Arab American University

Faculty of Graduate Studies

Assessment of reporting and documentation of Corona virus (COVID-19) outbreak in Palestine – Situation analysis

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This thesis was submitted in partial fulfillment of the requirements for Master's degree in

Health Informatics

May/ 2022

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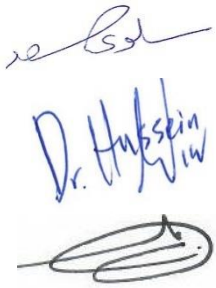
1. Supervisor: Dr. Salwa George Massad	
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Declaration

I certify that this thesis is submitted in fulfillment of the requirements for the degree of master's degree in health informatics. I, the undersigned is the presenter of this thesis, which has the title

"Assessment of reporting and documentation of Coronavirus (COVID-19) outbreak in Palestine – Situation analysis"

I declare that the work presented in this thesis is my own work, except where otherwise acknowledged, and that this thesis as a whole or any part of it has not been previously submitted to obtain an academic degree or scientific research with any other educational or research institution.

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Dedication

I dedicate this thesis to my family represented by my father and mother, who were the main support for me to reach what I am now, and I dedicate it to my sisters and brothers and all the friends and colleagues who encouraged me and helped me in my educational path.

Acknowledgment

First, I am grateful to God (Allah) who enlightened my way in choosing this particular issue for my thesis. Without God's guidance and will, I would not be able to do this work and endure all the obstacles and difficulties I encountered throughout my work. Thank you, God.

I would like to express my wholehearted thanks to my father and mother whom I owe my deepest gratitude for her continuous support, inspiration, and patience throughout my entire life and particularly through the process of pursuing my master's degree. Only because of their love and prayers, I have had the chance to complete this thesis.

I would like to give my greatest appreciation to my supervisor, Dr. Salwa Massad, for his supervision, encouragement, guidance, and patience throughout this study.

I would like to express my thanks to the faculty of health informatics; Arab American University with its entire staff.

My special thanks to Mr. Ali Al-Helou the General Director of the General Directorate of Information Technology who gave me the opportunity to pursue a master's degree and for all workers on the COVID-19 surveillance system for their help and support during the data collection phase.

I wish to express my gratitude to all my friends and colleagues for their encouragement and endless support.

Executive summary

The COVID-19 pandemic began to spread in China, December 2019 and then spread around the world, causing millions of infections and deaths. The first case appeared in Palestine in March 2020, which necessitated the existence of a technique for documenting COVID-19 cases to facilitate taking appropriate timely decisions by decision-makers in the PMoH to limit its spread and reduce deaths. Therefore, the PMoH, in cooperation with the PNIPH, has developed an electronic system using the DHIS2 platform to monitor and document infected, isolated, and quarantined cases and to track the spread of the novel virus.

As there has been no previous comprehensive evaluation for all the programs within the COVID-19 surveillance system, the main objective of this study was to evaluate the surveillance system using mixed methods approach, both self-administered survey and interviews of stakeholders. For the assessment of the performance of the system, we used CDC guidelines for assessment of communicable diseases surveillance systems performance based on: usefulness, flexibility, acceptability, representativeness, simplicity, timeliness, stability and completeness from the perspective of data entry clerks, developers, and stakeholders. Add to that, to evaluate actual completeness in addition to the perceived one, data was extracted for the main variables in the system at three-time intervals: March, 2020, September, 2020 and April, 2021, of the pandemic. Furthermore, I have evaluated the workflow to identify strengths, weaknesses, challenges, and opportunities to strengthen and improving the system to enhance documentation and reporting of COVID-19 cases.

This study was conducted in the West Bank 2021 using an electronic questionnaire to collect data between May 10 and August 1st, 2021, in parallel to the interviews with key stakeholders. The questionnaire was sent to 150 users where 132 questionnaires were completed (114 data entry

clerks, 8 developers, 10 stakeholders). The quantitative data from the online questionnaire was analyzed using SPSS 20, as for the interviews, it was analyzed manually using themes and subthemes.

