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CONTENTS

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Molecular Diagnostic Laboratory Setup and Maintenance for Sars-Cov-2

Burcu GÜRER GİRAY[1,2], Gökçe GÜVEN AÇIK[2], Yunus Emre BULUT[3], Asiye Çiğdem ŞİMŞEK[3], Mustafa Sırrı KOTANOĞLU[3]

Corresponding Author

Burcu GÜRER GİRAY

DOİ

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ABSTRACT

Importance of laboratory diagnosis has come to the spotlight once again with the COVID-19 pandemic caused by Sars-Cov-2 and significant changes have taken place in terms of laboratory operation. A global effort has emerged when all healthcare professionals faced a biological threat. Interlaboratory collaboration and multidisciplinary approach contributed to this effort. This study aims to explain step-by-step establishment of a fully capable laboratory for Sars-Cov-2 diagnosis to support local and global fight for the COVID-19 pandemic. Several precautions were taken, and disaster plans were updated because of the changes in employee health and workload distribution. Some of these are setting up a laboratory from scratch for microorganism diagnostic tests performed in pandemic cases, measures for healthcare workers, personnel assignment planning, changes in the variety and number of tests, innovations in quality standards and the contribution of laboratories to scientific studies. Ankara Molecular Diagnostic Laboratory has become one of the laboratories in Türkiye where Sars-Cov-2 and its mutations have been studied the most with 1,710,856 samples between 01 October 2020 and 01 May 2022 since its establishment and it has become the laboratory with the highest number of equipment and technical personnel in the capital. This study summarizes all the phases of Ankara Molecular Diagnostic Laboratory beginning with its establishment from the scratch and covers all the steps to render this facility fully operational.

[1,2] Assistant Professor Doctor, Yalova University Medical School Medical Microbiology Department Yalova, Ankara Provincial Health Directorate Public Health Molecular Diagnosis Laboratory Ankara. burcu.giray@yalova.edu.tr, Orcid Number: https://orcid.org/0000-0003-3165-8924

[2] MD, Ankara Provincial Health Directorate Public Health Molecular Diagnosis Laboratory, Ankara, gokce.guvenacik@saglik.gov.tr / Orcid Number: https://orcid.org/0000-0001-9788-9480

[3] Assistant Professor Doctor, Ankara Provincial Health Directorate Public Health Services, Ankara, yunusemrebulut@yahoo.com / Orcid Number: https://orcid.org/0000-0003-1501-2525

[3]Associate Professor, Ankara Provincial Health Directorate Public Health Services, Ankara, niemandmaster5@gmail.com / Orcid Number: https://orcid.org/0000-0001-8615-6150

[3]Associate Professor, Ankara Provincial Health Directorate Public Health Services, Ankara, mskotan@gmail.com / Orcid Number: https://orcid.org/0000-0002-6906-573X

INTRODUCTION

Severe acute respiratory syndrome coronavirus-2 (Sars-Cov-2), a new coronavirus, emerged in December 2019 in Wuhan, China is the etiological agent of the coronavirus disease 2019 (COVID) which was declared a pandemic by the World Health Organization (WHO) on March 11, 2020 (Tan et al., 2020). More than 532 million confirmed cases of COVID-19 have been reported worldwide with more than six million deaths by the end of March 2022 according to WHO data (WHO Situation Report., 2022). The first COVID-19 case in our country coincides with global pandemic declaration date and health services were significantly affected in the face of this unexpected situation (Finch et al.;2022). The diagnosis of COVID-19 infection caused by Sars-Cov-2 needs to be confirmed by laboratory tests. Reverse transcription and real-time polymerase chain reaction (RT-qPCR) based on the demonstration of Sars-Cov-2 viral RNA is the gold standard in diagnosis (Liu et al.; 2020). Sample collection, transportation and storage are the factors that affect the RT-PCR results mostly. Collecting accurute respiratory tract sample at the right time at the preanalytical stage is very important for an accurate and rapid molecular diagnosis of Sars-Cov-2 (Lippi, 2019). Number of centers performing the COVID-19 tests was increased shortly after the detection of the first case in Türkiye and this number has reached to 528 laboratories today (RTMH, 2022). The pandemic process still continues in the world and in our country. Some of the laboratories activated in this process have been integrated into existing laboratories and some have been established from scratch (WHO Interim Guidance, 2022). Ankara Molecular Diagnosis Laboratory which is the subject of our study is the highest capacity Sars-Cov-2 diagnostic test laboratory in Ankara. It is setup by repurposing emergency department of an old hospital and contains backups of every area.

Healthcare services have been severely affected by the COVID-19 pandemic and states have had to plan and act quickly. A guide titled "GP36-A, Planning Laboratory Operations During Disaster" was published by the Clinical and Laboratory Standards Institute (CLSI) based on previous experience (Williams et al.; 2014). This guideline published prior to the pandemic states that the annual re-emergence of common, severe, and seasonal influenza is a routine expectation. The possibility of the appearance of an unexpected new influenza strain with pathogenic potential has highlighted the need for each laboratory to carefully review its disaster plan periodically. The tests frequently performed during the pandemic are replaced by the intense Sars-Cov-2 diagnosis, follow-up, and screening tests while one-step reverse transcription and real-time polymerase chain reaction (RT-qPCR) based on the detection of mutated regions in viral RNA and Anti-SARS IgG, IgA, IgM tests have outstripped tests for other diseases (Lippi et al.; 2020). This significantly affected laboratory staff distribution, test load of the analyzers and material supply. In some cases, necessities such as kits and consumables and service requests could not be fulfilled (Lippi and Plebani, 2020). Health institution and the patients it served were affected in such situations. Some of the healthcare workers were reluctant to continue their work due to anxiety, some fell ill, and some passed away from the disease during the pandemic. Legal regulations or rewarding initiatives were implemented to prevent loss of personnel workforce and thus ensuring the healthcare service sustainability (Sharma B et al.; 2021, Tahamtan et al.; 2020). Special precautions had to be taken against viral contamination for the health and safety of laboratory workers with the pandemic. There were conflicts about the measures due to the lack of clear viral transmission routes information or data even though provisional guidelines were published at the beginning of the pandemic. Standards were improved with the increase viral transmission route evidencesduring the pandemic process.

The aim of this study is to evaluate the importance of the Molecular Diagnosis Laboratory which started its activities on October 01, 2020, within the Ankara Public Health, simultaneously authorized as the pandemic laboratory along with the effects on its staff and its operation as an instance of its preparation and setup processes during the pandemic.

MATERIALS AND METHODS

In our study, the preparatory phase in which samples from our laboratory were carried out in the laboratories established to respond to the COVID-19 pandemic, the phase in which the laboratory working system was rearranged, and the management of the personnel and samples were evaluated. COVID-19 (Sars-Cov-2 infection) was evaluated within the scope of contact tracing, epidemic management, patient monitoring at home and sample handling guide while de-identified samples were included in the study within the scope of routine work by the sample handling teams as a Scientific Advisory Board Study. The study was performed by retrospectively scanning the Laboratory Management Information System (LIMS) of the Ankara Molecular Diagnosis Laboratory after obtaining the approval of permission from Yıldırım Beyazit University Yenimahalle Training and Research Hospital Ethics Committee (Date: April 13, 2022, and Decision No: 2022-33). The study was in accordance

with the Declaration of Helsinki and its later amendments as revised in 2013.

Statistical analysis

Statistical Package of Social Sciences 22 (SPSS Chicago, IL, USA) software was used for data analysis and Excel was used to draw graphics. Categorical variables were expressed as numbers and percentages. The differences between the ratios were analyzed by Pearson chi-square analysis while $P<0.05$ was taken as statistical significance level.

Changes in Laboratory Organization

Laboratory Layout and Design

It has been decided to establish Ankara Molecular Diagnosis Laboratory where tests such as RT-qPCR, antigen antibody etc. for Sars-Cov-2 infection diagnosis are planned to be carried out in the emergency services unit of Numune Hospital which has physical and technical infrastructures such as sample reception, staff preparation room, automatic controlled door systems in terms of its layout and design. Personnel preparation areas, rest rooms and laboratory area where the personnel can wear their protective equipment before entering the laboratory have been designed. The Master Mix Preparation Room (Clean room), Extraction room, an Amplification room (Dirty room) and the room where the PCR devices will be placed are built for molecular analysis. It is very important that pre-PCR activities are separated from the amplification and analysis area as separate rooms or separate benches since there is usually a low amount of nucleic acid sample during preparation and a very high concentration after amplification. This means that false positive results can occur because of amplicon contamination if PCR is analyzed in the same area where the master mix and samples were prepared (Ortiz et al.; 2020).

Personnel working area was also made suitable for these conditions to ensure a one-way workflow. Areas that will enable healthcare professionals to change their personal protective equipment (PPE) since they may be contaminated with amplicon aerosols and intermediate sterilization stations where they can sterilize the PPEs under UV have been created for the personnel if they need to return to pre-PCR area from the amplification and analysis areas (Aberaa et al.; 2020). Since the physical conditions are suitable, these rooms are built with identical couple areas as backup so that the laboratory operations are not interrupted in case of possible contamination. Each room has dedicated special devices, equipment, and consumables. Equipment such as Real-Time PCR device, Biosafety cabinet II, refrigerator, freezer, vortex, and pipette set to be used in the COVID-19 test process and consumables such as pipette tips, Eppendorf tubes, gloves are provided by Ankara Public Health Laboratory. A significant increase in the sample density of the laboratory in 2022 is shown in Fig.1.

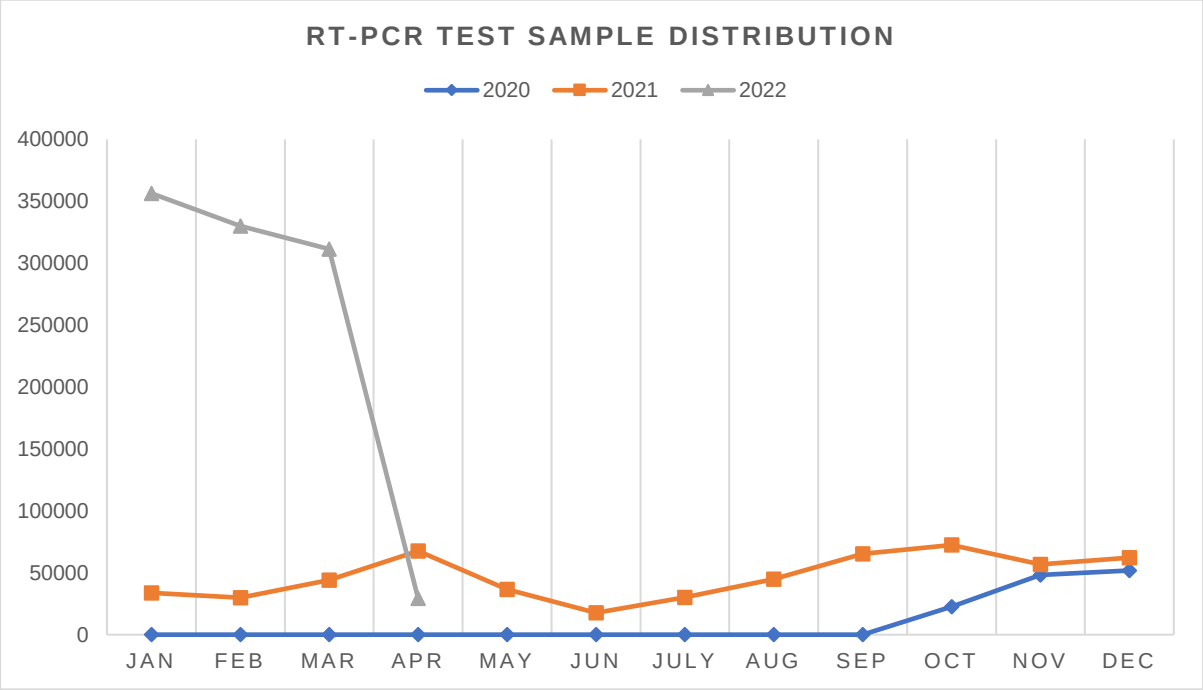

Figure-1 Distribution Chart of the Number of Samples Sent to Ankara *Molecular Diagnosis Laboratory from the Day It Was Opened Until April 2022 and the Comparison of the Total Number of Samples.*

Measures for Personnel Health

Some international and national guides on personnel health were published and updated at short intervals. Among these, the "Laboratory Biosafety Guidelines for Coronavirus Disease" published by WHO is the most up to date (WHO Interim Guidance, 2022). The purpose of this document is to provide provisional guidance on laboratory biosafety during the analysis of biological materials of COVID-19 patients. Each laboratory should take risk control measures by carrying out an institutional risk assessment to perform their analyses safely according to the guide.

