (2016). In this study, it was found that the available human resource information was only in the form of the number of nurses without displaying the level of education, specialization and competence of nurses. Information about the number of these workers is also only available nationally, provincially and districtly, not yet covering the number of nurses at the district and sub-district levels.

The existing nursing human resources information system has also not been able to produce information about the distribution of manpower as seen from the distribution of nurses and the comparison of nurses to the total population, which generally uses the ratio of 1 nurse: 100,000 population; and the calculated density of the number of nurses compared to the area of the territory. To see the distribution of nurses in an area generally can only be done by a human resource information system that has the ability to display maps that are usually found in geographic information systems.

CONCLUSION

The results of the study found three themes, namely the components of the information system, the features of the information system and the information produced. The need for a nursing human resource information system expressed by participants is an input in the development of a nursing human resource management information system model that can produce information about the number, competence, authority and equity of nurses in terms of geographical distribution and the ratio of nurses to the number of residents and density to the area.

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