The results showed that the overall performance is 72.36% from perspective of data entry clerks, 83.89% from perspective of developers and 62.2% from stakeholders' perspective. The least report satisfaction by stakeholders was for usefulness attribute. Furthermore, the results showed that the system is useful in setting policies and strategies to control the spread of COVID-19. The system is flexible as it can be easily modified or used for other emerging health events without need for additional time, effort, or financial costs. It is also able to integrate with other systems and can always work. In addition, the system is stable due to the lack of technical issues and the presence of stable servers and databases that allow continuous backup. Also, the data in the system is representative, accurately measuring the epidemiology of the pandemic, covers all governorates, ages and gender and can estimate the incidence of COVID-19 both nationwide and for specific districts, which helped decision-makers divide the regions into colors based on the number of infections to determine the appropriate measures for each region. Additionally, the result showed that the data is entered in real-time into the system and indicate that moving between different fields, data elements and programs within the system can be done with great speed. Moreover, the data is transferred directly from all programs to decision-makers, which makes it easy to publish reports to decision-makers daily. In addition, it is simple as the system has simple workflow without any complex parts, allows patient tracking easily and has clear reporting form. Furthermore, the result of the analysis of the completeness at three-time intervals showed improvement of data completeness over time. However, it was still perceived to be incomplete by users. Based on interviews with stakeholders, main reason behind incompleteness includes the lack

of daily monitoring and feedback from decision-makers. Yet, most users agreed that system provides all the necessary reports and indicators that helps in guide policies and procedures for assessing the spread of the pandemic. All the aforementioned features show that the system was acceptable by the different users.

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List of Abbreviations

AAUP	Arab American University of Palestine
CBS	Case-Based Surveillance
CDC	Centers for Disease Control and Prevention
CDRSS	Communicable Disease Reporting and Surveillance System
CDSS	Communicable Disease Surveillance System
CoD	Cause of Death
COVID-19	Coronavirus disease
CPS	Cell Phone Surveillance
DB	Data Base
DC	Data Center
DHIS2	District Health Information System platform
ECDC	European Centre for Disease Prevention and Control
eDEWS	Electronic Disease Early Warning System
EU	European Union
EWRS	Early Warning and Response System
GHRP	Global Humanitarian Response Plan
HCWs	HealthCare Workers
HESN	Health Electronic Surveillance Network
HIV	Human Immunodeficiency Virus
ICTV	International Committee on Taxonomy of Viruses
MERS	Middle East Respiratory Syndrome
MoI	Ministry of Interior

PHC	Primary Public Health
PMoH	Palestinian Ministry of Health
PNIPH	Palestinian National Institute of Public Health
PRP	Preparedness and Response Plan
PUS	Person Under Surveillance
SARS	Severe Acute Respiratory Syndrome
SMS	Short Message Services
SPSS	Statistical Package for the Social Sciences
TESSy	The European Surveillance System
UMMC	University Malaya Medical Center
UNRWA	United Nations Relief and Works Agency
WB	West Bank
WHA	World Health Assembly
WHO	World Health Organization

Chapter 1: Introduction

1.1 Background

The world has been exposed to many deadly diseases and epidemics, some of which were epidemics confined to a specific country or geographic region, whereas others were global pandemics, which represent a global challenge with potentially disastrous results. These epidemics and pandemics have resulted in anywhere from tens to millions of deaths and have had economic and social impacts on the entire world. Epidemics and pandemics have changed the course of history in a specific way, as infectious disease disasters differ from other types of disasters because they increase the risk of spreading infectious diseases and lead to elevated deaths rates.

Among the most famous of these epidemics are the Black Plague (the Black Death), the Plague of Justinian and the Plague of Emmaus in the Levant all of which took place during and prior to the middle ages. In the modern era, cholera, smallpox, Spanish flu, Ebola, SARS are among the epidemics that have affected the world. Coronavirus disease (COVID-19) is one such infectious epidemic. COVID-19 belongs to the family of coronaviruses and is the 7th member of the family of coronaviruses that infect humans. Others in this family include Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) that spread rapidly each of which have spread over the world in a very short time (Gorbalenya et al., 2020).

The first case of COVID-19 was discovered in Wuhan, China in December 2019 and had not been previously recognized in humans. On January 12, 2020, the World Health Organization (WHO) named this virus the new Coronavirus (nCOV 2019), and on February 12, 2020 it was officially called Coronavirus 2019 (COVID-19) (Liu et al., 2020). Later it was officially named SARS-CoV-2 by the International Committee on Taxonomy of Viruses (ICTV) based on the analysis of genetics, evolution and classification (Gorbalenya et al., 2020).