Appropriate personal protective equipment (PPE), determined by a detailed risk assessment, should be used by all laboratory personnel analyzing biological material of COVID-19 patients. All technical procedures should be performed in a way to minimize the generation of aerosols and droplets (van Doremalen et al.; 2020). Appropriate disinfectants with proven efficiency against enveloped viruses (for example, hypochlorite, alcohol, hydrogen peroxide, quaternary ammonium compounds, and phenolic compounds) should be consumed during the recommended contact time, at the correct dilution level and within the expiration date after solution preparation. “Good Microbiological Practice and Procedures” should be followed when processing and analyzing all specimens, for PCR testing (WHO Interim Guidance, 2022). It is stated that the lysis buffer in RNA extraction is effective in inactivating the Sars-Cov-2 virus (CDC 2020). Patient specimens from suspected or confirmed cases should be transported as "Biological Substance - Category B (UN3373)". Viral culture or isolates should be transferred as “Infectious Substance Affecting Humans - Category A (UN2814)” (WHO, 2019). It shows that the Sars-Cov-2 virus may be susceptible to disinfectants [1,000 ppm (0.1%) for general surface disinfection and 10,000 ppm (1%) sodium hypochlorite, 62% 71% ethanol for disinfection of sample spills; 0.5% hydrogen peroxide; biocidal agents such as quaternary ammonium compounds or phenolic compounds] with proven activity against enveloped viruses (Chin et al; 2020). In the interim guide published by WHO it is recommended to use PPE for healthcare professionals according to personnel and type of activity during the care of suspected, probable, and confirmed COVID-19 patients (WHO COVID-19, 2020).

Terms and duration of use, the rules to follow when removing, reusability and risks of PPE are specified in cases where there is a shortage of PPE such as medical masks, FFP2, FFP3, N95, N99, N100 or equivalent respiratory masks, protective clothing, protective glasses, face shield, gloves (COVID-19 Laboratory Biosafety Guide, 2020). It is recommended that medical masks and FFP2, FFP3, N95, N99, N100 or equivalent respirators can be used without removing them for up to 6 hours when dealing with COVID-19 patients and are eventually to be destroyed. FFP1 breathing mask without exhalation valve can be used as an alternative in the absence of a medical mask. It is stated that decontamination processes can be performed using disinfection or sterilization methods for FFP2, FFP3, N95, N99, N100 or equivalent respiratory masks while reuse of medical masks is not recommended. It is not recommended to use a respirator together with a medical mask to prolong its use, alternatively, a face shield should be used (WHO COVID-19, 2020).

Cotton uniforms as protective clothing, reusable (washable) patient or laboratory personnel aprons can be washed with detergent at 60 ºC’ and reused. Disposable laboratory personnel aprons or liquid-proof plastic aprons are recommended as an alternative to these clothes. Disinfection for the reuse of goggles and face shields that fully cover the eyes can be used. Cleaning with soap/detergent and water, followed by 0.1% sodium hypochlorite (pursued by rinsing with water) or a 70% alcohol wipe respectively is recommended for disinfection. Safety glasses that partially cover the eyes as an alternative to goggles and transparent binding sheets with rubber bands that can be designed by the personnel as an alternative to the face shield can be used. The use of double gloves and repeated use of the same gloves are not recommended unless surgical intervention is required.

A provisional guide for the laboratory operations has been published by the national health administrators in our country (COVID-19 Laboratory Biosafety Guide, 2020). It is recommended to have separate clothes or uniforms and to wear shoes or closed slippers, and not to go home with these clothes. Uniforms should not be hung in the same place (hanger, closet) as other daily clothes and personnel should refrain from going to resting aras with aprons. It is recommended not to consume food and beverages outside the rest areas. The rest room and technical areas with windows should be ventilated periodically. WHO recommends 6-12 air changes per hour by opening doors and windows in healthcare environments where there are most likely viral load-bearing particles. It is recommended to use "suction mode" and avoid recirculation of air when using the air conditioner (WHO,2020).

It is recommended not to allow anyone other than the personnel to enter the laboratory and to apply the social distance rule by using a security strip in the sample reception unit. Disinfectant should be provided to all rooms, including the rest room, offices and technical rooms, and its use should be encouraged. Personnel meals can be served as disposable rations (COVID-19 Laboratory Biosafety Guide, 2020). Wastes belonging to a possible and identified COVID-19 patient in the laboratory environment where Sars-Cov-2 test is studied should be considered as infectious waste and disposed of as medical waste in accordance with guidelines (Waste Management in the COVID-19 Pandemic, 2022).

Challenges Faced by Laboratory Staff in the COVID-19 Pandemic

Personnel were transferred from other national health institutions/hospital due to the need for experienced technicians for Sars-Cov-2 PCR analysis. Increase in the anxiety and uneasiness of contracting the disease in our country caused some health personnel to retire or resign in this process. Laboratory professionals were assigned to non-laboratory sampling units to collect naso-oropharyngeal swab. Staff lost their motivation and anxiety were created because of these assignments that were not within the scope of their training (Blasco-Belled et al.; 2022). Effective training and competency assessment programs ensure that the perseonel are knowledgeable and competent for the tassk assigned to them and in their responsibilities according to CLSI's guideline "QMS03, Education and Competence Assessment" (CLSI guideline QMS03, 2016)

In this guide, it is recommended the personnel have the necessary knowledge, skills, and behaviors to fulfill their duties and tasks assigned to them with high quality along with a consisten and predictably high performance. Administrative leave was given to personnel who are older (60 and over), pregnant, have cancer, have a disability report, and have chronic diseases in our laboratory. In addition, number of personnel working in laborator was minimized to reduce the risk of contamination. Personnel were divided into teams and worked in shifts to reduce the number of tests, viral load, and exposure. Laboratory technicians were trained to use more than one device or system. However, workload per staff increased despite the rapidly decreasing test load. Laboratory specialists were assigned to outpatient clinics or wards where the COVID-19 patient diagnosis and follow-up outside the laboratory is carried out.

Personnel assignments and shifts dynamically changed during the pandemic process and these changes were adapted to laboratory conditions. Difficulties were experienced at the beginning of the pandemic due to time constraints, uncertainty, insufficient training, irregularity in personnel employment and long shifts even though incentive extra compensation for healthcare personnel due to COVID-19 was paid. Information was collected on satisfaction related to institutional policies implemented during the epidemic including providing PPE, sanitation practices, additional transport arrangements and education with a survey (n=64) of medical laboratory specialists in a developing country [25]. 68% of the participants stated that they were generally satisfied with the measures taken by the institution to deal with the crisis. 56% of the participants were satisfied with the timely, appropriate, and adequate PPE supply and 88% with the general cleaning practices. 18% of staff believed that previous training was lacking to effectively confront the pandemic except 7 unbiased responses. Only 34% of the personnel thought that transportation to/from health institution was sufficient even though ease of transportation is provided for employees to use. Many staff felt significant anxiety and worry as they could carry the virus home (Jafri et al.;2020).

Innovations in Quality Standards

Sars-Cov-2 is considered a Group 4 biological factor that causes severe human diseases, poses danger to employees, has a high risk of spreading to the community but does not have effective prevention and treatment methods. Each laboratory should conduct its own risk analysis within the scope of exposure to the agent and prevention of risks for this reason corrective and preventive measures should be taken in the action plan to reduce the risk. New documents and instructions related to COVID-19 or updates to existing ones should be made in health facilities in accordance with the quality standards in health. "Laboratory Operating Procedure" in our laboratory was updated and new documents such as "COVID-19 Pandemic Preparation and Action Plan", "Highly Infectious Patient Sample Instructions", "Cleaning and Disinfection Recommendations and Products to be Used in Possible/Definite Cases of COVID-19", "Recommended Personal Protective Equipment for COVID-19 Disease and Its Use" and "Occupational Health and Safety Unit COVID-19 Instructions" were introduced.

RESULTS

Sars-Cov-2 RT-qPCR test was performed on 1,710,856 patient samples between October 01, 2020, and May 01, 2022, in our laboratory. 47.5% belonged to female patients and 52.5% to male patients while the median age was determined as 48.0 (age range 1–98) among these samples.When the sample amount rates based by months in 2021 for our laboratory which was opened in November 2020 after being authorized by the Ministry of Health were compared, it was seen that there was an increase in April and October ($p<0.01$; from 50.1% to 66.8%) while the total number of applications for April 2022 was found to be significantly decreased ($p <0.01$; from 49.9% to 33.2%). 68.9% are under 50 years old, 19.6% are between 50-64 years old, 11.5% are over 65 years old and the median was 40.0 (age range 18-96) when the age groups are examined.

CONCLUSIONS

All laboratory professionals have demonstrated an extraordinary effort despite the lack of human and technical resources and gained experience in crisis management. This crisis has proven once again that laboratory medicine is central to clinical decision-making. Therefore, health policy makers and institution management should plan further laboratory discipline more reasonably. The importance and value of laboratories which are not only in the diagnosis of the disease but also in the prognosis and treatment follow-up should be conveyed to the senior management. The medical laboratory community should convene nd share information with each other, communicate with clinicians and strive to work in a multidisciplinary manner.

Since we must live with the pandemic for a while, resources should be invested into mobile laboratories equipped with the necessary devices and equipment along with trained personnel to support local testing operations to prevent health system and laboratory services from overloading and even collapsing in extreme conditions. Current diagnosis and risk estimation conditions should be improved with the identification of new biomarkers specific to the infectious agent. More reliable epidemiological studies should be performed, and the accessibility of these kits should be increased with the availability of licensed test kits and standardization of test protocols. Hygiene rules should be imposed as an indispensable part of our lives in terms of employee health to prevent personnel workforce and regrettable healthcare professional demise.