Coronavirus (COVID-19) was declared a pandemic on March 11, 2020 by the WHO. Previous pandemics of coronaviruses include the 1918 Spanish flu (H1N1), the 1957 Asian flu (H2N2), the 1968 Hong Kong flu (H3N2), and the 2009 pandemic influenza (H1N1), which caused deaths of an estimated 50 million, 1.5 million, 1 million and 300,000 people respectively (Gorbalenya et al., 2020). Since then COVID-19 has spread rapidly globally and caused millions of illnesses and deaths (Liu et al., 2020). As of the 17th of June 2020, 443,488 deaths and 8,142,129 cases have reported worldwide since 31st of December 2019 according to the European Centre for Disease Prevention and Control (ECDC) (dos Santos, 2020).

In Palestine, the first case was discovered on March 5, 2020 in Bethlehem, which led to the closure of the city on March 7th and the discover of 16 cases in the West Bank, nine of which were in Bethlehem *(COVID-19 Pandemic in the State of Palestine - Wikipedi>*, n.d.). The pandemic then spread throughout Palestine, with which arose the need for a quick and easy documentation tool for the pandemic that allows for follow up on cases and a framework for making the right decisions to prevent the spread of the disease.

Regarding reporting and documenting COVID-19 cases, at the beginning of the pandemic, paper records were used to report and document cases of COVID-19. Later, and in response to the increase in cases of COVID-19, the Palestinian Ministry of Health (PMoH) decided to build an electronic surveillance system in cooperation with the Palestinian National Institute of Public Health (PNIPH) which was separate from the electronic surveillance system that used for other communicable diseases. The National COVID-19 Surveillance System was built using open-source the District Health Information System platform (DHIS2) which provides decision makers and stakeholders with statistics and indicators required for monitoring the epidemiological situation and examining the impact and burden of the pandemic. In addition, a public website was

developed and updated daily to provide timely statistics on the COVID-19 pandemic in Palestine based on data in the surveillance system.

1.2 Study Justification

Successful surveillance of communicable diseases enhances control efforts, such as the development of prevention policies and strategies. Globally, there have been several assessments for communicable disease, but to my knowledge there has been no previous assessment of the performance of the COVID-19 surveillance system globally and in Palestine. This is done with the aim of improving tracking and documentation of cases to facilitate timely data analysis and evidence-based recommendations to strengthen the COVID-19 surveillance system in the West Bank.

1.3 Problem Statement

At present, technology has become crucial to collect and document data in the healthcare sector and help decision-makers in taking the necessary decisions and steps to improve and develop the healthcare delivery and to provide evidence-based recommendations to improve the quality of care.

Monitoring the COVID-19 epidemic curve is the cornerstone of making decisions and implementing interventions related to public health (Prevention, 2020). Because of the rapid and substantial spread of COVID-19, it became necessary to evaluate the mechanism used to monitor and document the pandemic in Palestine. After more than a year of using an electronic surveillance system to collect and document data about COVID-19 cases in Palestine, it important to evaluate and assess the reporting and documentation system and its utility during the outbreak of Coronavirus (COVID-19) in Palestine. To my knowledge, there has been no previous

comprehensive evaluation conducted for all programs in the COVID-19 surveillance system in Palestine.

1.4 General Objective

The overall objective of the study is to examine the perceived overall performance of the COVID-19 surveillance system in documentation and tracking of COVID-19 infections in Palestine and assess the strengths and weakness of the system which will allow the PMoH to develop a plan and policies to strengthen the response to the virus, tracking cases, and for better preparedness for future outbreaks.

1.5 Specific Objectives

The specific objectives are:

1. Examine the perceived usefulness, flexibility, acceptability, representativeness, simplicity, timeliness, stability and completeness of the electronic surveillance system from the different users.
2. Evaluate actual completeness of main variables in the system at three-time intervals: March, 2020, September, 2020 and April, 2021
3. Examine the challenges and obstacles faced by users including stakeholders in the PMoH who utilize the COVID-19 electronic surveillance system and opportunities to strengthen the system.
4. Assess the existing surveillance system workflow for registered cases in the PMoH to identify strengths, weaknesses, and opportunities to reinforce and enhance the system.