DISCUSSION

Personnel duties and authorizations should be defined, and it should be determined by whom the relevant process will be managed during the crisis. Mental, social, and economic needs of the personnel should be considered and the efforts to meet these requirements should be standardized to provide sustainable and high-quality performance. Progress will be achieved in processes to determine which individual is infected in the short term and to monitor the progression of the disease while determinining vaccine effectiveness to be developed in the long term with the developments in laboratory medicine.Several contributions can be made to virus research, drugs and vaccines development, service and resource management in health centers and mobility analysis to predict and manage scenarios arising from health problems with artificial intelligence projects based on data science.

In the COVID-19 pandemic which affected the whole world, we were faced with the stages of establishing a laboratory from scratch because of the insufficient number of laboratories for Sars-Cov-2 diagnosis in our country. In general, the inconvenience of physical conditions, small laboratory spaces, insufficient and inappropriate consumables, lack of competent technical personnel to work in the laboratory and long bureaucratic processes in personnel recruitment were the limiting factors in the first place. Pandemics are unpredictable situations. There is a need for multidisciplinary management systems that can make and implement rapid decisions by coordinating the laboratories where the tests in which gold standard tests in diagnosis are carried out to manage disasters such as the COVID-19 pandemic. Most of the Sars-Cov-2 research focus on the identification of the virus and the availability of the laboratory facilities, required equipments and trained personnel are taken for granted. Therefore investigations for Sars-Cov-2 specific laboratory requirements and their specifications are quite scarce in the relevant literature. The safety and design considerations of a mobile biocontainment laboratory for COVID-19 outbreak is presented in a research (Linster et al.;2020) but this is a very specific and minimalistic case when compared to a full-scale pandemic laboratory setup and maintenance effort provided in this study.

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We would like to thank our colleagues who did not spare their work day and night, and who did not leave the laboratory for days by staying away from their children, homes and loved ones since the day the pandemic started and all the healthcare workers in our country who struggled under the same conditions.

Conflict of Interest

The authors report there are no conflicting interests to declare.

Ethical Approval

The study was performed by retrospectively scanning the Laboratory Management Information System (LIMS) of the Ankara Molecular Diagnosis Laboratory after obtaining the approval of permission from Yıldırım Beyazit University Yenimahalle Training and Research Hospital Ethics Committee (Date: April 13,

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Assessment of Disaster and CBRN Knowledge and Attitudes of First and Emergency Aid Program Senior Students

Gülseren GÜNAYDIN[1], Mustafa GÜNAYDIN[2]

Corresponding Author
Gülseren GÜNAYDIN

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ABSTRACT

This study was carried out to examine the knowledge and attitudes of the last year students of the first and emergency aid program about disaster and CBRN.

All of the students (84 people) studying at Gümüşhane University SHMYO in the spring semester of the 2019-2020 academic year were included in the study and constitute the sample of the study. Written consent was obtained from the participants for the study, and our research was conducted in accordance with ethical rules. In order to carry out the research; The necessary institutional permission from the Gümüşhane University SHMYO Directorate and the ethics committee approval (number 2019/1) to conduct the research were obtained from the Gümüşhane University Scientific Research and Publication Ethics Committee. In order to collect data and examine the disaster and CBRN (Chemical-Biological-Radiological-Nuclear) knowledge level and attitudes of the senior students of the first and emergency aid program, a survey form prepared by the researcher within the scope of the literature was used.

The senior students enrolled in the first and emergency aid program stated receiving disaster- (76.2%) and CBRN-related (79.8%) education, and 89.3% reported attending these practices. They were aware of having 75% and 100% additional roles and responsibilities during and after the disasters, respectively. Moreover, 51.2% of the participants remarked that they primarily engaged in therapy and health practices, whereas 63.1% indicated that they were partially ready in case of a disaster.

In line with the data obtained within the scope of the study, the senior students studying in the first and emergency aid programs have previously received training on disaster and CBRN issues and participated in exercises, they have a large role during and after the disaster, they mainly do treatment and health practices, in case of any disaster. However, it was concluded that they were partially ready.

[1] Lecturer, Trabzon University – Tonya Vocational High School – First-aid and Emergency Program, ORCID ID: 0000-0003-2471-5329, e-mail: gunaydingulseren@gmail.com.

[2] Lecturer, Karadeniz Technical University – Araklı Ali Cevat Özyurt Vocational High School – Occupational Health and Safety Program, ORCID ID: 0000-0002-7753-8541, e-mail: mustafagunaydin@ktu.edu.tr.

INTRODUCTION

There are several disasters taking place in today's world. Recent disasters originating from human involvement with nature have been especially devastating. Societies must take substantial measures against disasters in addition to their subsequent effects since the societal harm caused by disasters has been increasing gradually. In this context, a disaster might be defined as a natural or human-induced occurrence that results in physical, financial, and social losses for all or a part of society, halts or interrupts life and human activities, and affects the society with a low coping capacity (www.afad.gov.tr). The detailed analysis of the ensuing disasters indicates that human-made tragedies such as energy and power conflicts and global technical accidents stand out within the scope of the consequences of disasters. The deployment of chemical and biological warfare agents in recent battles has drawn particular attention. These conditions emerge as a threat or danger of inevitable consequence of intentional CBRN material usage (chemical, biological, radiological, and nuclear) as weapons in acts of terrorism and sabotage or by the unintentional release of CBRN materials used as byproducts or intermediates in industrial production, the health sector, laboratories, and scientific research (AFAD, 2023). Hence, it is crucial to build an effective disaster management system, identify local and national resources, and use them accordingly to properly manage disasters and be affected by them with minimal loss. In this regard, being in a disaster-ready state will contribute to communities recovering from disasters with less harm (Guerdan, 2009). Considering these scenarios, efficient personnel and the readiness of those personnel stand out as critical elements in disasters. A Turkish medical emergency team consists of an emergency medical technician (EMT), physician, emergency care technician (ECT, Paramedic), ambulance, and driver for delivering first and emergency medical aid services. In addition, there is also the disaster unit established under the provincial health branch directorates and the national medical rescue team (NMRT-UMKE), running its operation under this unit, providing medical emergency aid services (Aslantaş and Tabuk, 2021:46). In this context, based on the Van Earthquake that occurred in 2011, in the first hours of the event, by AFAD; Civil Defense Search and Rescue Units Directorates in 11 provinces and search and rescue, health and first aid personnel (8243 people) from 48 provinces and 39 institutions quickly reached the earthquake area and intervened (AFAD, 2023). This shows that we are at a very important level in terms of training effective personnel as a country. Several studies reported that nurses are among the health professionals not fully prepared to respond to disasters (Labrague et al., 2016:101-103; Çelik, 2010:44-51; Özcan, 2013:31; Taşkıran, 2015:52-60). Similarly, another study indicated that the disaster preparedness of the health workers was moderate (Tan & Acımış, 2022:110-112). However, a separate study focusing on disaster preparedness reported that the perceptions of disaster preparedness of 112 health workers at all stages were at a high level (Aslantaş and Tabuk, 2021:53). This study, therefore, aimed to assess the disaster and CBRN knowledge and attitudes of the senior students enrolled in the first and emergency aid program.

MATERIALS AND METHODS

Purpose of the Research

This study was carried out to examine the knowledge and attitudes of the first and emergency program senior students about disaster and CBRN.

Research Sample

The research sample consists of senior students (84 individuals) enrolled in the first and emergency aid program at Gümüşhane University VSHS during the spring semester of the 2019–2020 academic year.

Research Ethical Standards

The study participants provided their written consent, enabling the study to conduct in compliance with ethical standards. The Gümüşhane University Scientific Research and Publication Ethics Committee issued its approval (number 2019/1) for the research project, and the University VSHS Directorate provided the required institutional permission to carry out the research.

Data Collection and Analysis

The data of the study were collected by face-to-face interview technique with those who agreed to participate in the study. A survey form prepared by the researcher within the scope of the literature was used in order to collect the data and examine the level of knowledge and attitudes of the first and emergency program senior students about disaster and CBRN. In the data collection form; It consists of two parts in total, the part consisting of questions to determine the demographic characteristics of the participants and the questions to determine the knowledge and attitudes of the participants about disaster and CBRN. Data were collected by face-to-face interview technique through

the data collection form, the collected data were numbered and data were entered and analyzed using the IBM SPSS Statistics 21 package program. Frequency, percentage, arithmetic mean and chi-square tests were used in the analysis of the data.

RESULTS

Below is a summary of the study's findings in the form of a ratio and frequency (in parenthesis). Accordingly, the following data represents participants' demographic features. For the distribution of the gender variable, the female and male student rates were 63.1% (n=53) and 63.9% (n=31), respectively. Regarding the age-variable distribution, however, the rates of 9.5% (n=8), 41.7% (n=35), 17.9% (n=15), 15.5% (n=13), 13.1% (n=11), and 2.4% (n=2) correspond to the ages of 19, 20, 21, 22, 23, and 24, respectively. Regarding the marital status variable distribution, all participants were single; as a result, the rate was 100% (n=84). Finally, the distribution of the educational level variable was as follows; only 4.8% (n=4) of the students were high-school graduates, whereas 82.1% (n=69) of the students had an associate degree and 13.1% (n=11) had an undergraduate degree.

Table 1. Distribution of participants by variable "What does the term 'disaster' mean to you?"

VARIABLE		N	%	TOTAL
What does the term ' disaster' mean to you?	Natural disasters such as earthquakes, landslides, soil sliding, etc.,	11	13.1	84
	A widespread pandemic disease with a high transmission rate, such as swine flu, bird flu, etc.,	0	0.0	
	Terrorist acts with biological, chemical, or explosive agents,	0	0.0	
	Human casualties due to wreckages in coal and gold mining,	0	0.0	
	All	72	86.9	

Table 1 displays the distribution of the participant responses to the variable question **''What does the term 'disaster' mean to you?''** Accordingly, 13.1% of students (n=11) responded that the term 'disaster' refers to earthquakes and landslides-like incidents, while 86.9% of students (n=72) replied that disaster means all incidents, including earthquakes, pandemics, terrorist attacks, mining wreckage, etc. When the following question **''What characteristics should an event possess to qualify it as a disaster?''** was posed to the participants, the distribution of the responses for this query was as follows: 20.2% (n=17) of students responded that 'It should interrupt regular life,' while 89.8% (n=67) of students replied 'all' option, meaning that 'It should interrupt regular life, it should result in the inadequacy of existing local resources, increase in psychological and social problems, and cause economic crises.'

Table 2. Distribution of participants by variable "Have you ever experienced any disaster throughout your life?"

VARIABLE		N	%	TOTAL
Have you ever experienced any disaster throughout your life?	Yes	28	33.3	84
	No	56	66.7	

As depicted in Table 2, participants responded to the query **''Have you ever experienced any disaster throughout your life?''** with the following ratios; students who replied 'yes' were 33.3% (n=28), whereas it was 66.7% (n=56) for 'no' response.

Table 3. Distribution of Participants by Disaster-Related Education Variable

VARIABLE		N	%	TOTAL
Receiving Disaster-Related Education	Yes	64	76.2	84
	No	20	23.8	

Table 3 illustrates the distribution of students who received disaster-related education; as a result, 76.2% (n=64) of the students responded with 'yes', whereas 23.8% (n=20) of them replied that they did not receive any disaster-related education.

Considering the distribution of the responses given to the query **"Have you ever participated in a disaster drill before?",** 89.3% (n=75) of the students replied with 'yes', whereas 10.7% (n=9) responded with 'no'. However, the answers given the variable **"Which disaster drill did you participate in?"** indicated that

the percentage of students who responded 'fire' was 29.8% (n=25), 'earthquake' was 47.6% (n=40), and 'other/did not participate' was 22.6% (n=19). The distribution of the responses to the variable **"Is there a disaster plan for the place where you live?"** revealed that the rates of students who responded as 'yes', 'no', and 'no reply' were 21.4% (n=18), 20.2% (n=17), and 58.3% (n=49), respectively. When the students were asked **"Whether they reviewed a Disaster Plan or not,"** %11,9 (n=10) of them replied yes, whereas %88,1 (n=74) responded no for this variable. The distribution of the student responses to the variable **"Do you have an emergency bag (go bag) where you reside"** resulted in 16.7% (n=14) affirmatively, whereas 83.3% (n=70) negatively. Finally, for the variable of **"Would you like to prefer a course on Emergency Aid and Disaster Management in the Curriculum?",** 94.0% (n=79) of the students responded with 'yes', whereas only 6.0% (n=5) replied 'no'.

Table 4. Distribution of participants by variable "What does the term 'CBRN' imply to you?"

VARIABLE		N	%	TOTAL
What does the term 'CBRN' imply to you?	Chemical, Biological, Nuclear, Reactive	11	13.1	84
	Radioactive, Biological, Chemical, Nuclear	7	8.3	
	Chemical, Biological, Radioactive, Nuclear	66	78.6	

When the distribution of the variable **"What does the term 'CBRN' imply to you?"** is examined, the rate of students choosing the response 'Chemical, Biological, Nuclear, Reactive' was 13.1% (n=11); however, the response rate was 8.3% (n=7) for 'Radioactive, Biological, Chemical, Nuclear' and 78.6% (n=66) for 'Chemical, Biological, Radioactive, Nuclear.'

According to the distribution of the variable **"Have you ever received education on CBRN issues?"** the rate of the student responses as 'yes' was 79.8% (n=67), whereas it was 20.2% (n=17) responded as 'no'. When asked **"Where did those who received education on CBRN issues?"** the participants gave two different answers: 92.6% (n=62) and high school (7.4%, n=5). The percentage of students who answered 'yes' and 'no' to the question about the distribution of the variable **"information about the characteristics of CBRN agents"** was 34.5% (n=29) and 15.5% (n=13), respectively; however, 50% (n=42) of the students responded this query 'partially'. Analysis of the participant distribution on the **"preliminary education and practice about CBRN"** variable revealed that 95.2% (n=80) of the students had preliminary education and practice, whereas 4.8% (n=4) of them had none. Regarding the distribution of the **"knowledge about medical intervention in CBRN attacks"** variable, the rates of students who responded as yes and no were 89.3% (n=75) and 10.7% (n=9), respectively. Finally, when taking into account the distribution of the variable **"knowing what to do in the event of a CBRN attack, either actual or probable,"** 67.9% (n=57) of the students responded positively, while 32.1% (n=27) of them answered negatively.

Table 5. Distribution of participants by variable "Information about syndromes and symptoms ensuing from exposure to the CBRN agents"

VARIABLE		N	%	TOTAL
Information about syndromes and symptoms ensuing from exposure to the CBRN agents	Yes	36	42.9	84
	No	7	8.3	
	Partially	41	48.8	

As depicted in Table 5, when the distribution of the variable "**Information about syndromes and symptoms ensuing from exposure to CBRN agents**" is examined, the rates of students who responded as 'yes' and 'no' were 42.9% (n=36) and 8.3% (n=7), respectively. However, 48.8% (n=41) of the students replied to this query as 'partially.' Considering the student distribution for the **"Awareness on how to protect themselves from any CBRN attack"** variable, the rate of students who said 'yes' and 'no' were 48.8% (n=41) and 51.2% (n=43), respectively.

Regarding the distribution of the **"The weapon with which you are most familiar in today's world"** variable, while 22.6% (n=19) of the students responded with the nuclear weapon, 48.8% (n=41) of them replied to other option (atomic bomb, AK-47, Rocket, Bullet, etc.). However, 28.6% (n=24) of the students posed no response to this query.

Table 6. Distribution of participants by variable "Using equipment in any CBRN attacks and retaining information about their attributes"

VARIABLE		N	%	TOTAL
Using equipment in any CBRN attacks and retaining information about their attributes	Yes	20	23.8	84
	No	14	16.7	
	Partially	50	59.5	

As displayed in Table 6, an assessment of the student distribution for the " Using equipment in any CBRN attacks and retaining information about their attributes" variable indicated that the percentage of students who responded affirmatively and negatively were 23.8% (n=20) and 16.7% (n=14), respectively. However, 59.5% (n=50) of the students answered this query as 'partially'.

Table 7. Distribution of Participants by Variable "Are you aware of the early warning system?"

VARIABLE		N	%	TOTAL
Are you aware of early warning system?	Yes	44	52.4	84
	No	11	13.1	
	Partially	29	34.5	

According to the distribution of the variable **"Are you aware of any early warning mechanism?"** as shown in Table 7, the percentage of students who responded with 'yes' and 'no' was 52.4% (n=44) and 13.1% (n=11), respectively. However, 34.5% (n=29) of the students answered this query with the 'partially' option.

Considering the student distribution for the variable of "Whether the public has information of shelters in any CBRN attack", the response rates of students for 'yes' and 'no' were 61.9% (n=52) and 38.1% (n=32), respectively. Similarly, in the distribution of answers given according to the variable "Where is the safe places for the public if there is any CBRN attack?", the response rates of the students were 93.1% (n=41) for shelter and 6.9% (n=3) for safe zones. Regarding the student distribution for the variable "Whether waste management is essential after the CBRN Attacks", 88.1% (n=74) of the students replied with 'yes', whereas 11.9% (n=10) answered with 'no'. Participants answered three sub-queries for the "When do paramedics have a critical role to play?" variable. For instance, when asked about the roles of paramedics in the pre-disaster period, 34.5% (n=29) of the students agreed, whereas 64.3% (n=54) disagreed. Contrarily, 75.0% (n=63) and 23.8% (n=20) of the students agreed and disagreed, respectively, when asked about the roles of paramedics during the disaster. However, all students 100.0% (n=84) agreed that paramedics have a role in the post-disaster period. The distribution of the students for the "As a paramedic, are you prepared for disasters?" variable was as follows; 36.9% (n=31) of the students responded with 'yes', whereas 14.3% (n=12) replied 'no'. However, 48.8% (n=41) of the students responded with 'partially ready' for the disasters. The distribution of student responses to the query "What roles do you think a paramedic plays in a disaster" displayed that 51.2 (n=43) of students responded with 'treatment/care,' 36.9% with 'search and rescue,' and 11.9% (n=10) selected 'other' option (consultant, coordinator, educator, administrator). Finally, the answers given to the query "Who is the responsible authority for CBRN or Disasters?" was as follows; 4.8% (n=4) of the students responded with State and 2.4% (n=2) with AFAD; however, a sizable portion, 92.9% (n=78), of the students believed that all governmental bodies (State, AFAD, Ministry of Interior, non-governmental organizations, etc.) were responsible authorities for disasters.

DISCUSSION

This study aimed to evaluate the disaster and CBRN knowledge and attitudes of the first and emergency aid program senior students.

The current study revealed that 76.2% and 79.8% of the first and emergency aid senior students studying at the university received disaster-related and CBRN-related education, respectively. In addition, 89.3% of the participants attended disaster drills. When asked where they received their education on CBRN- and disaster-related topics, 92.6% of them referred to the universities in which they enrolled. From this perspective, the universities serve as the primary basis for the sizable mass of First and Emergency Aid Students to receive their education in CBRN. Suryantoa et al. (2018) reported that health-related education contributes positively to individuals' knowledge levels. Another study by Mozafari et al. (2021) concluded that education comprehensively improved the personal degree of knowledge. Abelsson et al. also emphasized that receiving education assertively influenced skill development. Hasan, Uddin and Younos stated in their study in 2020 that nursing students in Bangladesh have

low level of disaster knowledge and the reason for this is poverty and they have difficulty in reaching quality education because of this situation. Carter, Drury and Amlot stated in their studies in 2020 that having preparedness information in CBRN events would result in a positive development. According to Güner (2016), individuals who attended the disaster drills had a greater level of disaster-related medical knowledge than those who did not.

In another conclusion, the current study ascertained that 88.1% of the First and Emergency Aid students never reviewed a disaster plan, and 78.5% of them were unaware of the availability of a disaster plan for the region in which they resided. The current study also discovered that 83.3% of the students did not have an emergency bag in their residence. In a survey conducted among 112 health professionals, Tan and Acımış (2021) reported that they posed a moderate disaster preparedness level. The current study participants also opined that the significance of paramedics would increase during (75%) and immediately after the disasters (100%).

Considering the distribution for the variable "What roles do you think a paramedic plays in a disaster", 51.2% of the First and Emergency Aid Students responded with 'treatment/care' and 36.9% with 'search and rescue.' The remaining 11.9% of students replied 'other' option (consultant, coordinator, educator, administrator). Güner (2016) reported that the professions, including Emergency Medical Technician and Ambulance and Emergency Care Technician groups, had a higher degree of disaster-related medical knowledge. Gündüz and Ersoy (2022) also found that, in addition to regular education, individuals with medical response experience had a higher degree of knowledge than those without experience.

Regarding the variable "Are you prepared for the disaster?", the study found that 63.1% of respondents were only partially ready for the disasters. Aslantaş and Tabuk (2021) reported that the 112 station employees had a high perception of preparedness at all stages of the disaster. As another variable, "Awareness on how to protect themselves from any CBRN attack", 48.8% of the students indicated their preparedness (yes responses). Similarly, Dinçer and Kumru (2021) reported that merely 23.2% of the participants responded that they were aware of the application procedures in case of a CBRN attack. Regarding the variable "Who is responsible for CBRN attacks or disasters?", a minority of the students responded to this query as State (4.8%) and AFAD (2.4%); however, the vast majority (92.9%) indicated that all institutions, including State, AFAD, Ministry of Interior, non-governmental organizations, and similar bodies, were responsible. Therefore, it is safe to say that almost all First and Emergency Aid students' opinions converged that all public entities and citizens are accountable for CBRN attacks and disasters.

CONCLUSIONS

In line with the data analyzed, the current study concluded that the senior students in the first and emergency aid program previously received disaster- and CBRN-related education participated in their drills, had more responsibility during and after the disaster, primarily carried out treatment and health procedures, and was only partially ready for any disaster. According to the study findings and in line with other literature, providing the necessary disaster- and CBRN-related education at regular intervals and conducting drills periodically in light of this training will significantly improve the knowledge of employees and students. This study recommends regularly supplementing the necessary theoretical and practical disaster-related practices with additional training activities, such as working under challenging conditions, advisory and guiding, and social and psychological training, for health providers to serve effectively in disasters.

Conflict of Interest

The author indicate no conflict of interest.