We expect that the overall performance of the system is accepted by the different users except completeness of data. We assume that the data will be incomplete but it improves with time.

In addition, we assume that the surveillance system gives all needed reports and indicators which can guide policies and procedures regarding the situation of the pandemic in Palestine.

1.6 Thesis Structure

The thesis includes six chapters, listed as the following:

Chapter One: Introduction

This chapter establishes the theme of the study, the problem statement, documentation of the COVID-19 outbreak in Palestine, gaps in the literature that this study will fill and both the wide-ranging and specific objectives of the study.

Chapter Two: Literature Review

This chapter will start with a brief literature review regarding communicable diseases in the world and in Palestine, and the difference between monitoring and surveillance. It will also include a review of previous assessments looking at reporting and documentation of communicable diseases in general and the different models used for reporting and documentation of communicable diseases globally, in the case of COVID-19 specifically globally and in Palestine.

Chapter Three: Conceptual Framework

This chapter includes a framework used for the assessment of the COVID-19 surveillance system from the different users' perspectives.

Chapter Four: Methodology

This chapter features a detailed description of the study methodology including the study area and setting, study population and sample, study subjects, study design overview, data collection methods and measurements, study tool, validity and reliability, data management, analysis plan and ethical consideration.

Chapter Five: Results

This section of the thesis will present the study findings from both the quantitative and qualitative study.

Chapter Six: Discussion, Conclusion and Recommendation

This section includes an analysis of the study findings and contextualizes the research using related theories and with other comparable studies. It also provides evidence-based policy recommendations to strengthen the COVID-19 surveillance system.

1.7 Summary

This introductory chapter contains the background, problem statement, study objectives (general and specific), and thesis structure. The following chapter includes the literature review about communicable diseases and models used for documenting and reporting them.

Chapter 2: Literature Review

2.1 Introduction

This chapter will start with a brief literature review regarding communicable diseases in the world and in Palestine, and the difference between monitoring and surveillance. It will also include a review of assessments looking at reporting and documentation of communicable diseases in general and the different models used for reporting and documentation of communicable diseases globally, in the case of COVID-19 specifically globally and in Palestine.

2.2 Communicable Diseases (Contagious Diseases)

Communicable diseases have spread throughout history and have caused huge numbers of deaths especially in large outbreaks of these diseases in the world (SAKAY, 2020). Infectious diseases are caused by pathogenic microbes such as germs, viruses, parasites, and fungi, and can spread directly or indirectly (WHO EMRO | Infectious Diseases | Health Topics, n.d.) from an infected person to another person, or group of people, or through an animal, vector, or non-living environmental factor to a susceptible animal or human (Definitions for Consideration | State TB Prevention & Control Laws | TB Laws & Policies | Resources & Tools | TB | CDC, n.d.).

There are many communicable diseases that require reporting to health departments or appropriate government agencies in the region where the epidemic has spread such as human immunodeficiency virus (HIV), measles, salmonella, , hepatitis A, B and C, and blood-borne diseases (Edemekong & Huang, 2019). These diseases can be classified into three categories: diseases that cause high levels of death, diseases that place heavy burdens on the population, and diseases that can have serious global repercussions, given the speed and the unpredictable nature of their spread (WHO EMRO | Infectious Diseases | Health Topics, n.d.).

In Palestine, the history of epidemics has been documented by the integrated records of health since the establishment of the government of Palestine under the British Civil Mandate in the year 1920, and officially in the year 1922. According to reporting by the government of Palestine, from 1920 until 1945/1946, the most common diseases in Palestine were ophthalmia (trachoma) and malaria.