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Ontario's Digital Health Vision in the post-COVID-19 Pandemic Era: A Canadian Perspective

Fatih SEKERCİOĞLU[1], Syed HAMİD[2]

Corresponding Author
Fatih SEKERCİOĞLU

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ABSTRACT

The Canadian healthcare system has successfully enabled the average Canadian to live a longer life since the early 1980s. Yet, the prevalence of chronic diseases among Canadians is higher than ever, thereby increasing pressure on the healthcare system to develop a new vision based on the realities of the post-COVID-19 pandemic. The responsibility for Canada's healthcare is allocated amongst multiple actors and/or agencies, as the federal government and provinces/territories have significantly different responsibilities. Our study aims to discuss digital health strategies in Ontario, Canada. We examine best practices across the world and propose a digital health vision for Ontario and elsewhere. The lack of an integrated healthcare system often limits access to digital health tools, thus creating a fragmented digital health environment with organizational silos of health information. As a result, healthcare services may not use the advantages of digital health tools efficiently and effectively. We discuss some of the challenges of creating a digital health vision, such as financial feasibility, privacy, ease of use, and reaching vulnerable populations.

[1]Assistant Professor, School of Occupational and Public Healtrh, Toronto Metropolitan Universirty, Toronto, fsekercioglu@ryerson.ca / Orcid Number: 0000-0003-1249-7432

[2] Research Assistant, School of Occupatiopnal and Public Health, Toronto Metropolitan University, Toronto. Ordic number: 0000-0002-8965-657X

INTRODUCTION

In the post-COVID-19 pandemic era, healthcare modernization is being driven by the rapid development and innovation of digital health technologies, thus providing a significant opportunity for addressing various shortcomings in healthcare (Desveaux et al., 2019). Digital health can be broadly defined as "the transfer and delivery of healthcare and health resources and services through information and communications technologies" (Hyman et al., 2022). The various applications of digital health technologies range from diagnosis and treatment to health management and healthcare delivery (Mathews et al., 2019). Digital health innovations equip healthcare providers with the tools needed to get a more holistic view of patient health through an intersection between technology and healthcare. Recent digital health innovations offer an opportunity to improve health and healthcare delivery by empowering consumers to access their health information through a variety of digital tools, giving patients more control over their health (Ontario Ministry of Health, 2022).

Over the last 40 years, the Canadian healthcare system successfully enabled the average Canadian to live a longer life with fewer disabilities (Lattimer et al., 2019). However, the prevalence of chronic diseases among Canadians is higher than ever before, thereby increasing the pressure on the healthcare system and placing more responsibilities on individuals for managing their own health (Lattimer et al., 2019). Despite the constant innovations of digital health technologies, the operating model for delivering healthcare in Canada remains the same (Hyman et al., 2022). As users within the Canadian healthcare system are becoming more involved with their health and gaining increased access to their health information, Canada needs to re-evaluate its healthcare model. The variability between and within provinces and territories in digital health technologies contributes to the complexity of the healthcare system, thus making it challenging to adopt a new operating model that is more effective (Barr & Randall, 2021). New policies and practices are needed to address the complex stakeholder environment and seamlessly merge the gaps created by high-level policy barriers between the Canadian healthcare system and patients (Lattimer et al., 2019). Given that the responsibility for Canada's healthcare is allocated amongst multiple actors and/or agencies as the federal government and provinces/territories have significantly different responsibilities, this study discusses the digital health strategies in Ontario, examines best practices across the world, and proposes a digital health vision for Ontario and elsewhere. Moreover, this study discusses some of the challenges of creating a digital health vision, such as financial feasibility, privacy and ease of use, and reaching vulnerable populations.

Digitization of Ontario's Healthcare System

The Government of Ontario shifted their focus onto Digital Health in 2015 by introducing the Digital Health Strategy (Desveaux et al., 2019). The Digital Health Strategy assessed existing public health programs and identified whether digital innovation could be integrated into those programs (Desveaux et al., 2019). The University Health Network, Canada's largest academic research hospital, laid the foundations for digital health with the implementation of ConnectingGTA, a digital health service that electronically integrates patient data across the healthcare continuum (Isaackz & Chang, 2019). As a result, clinicians and patients have a better experience at the point of care because clinicians can easily access relevant patient information, thus providing faster and more coordinated care to patients (Isaackz & Chang, 2019). ConnectingGTA allows providers to share health information more effectively and improve treatment waiting times (Isaackz & Chang, 2019). Although the digital health landscape was transformed through the introduction of ConnectingGTA, especially the way data is used to collaborate, the digital health environment is fragmented due to silos of personal health information (Isaackz & Chang, 2019). Unfortunately, in many cases, digital health technologies remain to be used at the local scale.

Desveaux et al. (2019) identified various target areas at the policy level that should be prioritized in order to catalyze digital health innovation in Ontario. Firstly, Desveaux et al. (2019) suggests that a system-level definition of innovation is needed since the current broad and varied definitions of innovation across key stakeholders hinder effective communication and collective action (Desveaux et al., 2019). Furthermore, Desveaux et al. (2019) proposed that a clear overarching mission for digital health innovation would reduce tension between the healthcare system and patient benefit. The publicly funded nature of the healthcare system results in pressure between the needs of the healthcare system and the benefits experienced by the patient, which is exacerbated by the fact that while the patient benefits from the service, they do not pay for the service (Desveaux et al., 2019). Currently, virtual care is driven by the needs of individual organizations, and the patient experience is seldom considered, leading to virtual care initiatives that are characterized by a top-down approach instead of a frontline approach (Desveaux et al., 2019). The Council of Academic Hospitals of Ontario (CAHO), one of Ontario's Ministry of Health's selected innovation brokers, represents Ontario's 23 research hospitals and acts as an entryway for innovations into Ontario's healthcare system (Chahal & Rudnick, 2019). CAHO published a list of critical problems that required intervention from digital health innovators, resulting in innovators responding to the specific needs of the CAHO member hospitals (Chahal & Rudnick, 2019). With each member hospital having

an independent decision-making process for the proposed digital health projects, a series of challenges arise, namely hospitals struggling to process the numerous digital health projects and having an acceptance criterion that rejects/defers 90% of the proposals (Chahal & Rudnick, 2019). Digital health innovators responding to the critical issues published by CAHO is an example of virtual care initiatives that cater to the needs of individual organizations. Furthermore, clinician resistance is another reason a less effective top-down approach is favoured since clinicians oppose the implementation of digital health innovations they perceive to be disruptive (Desveaux et al., 2019). Palacholla et al. (2019) supports these findings, and further suggest that the adoption of emerging digital health technologies is strongly influenced by its ability to integrate into the existing workflow of healthcare providers. Digital health technologies that were ready to be utilized within pre-existing clinical workflows were less likely to face clinician resistance (Palacholla et al., 2019).

Ontario's key players within the virtual care environment are fragmented and operate as independent organizations, leading to a lack of accountability and the absence of an agenda to follow (Desveaux et al., 2019). Ontario's Ministry of Health developed a Digital Health Board that acts as an advisory committee (Desveaux et al., 2019). The Digital Health Board is defined as a "sponsor" of digital health, and as a result is acquitted from taking any accountability for Ontario's digital health innovations (Desveaux et al., 2019). The lack of a fully responsible agency creates a significant challenge to implement digital health innovations efficiently and timely in Ontario. The most recent attempt to coordinate health care delivery was the formation of Ontario Health agency in 2019.

Another consequence of the fragmented virtual care environment is a virtual landscape with a varying range of digital health technologies (Desveaux et al., 2019). As a result, hospitals across Ontario do not have a uniform approach regarding virtual care because they acquire digital health technologies driven by a procurement process specific to the institution (Desveaux et al., 2019). Although Ontario's Ministry of Health has recently developed guidelines regarding data access and exchange of data between hospitals and primary healthcare providers in Ontario, it has left interoperability specifications to be prioritized at a later date (Ontario Ministry of Health, 2022). Desveaux et al. (2020) claims that existing regulations and incentives in Ontario stifle digital health innovation by reinforcing the status quo, which in turn results in institution-specific procurement processes for digital health innovations, thus resulting in operational silos that exacerbate the fragmented nature of the digital health environment in Ontario.

The Province of Ontario currently uses two main platforms in the context of digital health system: 1. Ontario Telemedicine Network; 2. E-health Ontario with overarching goals of supporting clinical decision-making, enhancing healthcare services and improving the health of Ontarians (Ontario Health, 2023). It took several years to develop and activate the electronic medical record programs such as Digital Health Drug Repository (DHDR), Clinical-Connect, Clinical-Viewer. The aforementioned digital health programs are connected to all of the heath care provider offices and institutions (Ontario Health, 2023). The next main challenge is developing systems that can reach vulnerable populations such as older adults in their homes which will consequently reduce pressure in the health care facilities.

Barriers to Establish an Effective and Efficient Digital Health System in Ontario

As digital health technologies evolve outside the health system and become increasingly available to consumers, the need for a digitally integrated healthcare system grows. According to a large Canadian study, 39 percent of Ontario's population track one or more aspects of their health using digital health technologies (Parè et al., 2018). Moreover, close to 86 percent of family doctors in Canada are utilizing a digital system to access electronic records, a 13 percent increase from 2015 (Canadian Institute for Health Information, 2020). Canadian provinces lag far behind peer countries with regard to accessing digital health services (Neumeier, 2019). Canada was ranked last out of eleven countries in terms of access to care in the 2017 Commonwealth Fund rankings, indicating that while digitally integrated tools for healthcare have advanced considerably, the healthcare system still falls behind (Neumeier, 2019). A key driver of this is the misalignment between the needs of patients and the design of the healthcare system with regard to digitally integrated tools (Hyman et al., 2022). Challenges to Ontario's ability to implement a digitally integrated framework that will adequately meet patient needs include financial feasibility, privacy and cybersecurity, and ease of use.

The fragmented nature of the healthcare system has resulted in healthcare institutions utilizing institution-specific processes to obtain digital health technologies (Desveaux et al., 2019). Since Ontario's healthcare organizations have different approaches to procuring digital health technologies, it is difficult to maintain consistency.

A large survey conducted in Alberta indicated that older Canadians and Canadians with lower education were less likely to utilize digital health tools, especially if the digital health tools were only available in English (Hyman et al., 2022). Ontario needs to avoid creating a digital divide by integrating digital health services that do not consider language barriers and the digital health literacy of the population (Superina et al., 2021). Digital health tools need to be tailored for minority populations, especially immigrants and older ethnic

minorities. Hyman et al. (2022) conducted a study in British Columbia and found that immigrants, older adults, and older ethnic minorities are less likely to use digital health tools due to low English and technology literacy (Hyman et al., 2022). Therefore, the implementation of digital health innovations must involve an assessment of the needs of ethnic minority groups concerning their digital health literacy (Hyman et al., 2022). The design of digital health tools should incorporate cultural norms and preferences in order to increase the accessibility of the tools to marginalized communities (Hyman et al., 2022). With healthcare systems rapidly transforming to adopt digital health innovations, it is critical to emphasize the importance of community participation to develop effective and culturally appropriate digital health tools (Hyman et al., 2022).

Although the use of digital health technologies has great potential to alleviate the stress placed on the healthcare system, there is an increased concern with cyber security as there will be a financial incentive to exploit personal data (Baumgart, 2020). Given the rising concerns of cyber security, legislation calling for tighter data protection is required (Baumgart, 2020). The current guidelines that govern the use of personal health data across Canadian provinces have a large degree of variation on what is covered under the guidelines and the level of details provided (Barr & Randall, 2021). Ontario offers several guidelines covering topics that range from encrypting and securely storing personal health information electronically to the proper disposal of electronic information (Barr & Randall, 2021). Moreover, Ontario is among the only provinces in Canada that provided specific guidelines regarding the collection, transfer, use, storage, and destruction of digital health information (Barr & Randall, 2021). As healthcare delivery becomes more reliant upon digital health technologies, the vulnerability to cyber-attacks increases as well (Ontario Ministry of Health, 2022). One particular challenge for Ontario will be to establish an electronic medical record system across large hospitals and smaller physician practices that is resistant to being penetrated by malware (Siegel, 2020). Currently, OntarioMD certifies electronic medical records based on pre-established requirements for privacy and security of patient data (Siegel, 2020). However, with the introduction of a digitally integrated system that has the ability to transfer data within Ontario's healthcare system, the security standards must be updated to minimize the chance of cybercriminals launching successful ransomware attacks (Siegel, 2020). The 2019 LifeLabs hack allowed cybercriminals to steal the health data of 15 million patients in Ontario and British Columbia and shut down computer systems of three hospitals in Ontario by successfully downloading malware onto one laptop that was connected to the entire health network (Siegel, 2020). Therefore, Ontario will have to develop tools and resources for clinicians and patients in order to actively safeguard health information and prevent cyberattacks.

Organizations that develop digital health innovations are financially responsible for procuring funding and maintaining ongoing funding throughout the development and implementation of digital health innovations (Desveaux et al., 2019). Innovations are primarily funded through institutional operating budgets or public grants through national agencies like the Canadian Institutes of Health Research (Desveaux et al., 2019). The delicate funding structure impacts the sustainability of innovations and results in siloed investments that challenge the implementation of innovations. As a result, Ontario will need to design policies that take into consideration funding structures, since currently the responsibility for sustained funding is on the organization, thereby impacting the sustainability of the digital health project (Desveaux et al., 2019). Additionally, the lack of financial means acts as a patient-level barrier for the usage of digital health tools (Whitelaw et al., 2021). Ontario will need to create guidelines that allow digital health technologies to be tailored depending on the affluence of the region they will be implemented in (Whitelaw et al., 2021). This includes pricing digital health tools fairly, so they can be used by the target users, the ability for patients to claim digital health tools through insurance plans, and the development of infrastructure that will allow digital health tools to operate in remote region (Whitelaw et al., 2021). The pandemic response enabled the testing and the use of newer digital health technologies but there still need to be future planning in regards to staff training and financial feasibility. Ensuring health equity when developing digital health technologies should be an integral foundation.

Best Practices in Digital Health Systems

The use of digital health technology in Canada was of great benefit during the COVID-19 pandemic and can be of even more significant benefit in the future if the potential is realized and harnessed. According to Hyman et al. (2022), if every Canadian had access to digital health tools there would be an approximate decrease of 47 million in-person visits to healthcare providers, resulting in significant financial gain. Clearly, digital health innovations have tremendous potential in meeting the healthcare needs of Canadians, and policies that encourage digital health innovations and expand access to digital health technologies for Canadians can assist the Canadian healthcare system to evolve.

Healthcare strategy should focus on the patient experience rather than the institution, and the implementation of effective digital health technologies can achieve that. The UK National Health Service (NHS) utilizes Amazon to deliver virtual care to NHS patients, in an effort to make clinical services available digitally to patients (Webster, 2019). Utilizing Amazon to deliver virtual care allowed the NHS to divert

patients from having to visit physical healthcare facilities, and instead enjoy the benefits of a virtualized setting, thus mitigating backlogs and excess waiting times (Webster, 2019). The introduction of technology companies into the digital health realm led to the successful implementation of digital health technologies in many countries such as India and Brazil (Webster, 2019). For example, an online pharmacy named "1mg" launched an e-pharmacy in India that allowed its services to become available to patients living in small villages that did not have access to physical pharmacies (Webster, 2019). By allowing digital health innovations to be delivered by technology companies that can fulfill the demand for digital health services, the NHS was able to effectively integrate patient-focused health innovations.

Germany has specific legislation targeted toward having a uniform definition of standards, which results in healthcare digitization occurring under a standardized framework (Weber & Heitmann, 2021). The legislature in Germany defines interoperability as the ability for systems and organizations to work together seamlessly and has initiatives that emphasize collaboration between systems throughout the healthcare system (Weber & Heitmann, 2021). Germany regulates the exchange of information in the health care system by requiring the digital health documents to be designed in such a way that the data can be exported in suitable interoperable formats and used throughout the healthcare continuum (Weber & Heitmann, 2021). Moreover, the digital health innovations in Germany are required to use interoperable interfaces, in an effort to readily integrate into the healthcare system (Weber & Heitmann, 2021). Since health organizations, health systems, and digital health innovations are required to use interoperable interfaces, data exchange between digital health technologies and the healthcare system is possible (Weber & Heitmann, 2021). This allows Germany to store patient data in a centralized electronic health record, which allows patients to quickly access their updated health data and transfer data from their digital health tools into the centralized electronic health record (Weber & Heitmann, 2021).

An innovative approach to digital health system was developed by Turkey in 2015 with the establishment of a web-based, mobile Personal Health Record (PHR) system, e-Pulse (Şık, Aydınoğlu, & Son, 2021). The e-Pulse enables both health care providers and patients reach personal health data conveniently. The system integrates the information systems of all health institutions so that the members of the public can view their lab results, medical images, prescription and medication details, emergency information, diagnosis details, reports and health records conveniently.

The government of Israel has implemented policies that allow health information to be shared through a central repository that collects health data from electronic medical records and makes it available to researchers (Lattimer et al., 2019). Similarly, the Alberta Health Services, responsible for administering healthcare services and delivery to the residents of Alberta, developed the most extensive integrated digitalized healthcare system in Canada by creating a central repository to seamlessly disseminate health data across the province (Baumgart, 2020). The Alberta Electronic Health Record Information System (EHRIS) provides access tools through the Alberta Netcare Portal, thereby allowing users to view their health data electronically (Baumgart, 2020). The Alberta Netcare Portal is linked to the Connect Care system, which is a central access point that collects and stores health information and disseminates health information as required to patients and healthcare providers (Baumgart, 2020). The digital infrastructure initially developed for the Connect Care system allowed Alberta Health Services to implement various virtual health services during the COVID-19 pandemic (Baumgart, 2020). Thus, Alberta's ability to develop an integrated digital health infrastructure allowed Alberta's population to appreciate elements of digital health like electronic referrals to healthcare providers, virtual consultations, and access to their own medical records (Baumgart, 2020).

The Australian Digital Health Agency (ADHA) formed the National Digital Health Strategy in an effort to improve the Australian health infrastructure and lay the foundation for a seamless transition to digital healthcare (Australian Digital Health Agency, 2022). The ADHA established seven strategic priorities that it aims to achieve by 2022 (Australian Digital Health Agency, 2022). One of the key strategic priorities is providing access to health information to both patients and healthcare providers (Australian Digital Health Agency, 2022). The introduction of My Health Record, an electronic health record system, in 2018 allowed every Australian to have immediate access to their health information (Australian Digital Health Agency, 2022). Moreover, starting in 2022, healthcare providers were also able to access and manage patient's My Health Record, thus allowing for faster dissemination of information across the healthcare system (Australian Digital Health Agency, 2022). Australia's My Health Record provides similar advantages to Alberta's Connect Care system which includes better coordination of healthcare services, a more efficient healthcare system, reduction of duplicate testing, and immediate access to patient data (Australian Digital Health Agency, 2022). The use of digital health records provided clinicians with comprehensive medical records and reduced duplicated pathology tests by 18% per week (Biggs et al., 2019). The My Health Record platform allowed health information to be securely exchanged through protected digital channels (Australian Digital Health Agency, 2022). Furthermore, My Health Record utilizes a standard method to collect patient data, thus making the system interoperable in various public and private clinical settings (Australian Digital Health Agency, 2022).

Another advantage of My Health Record is healthcare providers will minimize harm to patients by preventing adverse drug events and medication errors, since all prescribers and pharmacists will have access to the patient health information (Australian Digital Health Agency, 2022). According to Biggs et al. (2019), 2-3% of hospital admissions in Australia each year relate to a medication error, and cost $1.2 billion annually. The improved access that My Health Record provides to patients and clinicians should reduce the number of medication errors (Biggs et al., 2019). Although there are considerably well-designed programs in some countries around the world, it is evident that there is not one best solution where a digital health system addresses the all of the challenges including financial feasibility, privacy, ease of use, and reaching vulnerable populations.

Proposed Solutions to Ontario's Digital Health System

As a consequence of the Canadian healthcare system being under both provincial/territorial and federal jurisdictions, the access to health information is limited at the patient level, resulting in patients having to personally communicate their healthcare information at every point of care (Canadian Institute for Health Information, 2020). Access to digital health tools is further limited by the lack of an integrated system, thus creating a fragmented digital health environment with organizational silos of health information that make it difficult for digital health tools to utilize health data to improve the patient experience (Lattimer et al., 2019). Efforts have been made on a local scale to create an integrated digital health system, such as the Ottawa Hospital partnering with five other health organizations to implement a central digital health information system, or the ConnectingGTA program electronically integrating patient data across the healthcare continuum (The Ottawa Hospital, 2019). Ontario used ConnectingGTA as a blueprint to roll out a provincial electronic health record, somewhat improving the integration of care (Isaackz & Chang, 2019). However, the electronic health record has varying success in integrating into clinical workflows, making it more likely to face clinician resistance (Mehta et al., 2020). Furthermore, the heterogeneous nature of the electronic health record results in minimal interoperability between platforms (Mehta et al., 2020). Policies and regulations need to be updated to ensure they allow health data to be shared efficiently across the healthcare system while maintaining confidentiality (Lattimer et al., 2019). Furthermore, digital connectivity that allows for the seamless dissemination of health data while preserving data security will significantly improve digital health technologies that depend on data analytics (Lattimer et al., 2019). To establish an effective digital health framework, Ontario needs to implement a system-level definition of innovation for key stakeholders to follow, create a central database for patients to access their health information, and resolve the lack of interoperability that is preventing the development of new digital health innovations (Lattimer et al., 2019). The lack of a system-level definition for digital health innovations identified in Ontario hinders effective communication and collective action in the development of digital health technologies (Desveaux et al., 2019). Existing digital health frameworks that have been developed in other provinces and overseas can provide direction to Ontario's digital health framework.

Digital health innovations lack a clear overarching vision and instead are driven by the requirements of individual organizations (Desveaux et al., 2019). Ontario needs to focus on developing a client-driven strategy that will allow digital health innovations to be better implemented across the province (Choudhury, 2020). This can be achieved by establishing a standardized interoperable interface for digital health systems across the province.

The integral step to establish a better digital health framework is crating an agency with a mandate to develop and maintain digital health systems. This proposed agency should be at both provincial and federal levels so that the unity can be maintained across Canada. Another key component will be the implementation of legislation that creates a uniform definition of standards, resulting in healthcare digitization occurring under a standardized framework. Ontario can utilize Alberta's EHRIS as a blueprint for developing a central repository of digital health data and superimpose it with policies similar to the ones Germany implemented, thus allowing data to be easily integrated. A standardized framework that regulates information in the healthcare system and requires data to be collected in an interoperable format would encourage collaboration throughout the healthcare continuum and create a better initiative for digital health innovations to integrate seamlessly into the healthcare system. A central repository would also address the fragmentation of the digital health environment resulting in silos of personal health information. Ontario can utilize organizational repositories to develop an infrastructure that has the ability to connect the organizational repositories that captured, store, and maintained patient diagnostic, treatment, and care information, to a central repository as done in Israel.