There are many other epidemics that have impacted Palestine throughout history before the Mandate, which required attention to the means and quality of healthcare. Palestine before the Mandate was not without a healthcare system, as traditional physicians had an important role in providing the necessary care even after the arrival of modern medical methods. Ophthalmia (trachoma) affected 60% to 95% of school children, with the highest percentage in rural due to lack of health care. This percentage decreased considerably at the end of the Mandate, due to the establishment of health centers in most cities and many villages, as well as the establishment of a central eye hospital in Jerusalem (Saint John) (Abu Sitta, 2020). As for malaria, it was widespread in swampy areas, though statistics from the Palestinian government in 1942 indicated that only three of the 1707 people who were treated had died from the infection. While the proportion of malaria patients was 7% of the total patients who registered for treatment in the year 1922, this proportion decreased to one-tenth of the patients in the year 1944. In 1918, one sixth of the people of Beit Jibrin died within only 3 months, and it is one of the areas where the malaria epidemic has spread (Abu Sitta, 2020).

The Mandate government's reports recorded the spread of smallpox in December 1921 and the cholera that spread in densely populated cities in 1902 due to the lack of adequate healthcare and again in the First World War by Turkish soldiers, especially during the famine in 1915 (Abu Sitta, 2020).

2.3 Communicable Disease Control (Monitoring and Surveillance)

Monitoring and surveillance are activities involving collecting and managing information. They are necessary and integral elements of management planning since such plans must be based on accurate information (Alexander, 2008).

Monitoring is ongoing, continuous and routine efforts directed to assess the status of health and disease of a given population (Kumar, 2005), and is an essential component of management planning. The WHO defines the monitoring as *"the routine and continuous tracking of the implementation of planned surveillance activities (monitoring the implementation of the action plan) and the overall performance of surveillance and response systems"*(WHO, 2018).

Surveillance is often confused with monitoring. Surveillance is the conduct of frequent standardized surveys in order to detect the change (Alexander, 2008) and is a more intensive form of data registering than monitoring (Kumar, 2005). Surveillance lacks "formulated standards" which are very important in monitoring. Surveillance does not distinguish between acceptable and unacceptable change but is only used to detect change (Alexander, 2008).

The WHO defines the surveillance as *"as a periodic evaluation of the importance, effectiveness and impact of activities in light of the objectives of monitoring and response systems"*(WHO, 2018). Surveillance is continuous monitoring of the distribution and spread of a disease or infection in order to assist an effective control and prevention of such spread. Table 1 below summarize main differences between monitoring and surveillance.

Monitoring, surveillance and investigation of infectious diseases and other health threats are vital capabilities of an effective health system. The International Health Regulations (2005) require public health monitoring to maintain an integrated national health system (WHO-HealthSystems,

2005). It is necessary to determine the extent of a disease or epidemic, to understand how it works and to determine the necessary interventions to prevent its spread. Additionally, public health practitioners need to continuously review their performance in detecting and responding to communicable diseases.

To achieve this, there must be an effective monitoring and surveillance system that helps in defining actions and measures that should be taken and should cover a reasonable period of time in order to determine the change in prevalence over an entire community rather than individuals (Clark & Turner, 2021). This will in turn help to provide reports on activities, interventions and resources to decision makers to ensure a timely and effective response and prevent or control the outbreak of communicable diseases.

Table 1 Differences between surveillance and monitoring (Kumar, 2005)

Monitoring	Surveillance
Specific and essential part of surveillance	Broad term, monitoring is one of constituent
Formulated standard	Lacks formulated standards
Carried out by any technician or any automated machine	Require professional analysis and sophisticated judgment of data leading to recommendation of control action
Differentiate between acceptable and unacceptable change	Doesn't differentiate between acceptable and unacceptable change

The Communicable Disease Surveillance System (CDSS) is a multi-functional system that monitors and analyzes patient data such as demographic, geographic and disease/case information and provides accurate identification and timely reporting of the nature and prevalence of cases, which helps in successful disease control (Department of health and senior services, n.d.).

2.4 Objectives of Communicable Diseases Surveillance and Monitoring

1. Early detection and containment of epidemics in their early stages before they spread
2. Determining priorities in planning to solve health problems
3. Identification of groups most at risk
4. Knowing and identifying the various risk factors responsible for the occurrence of diseases incidence or deaths
5. Knowing disease trends for use in proper planning to provide appropriate health services
6. Evaluating preventive and control measures and introducing the necessary modification according to the epidemiological variables of the disease (Jordan Ministry of Health, n.d.)