A central repository was one of the key strategic priorities in Australia's digital health framework, resulting in faster dissemination of information across the healthcare system. The development of My Health Record allowed Australia's healthcare system to appreciate immediate access to patient's health information, resulting in better coordination of healthcare services and a more efficient healthcare system. Therefore, an electronic health record system in Ontario that builds on the foundations laid by

ConnectingGTA and utilizes a central repository will be better structured and allow for the seamless dissemination of health data on a provincial scale across healthcare providers with varying electronic health record systems, thereby developing digital connectivity across Ontario. Investment in telehealth infrastructure will address health equity issues and result in considerable savings. Palacholla et al. (2019) states that the ability for a digital health innovation to integrate into existing clinical workflows is a significant predictor of the success of that digital health innovation. The formation of Ontario Health was a step in the right direction but has not been sufficient to address the future needs of Ontario's digital health framework. More investment including human and financial capital is required to enhance the current system.

CONCLUSIONS

The Canadian healthcare system has been successful in enabling the average Canadian to live a longer life since the early 1980s but the prevalence of chronic diseases among Canadians is higher than ever, thereby increasing pressure on the healthcare system to develop a new vision based on the realities of the post-COVID-19 pandemic. The responsibility for Canada's healthcare is allocated amongst multiple actors and/or agencies, as the federal government and provinces/territories have significantly different responsibilities. Based on our comprehensive review of the best examine best practices across the world, we argue that integrated healthcare system often limits access to digital health tools, thus creating a fragmented digital health environment with organizational silos of health information. We propose establishing a new organization at the provincial and federal levels with a sole digital health mandate to develop an effective and efficient digital health vision for Ontario.

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Nurse's welfare in terms of compensation, job stress, and Job Sat isfaction against Nurse Performance in Indonesia

Rendi Ariyanto Sinanto[1]

Corresponding Author

Rendi Ariyanto Sinanto

DOİ

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ABSTRACT

Nurses are at the forefront of health development in Indonesia. Currently, the nursing profession still needs to be prosperous and has problems related to compensation, job stress, and job satisfaction. This study aims to determine how payment, job stress, and job satisfaction on nurse performance. The method used in this research is a literature study by taking the data source through garuda.ristekbrin.go.id, published in the 2015-2020 period and downloaded on 12-16 March 2021. After selecting and identifying according to the inclusion criteria, ten articles were reviewed. The results showed that the welfare of nurses is paramount, and appropriate compensation has a significant effect on motivation and enthusiasm to improve nurse performance. Nurse performance is related to work stress experienced by nurses. The welfare of nurses influences work stress, and the workload is not appropriate. Then low work stress on nurses can increase the productivity of nurse performance. Productive nurse performance can provide nurse job satisfaction so that the quality of nursing services becomes optimal. Suggestions for the government to pay attention to nurses' welfare to achieve an optimal health degree from prosperous and dignified nurses.

[1] *Faculty of Public Health Universitas Ahmad Dahlan e-mail: rendisinanto@gmail.com*
Orcid Number: https://orcid.org/0000-0003-4598-080X

INTRODUCTION

Nurses are one of the frontline elements in health development, Law Number 38 of 2014 concerning Nursing states that nurses are an integral part of health services based on nursing knowledge and tips. Nursing services prioritize holistic aspects, including biological, psychological, sociological, and spiritual elements, comprehensively provided to individuals, families, or groups, both healthy and sick, to achieve optimal health (UU No 38 tahun 2014; Salbiah, 2006).

Nurses are the most significant number of health workers in Indonesia. According to data from the Ministry of Health, as of December 2019, 376,136 nurses are employed in health service facilities throughout Indonesia (Kemenkes, 2019). Even though they are in the first rank of the most significant number of health workers, not all nurses get decent welfare. In 2014 the Indonesian National Nurses Association obtained data that 11,300 nurses worked as honorary and voluntary workers in government-owned institutions (Kemenkes, 2017).

Currently, the nursing profession still needs to prosper. The compensation received by nurses needs to be commensurate with the workload done. Research by Husin, Huda, and Ranisa (2017), found that management must evaluate the wage system that is not appropriate. According to the results of this study, it is concluded that the nurses' payroll system or wages still needs to be feasible, so there is a need for a better change in the nurses' payroll system (Husin et al., 2017).

Also, many honorary and voluntary nurses still need the government's attention in Indonesia. According to a report from DPR.go.id Wednesday, February 26, 2020, it was found that members of Commission IX of the House of Representatives of the Republic of Indonesia requested that honorary nurses receive priority attention. The government is considering appointing honorary nurses as state civil servants (DPR RI, 2020). Based on this report, it is evident that honorary nurses have yet to receive good government attention, especially regarding compensation at work.

The nursing profession currently has various serious problems, especially related to an increase in the number of nurses increasing every year, and need to be matched by the available employment opportunities. This is in line with the Ministry of Health data that the national need for nurses per year is 24,825 people, and the excess production of nurses is 11,067 to 22,060 nurses per year (Kemenkes, 2011). Also, this is influenced by the increasing number of nursing colleges in Indonesia. As evidenced by Santy's (2012) research, it was found that an increase in nursing colleges increased nurse graduates. Also, according to Ristekdikti (2016), nursing colleges have increased significantly in Indonesia. For diploma education, there are 416, and for professions are 257 institutions (Ristekdikti, 2016).

In addition to welfare issues related to compensation or salaries, then the problem of escalating the nurse workforce, which continues to increase every year, there are also problems related to nurses' job satisfaction. The results of Yulinast's research (2016) found that the level of job satisfaction among implementing nurses is still low (60.7%). This proves that current nurse satisfaction is low, and there is a need for efforts to increase the job satisfaction of nurses. There are also research results from Pangulimang, Pandelaki, and Porotu'o (2019), which state a relationship between salary and job satisfaction. This is an indicator that a fair wage will provide satisfaction to nurses.

The level of stress in the nursing workforce is also a problem. Nurses' workload is very high, which is not proportional to the compensation obtained so it can cause stress on nurses. This is in line with the results of research by Martyastuti, Isrofah, and Janah (2019) which state that there is a relationship between workload and stress levels in nurses. Nurse stress and satisfaction will undoubtedly affect the performance of nursing care provided to the community. This is in line with the research of Sirait, Pertiwiwati, and Herawati (2017) that a sound wage system will give satisfaction to nurses, which impacts good employees. Based on the research results, it can be concluded that the compensation factors received by nurses influence stress and satisfaction. If the compensation is appropriate, then the service will be good.

Nurses can provide professional services to patients if the welfare of nurses is fulfilled. Research results say that voluntary nurse workers expect attention from agencies and the government to be prosperous (Siregar & Antoni, 2017). This study confirms that the nursing staff has not received good attention, which can cause the risk of decreasing the quality of nursing care because the nursing profession is not yet prosperous.

Based on the description above, the formulation of the problem in this study is how are compensation, job stress, and job satisfaction on the performance of nurses. This study aims to determine how pay, job stress, and job satisfaction impact nurse performance. This research will benefit the government in prioritizing the nursing profession without policy discrimination. In addition, it will also help the nursing profession to be prosperous and dignified to realize professional nursing care from successful nurses to an optimal health degree.

MATERIALS AND METHODS

This research was conducted using the literature review method from March 12, 2021, to March 16, 2021, with narrative reporting. The study was conducted on articles on http://garuda.ristekdikti.go.id published from 2015 to 2021.

The sequence of processes carried out in this study: 1) Identification of research questions, 2) Developing research protocols, 3) Determining the location of the database which is used as a search area, 4) Selection of relevant research results, 5) Selecting quality research results, 6) Extraction of data from individual studies, 7) Synthesis of results, 8) Presentation of results. (Perry & Hammond, 2002 in Siswanto, 2012) (Siswanto, 2012).

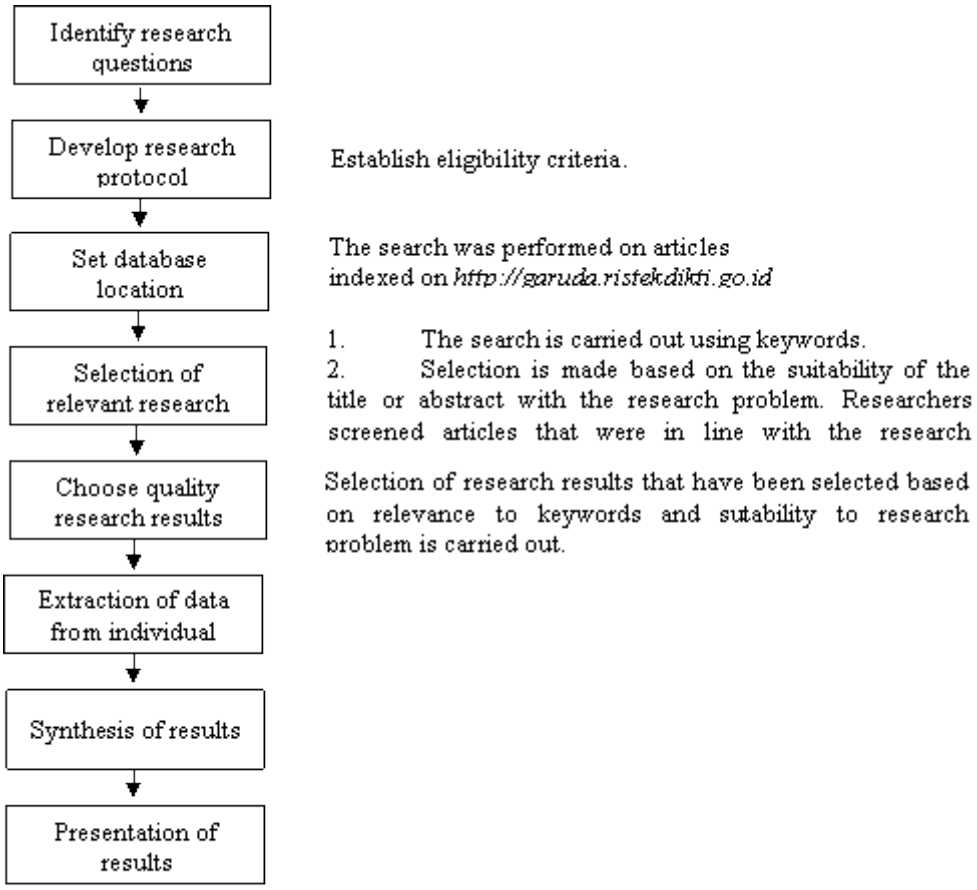

Figure 1. Research Process Sequence

Eligibility Criteria

Inclusion criteria

- The research was conducted in Indonesia in the 2015-2020 period.
- The article is published on http://garuda.ristekdikti.go.id
- The article discusses the number of nurses, the welfare of the nursing profession, the nurse's wage system, the job satisfaction of nurses, and work stress on nurses.

Exclusion criteria

- Articles that cannot be downloaded
- Abstract articles are not clear.

Selection of articles obtained

The selection stage is carried out through the following process:

- Keyword assignment

Search for articles that investigate problems according to the research topic using the following keywords: nurse welfare, nurse condition, nurse salary, nurse satisfaction, nurse stress, and nurse compensation.

- Exploring the title, the abstract was carried out based on the eligibility criteria
- I was exploring the contents of articles on eligible articles.
- I scanned the bibliography to explore the article's relevance with the research being carried out.