2.5 Components of Communicable Diseases Surveillance

Communicable diseases surveillance consists of two main components:

1. An information collection system that provides the necessary information about the occurrence of diseases covered by surveillance. The basic information for each disease includes the basic variables: When did the disease occur? Where did the epidemic disease occur? Who is the person who got sick?
2. An epidemic and outbreak investigation system, where additional information is collected and analyzed in order to know and examine how the epidemic or outbreak occurred, how to contain and control it, and the most important measures to be taken to prevent its occurrence in the future. (Jordan Ministry of Health, n.d.)

2.6 The Communicable Disease Surveillance System Supportive Functions

Surveillance systems support functions are important to achieve better performance of communicable disease surveillance systems and to improve the conduct of the communicable disease core activities, these functions are:

1. Setting standards such as case definitions, standard case management guidelines, and standard investigation procedures
2. Training such as surveillance, epidemiology, and laboratory)
3. Supervision
4. Communication systems such as radio, fax, email, telephone and health updates
5. Providing resources such as human resources with appropriate skills and competencies, material resources, and financial resources (WHO, 2018).

2.7 Surveillance Systems for Communicable Diseases in Palestine

The PMoH is the main provider of health services in Palestine and has succeeded in combating and preventing many communicable diseases with the support of international organizations such as the WHO and UNRWA (Palestinian Ministry of Health, 2020). For decades, many communicable diseases have spread in Palestine, as is the case with other countries around the world.

The list of notifiable communicable diseases has been amended several times based on the Palestinian law for reporting communicable diseases, which has been in place since 1940 (Awad, R, A Al Rahman Omer, 2001).

In the West Bank and Gaza, the Department of Epidemiology has divided the reporting forms into 3 groups of diseases as presented in (Table 2) (Group A, Group B, Group C). Communicable diseases that are placed in group A should be reported immediately within 24 hours by telephone or fax and should initiate investigation within 24 hours to control spread of disease. Communicable diseases that are place in group B should be reported and initiate investigation within 1 week because these diseases require less urgency. For the diseases that are places in group C, incidents should be reported within 1 month and not required to initiate investigation for every case.

Previous paper-based systems made counting the number of infected cases difficult, and therefore it was necessary to have an electronic surveillance system to monitor cases and help decision makers to set policies and limit the spread of epidemics.

In the West Bank the General Directorate of Information Technology within the Central Preventive Medicine Department at the PMoH, has created an electronic surveillance system for monitoring communicable diseases and extracting needed reports using Microsoft Access and analyzing data

using SPSS. The system was developed using the DHIS2 platform in coordination with the Palestinian National Institute of Public Health (PNIPH) and digitize case-based surveillance (CBS) forms to simplify reporting, improve completeness, and increase timeliness in the data flow on the national level. This enables decision makers to inform policies and strategies to prevent the spread of diseases, provide data and information related to the control of communicable diseases and prepare periodic reports requested by officials simply and efficiently.

Through the mentioned surveillance system, the PMoH has computerized the most prevalent communicable diseases in Palestine, which are classified into the three categories (A, B, C) as presented in (Table 2). The CBS system has more than 90 indicators and 19 dashboards that helps detect outbreaks of epidemic-prone diseases, monitor diseases with a high burden, and monitor progress towards national or international control/eradication targets.

Through this surveillance, the responsible users complete the initial diagnosis form (investigation form) (Figure 1) and based on the selected diagnosis the system allows them to report to the appropriate program. Based on data filed for the programs presented in (Figure 2, Figure 3), decision makers can extract reports and charts such as charts presented in (Figure 4, Figure 5) which allow them to make policies and procedures that protect people and prevent infection by distributing vaccines and documenting such interventions using this surveillance system.