Data collection process

Data was collected manually using a form consisting of author, article title, name of journal or conference, and year of publication.

Types of data

The types of data taken are:

- Research titles.
- Researchers.
- Names of journals or conferences and universities.
- Research results relevant to the research problem.

The exploration of the search keywords is summarized in table 1:

No	Keywords	Articles found	Selected articles	Published articles
1	Nurse welfare	7	1	6
2	Nurse's condition	12	0	12
3	Nurse salary	3	1	2
4	Nurse satisfaction	320	4	316
5	Stress nurse	192	2	190
6	Compensation for nurses	28	2	26
	Total	562	10	552

RESULTS

According to a search on the database, it was found that 562 articles were relevant to keywords, and all articles were written in Indonesian. The research was conducted in the 2015-2021 period. Based on the number of articles found, 552 articles were excluded because they were included in the exclusion criteria, and ten articles were included in the inclusion criteria. The following are the results of the research found summarized in table 2.

Table 2. Research Results

Author/Title	Result
(Sabrina et al., 2015) / "The Effects of Compensation, Organizational Communication, and Work Environment Against the Job Satisfaction of Nurses at PKU Muhammadiyah Gombong Hospital"	The results of this study indicate that compensation has a positive and significant effect on job satisfaction. Organizational communication has a positive and significant impact on job satisfaction, and the work environment has a positive and significant impact on job satisfaction.
(Akhmadi et al., 2016) / "The Effect of Compensation and Job Satisfaction on the Organizational Commitment of Nurses and Contract Midwives at Bhayangkara Hasta Brata Hospital Batu Malang"	The results showed that compensation had a significant effect, either directly or indirectly, through job satisfaction on nurses' and midwives' organizational commitment.
(Ferawaty et al., 2016) / "The Effect of Rewards and Motivation on Job Satisfaction of Public Service Agency Nurses (BLU) at Bhayangkara Hospital Makassar"	The results showed that rewards affected nurses' job satisfaction, motivation affected nurses' job satisfaction, and tips and inspiration had a simultaneous effect on the job performance of nurses.
(Hardani, 2016) / "Job Stress, Job Satisfaction With Quality of Life of ICU Nurses in Type B Hospital"	Job stress will affect the quality of life of nurses.
(Fitria & Sawitri, 2017) / "The effect of rewards, incentives, division of tasks and career development on job satisfaction of nurses in Prof. orthopedic hospital. Dr. R. Soeharso Surakarta"	The results showed that reward has a positive and significant effect on the job satisfaction of nurses, incentives have a positive and significant impact on the job satisfaction of nurses, division of tasks has a positive and significant impact on the job satisfaction of nurses, and career development has a positive.

(Lukito et al., 2017) / "The Relationship Between Work Stress and Work Productivity In Inpatient Nurses Tk III Hospital 07.08.01 R.W. Mongisidi Telling Manado"	There is a relationship between work stress and work productivity.
(Putri et al., 2018) / "Factors Related to Job Satisfaction of Inpatient Nurses at the Tugurejo Regional General Hospital Semarang"	The results showed a relationship between recognition, potential development, promotion opportunities, income, working conditions, hospital policy and administration, individual interaction, and supervision with nurses' job satisfaction.
(Mukti, 2018) / "Analysis of the Effect of Job Stress, Work Support and Salary Satisfaction on Turnover Intention of Nurses (Study at Nirmala Hospital, Purbalingga)"	The results of this study indicate that job stress has a positive and significant effect on nurse turnover intention. Then work support hurts turnover intention, and the consequences of salary satisfaction hurt turnover intention.
(Sulidah & Retnowati, 2019) / "Analysis of the Relationship of Welfare Levels on Motivation and Job Satisfaction of Nurses and Midwives in Border Area Community Health Centers"	There is a relationship between the level of welfare, motivation, and job satisfaction of nurses and midwives.
(Hikmat & Melinda, 2019) / "The Relationship between Workload and Job Satisfaction of Nurses"	There is a relationship between workload and the job satisfaction of nurses.

DISCUSSION

The results of the review of the selected articles show that compensation has a significant effect on job satisfaction. According to Ardana (2012), compensation is everything employees receive as a service from their contribution to the company. In this case, nurses' compensation is a form of wages earned for their contribution to healthcare facilities. Research by Ferawaty et al. (2016) found that rewards affect the job satisfaction of nurses. The same results were found in the study of Putri et al. (2018), that there is a relationship between income and job satisfaction of nurses. Job satisfaction is an attitude that is fun and loves the job being done (Hasibuan, 2007). Then there are also research results that state that compensation has a significant effect directly or indirectly through job satisfaction on nurses' organizational commitment. According to this description, it can be concluded that the appropriate compensation can increase the job satisfaction of nurses.

Research from Sabrina et al. (2015) shows that compensation positively and significantly affects job satisfaction. This result is in line with Mukti's (2018) research that salary satisfaction hurts turnover intention, meaning that fair wages can provide satisfaction to nurses. Hence, the nurse's desire to resign is low. According to Rino's research (2017), it is known that the job satisfaction of civil servant nurses (43.6%) is in the unsatisfied category. Job satisfaction of noncivil servant nurses (56.4%) is in the dissatisfied category. According to the results of this study, it is concluded that when Many nurses feel aggrieved, they need to be adequately rewarded to increase their job satisfaction (Rino, 2017).

According to Putri et al. (2018), hospital policy and administration can be a factor in job satisfaction for nurses. This can be in the form of incentives the hospital provides to nurses. Incentives are wages other than fixed salaries that aim to increase employee productivity. This is in line with Fitria and Sawitri's research (2017) that incentives have a positive and significant effect on the job satisfaction of nurses. The division of tasks and career development also affect the job satisfaction of nurses. There are research results that are in line with Manuho, Warouw, and Hamel (2015). It is known that there is a relationship between workload and nurses' performance in providing nursing care. Based on these results, it can be concluded that employees who get attention such as division of tasks, and career development from the workplace will feel comfortable and satisfied at work, increasing work productivity. Based on a study, it was found that recognition, potential development, and promotion opportunities were factors in achieving job satisfaction for nurses.

Nurses who get decent awards will undoubtedly have the motivation to carry out professional nursing services. According to Hamzah (2011), motivation encourages someone to behave to achieve specific goals. This theory is in line with Vanchapo and Lewar's (2020) research that wages affect employee motivation. According to a study by Novitasari (2019), satisfaction significantly correlates with nurse performance. The same results were found in Ferawaty et al.'s (2016) research that motivation influences nurses' job satisfaction and rewards, and motivation simultaneously affects nurses' work performance. According to the results of this study, appropriate compensation will increase the work motivation of nurses to create good performance in nursing services.

Also, Fitria and Sawitri's research (2017) found that reward significantly affects nurses' job satisfaction.

According to Hasibuan (2010), a reward is a reward for workers' services to encourage enthusiasm for work. According to this description, it can be concluded that the nurse who gets the award will be prosperous, so he is satisfied at work. Prosperity is a human condition in a thriving, healthy, and peaceful state (Widyastuti, 2012). According to this theory, nurses with a good level of welfare will provide good nursing services. This is supported by the research results from Sulidah adn Retnowati (2019), that there is a relationship between the level of welfare and motivation and job satisfaction of nurses and midwives.

Then organizational communication and work environment positively and significantly affect job satisfaction. This is in line with Oldemar's (2015) research which states that the climate affects job satisfaction. The same results found that working conditions have a relationship with the job satisfaction of nurses. Organization and leadership affect the job satisfaction of a nurse. Research says that work support hurts nurse turnover intention, meaning that the higher the work support from the organization or leader, the lower the nurse's desire to leave their job.

In addition to compensation, there is a workload that affects the job satisfaction of nurses. This is by the research of Hikmat and Melinda (2019) that there is a relationship between nurses' workload and job satisfaction. According to Marquis and Huston (2000), the workload is a series of activities carried out by nurses at healthcare facilities (Marquis & Huston, 2000). According to Nursalam (2014), nurse workload is the nurse's entire activity while on duty in the health unit. Nurses with a light workload tend to carry out nursing services well and avoid work stress, which can reduce the quality of service. This is in line with the research of Jundillah, Ahmad, and Saktiansyah (2017), which states that there is a relationship between workload and work burnout on the incidence of work stress in nurses. According to the results of this study, it proves that good nursing services can be achieved if nurses' stress level is low, the workload is light and promising job satisfaction.

Job stress on nurses can affect nursing services. Job stress occurs due to stimulation in work and affects work's smoothness (Christian, 2005). According to research by Rewo, Puspitasari, and Winarni (2020), it was found that there was a relationship between workload and work stress on nurses. Then work stress will affect the performance of nurses. This is in line with research according to Premana, Arisdiani, and Nurmalia (2015) that there is a relationship between work stress and nurse performance. The same results are found in the research of Mandagi, Joseph, and Rattu (2020), that there is a relationship between job stress and nurse performance, meaning that nurses with high work stress have poor performance. The same study found a relationship between work stress and productivity (Lukito et al., 2017 ; Nurhikmah et al., 2018). According to the results of these studies, it is proven that job stress can affect nursing services.

Based on research from Sulistyawati, Purnawati, and Muliarta (2019), it was found that the work stress level of nurses describes that the majority have moderate stress levels. The same research also states that nurses who experience stress 95.4% (Mulfiyanti et al., 2020). A study says that there is a relationship between job satisfaction and job stress in nurses (Tisa et al., 2018). Then, research says that work stress has a positive and significant effect on nurse turnover intentions, meaning that nurses with higher work stress will have a greater chance of leaving their job. Nurses who have job satisfaction have low-stress levels, and job satisfaction will improve the performance of nurses. This is in line with Mariana and Irfani's (2015) research, which states a significant relationship between job satisfaction and job loyalty of nurses.

Also, research says that job stress can affect the quality of life of nurses. Nurses who experience work stress will affect their performance in nursing services (Surtini & Saputri, 2020; Lumingkewas et al., 2015). Job stress also impacts the physical condition of nurses, such as fatigue. This is supported by research by Mulfiyanti et al. (2020), which states a significant relationship between work stress and fatigue. Fatigue in nurses will provide sub-optimal service quality due to nurses' changing habits, one of which is disturbed sleep patterns. This is in line with Triwijayanti, Romiko, and Dewi's (2020) research on a relationship between sleep problems and nurse performance. According to the results of this study, it can be concluded that work fatigue and stress will influence nurses' performance.

CONCLUSION

Based on the literature review, it can be concluded as follows:

The nurse is one of the health workers who are with the patient 24 hours a day, so the presence of a nurse is very strategic in health services. A health service, in this case, nursing service, will be optimal if it is carried out by economically, socially, mentally and spiritually prosperous nurses. Welfare for nurses is very important, and appropriate compensation significantly influences motivation and enthusiasm to improve nurse performance. Nurse performance is related to work stress experienced by nurses; work stress is influenced by the welfare and workload of nurses that are not appropriate. Then low work stress on nurses can increase the productivity of nurse performance. Productive nurse performance can provide nurse job satisfaction so that the quality of nursing services becomes optimal.

SUGGESTION

Suggestions for the government of the Republic of Indonesia to provide policies that favour the nursing profession by paying attention to the welfare of nurses so that optimal health degrees can be achieved from prosperous and dignified nurses. Then the Indonesian National Nurses Association (PPNI) can guard the government's policies for the nursing profession so that the nursing profession does not experience policy discrimination.

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