Table 2 Communicable disease in Palestine

Disease Name	Category
Acute Flaccid Paralysis	A
Acute Flaccid Paralysis after 60 days	A
Brucellosis	B
HIV & AIDS (Case and Infection)	A
Hepatitis A	B
Hepatitis B: Case	B
Hepatitis C: Case	B
Bites: Animal Bite	C
Leishmaniosis : Cutaneous	B
Leishmaniosis : Visceral (Kalazar)	B
Meningococcal Meningitis	A
Homophiles Influenza	A
Other Bacterial Meningitis	A
Encephalitis	B
Viral Meningitis	B
SARI Cases (flu A(H1N1,H3N2,H5N1),Flu.B)	A
Suspected Measles & Suspected Rubella	A
Tetanus Adult	A
Tetanus Neonatal	A
Tuberculosis: Extra pulmonary	B
Tuberculosis: Pulmonary	B
Typhoid & Paratyphoid	B

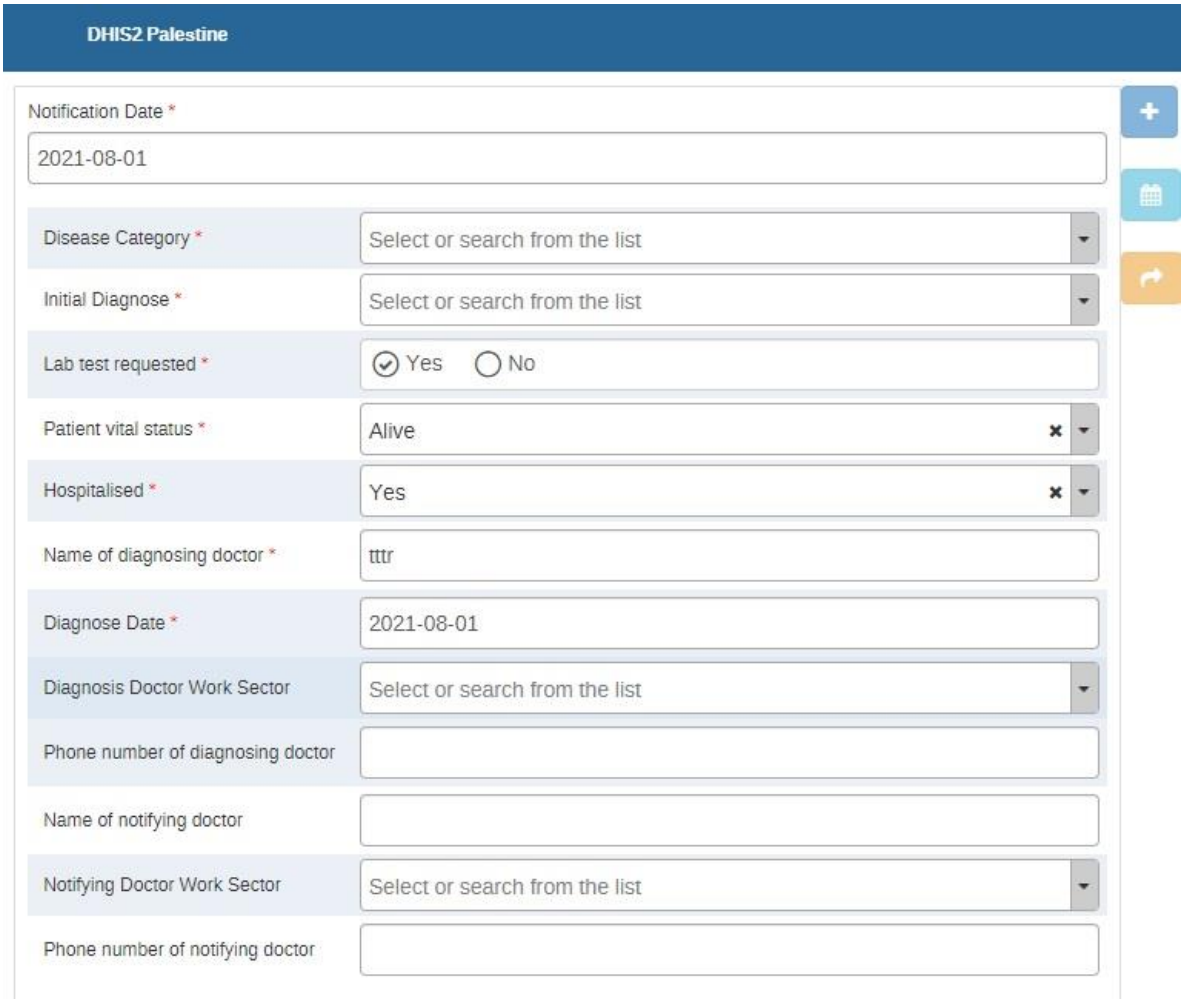


Figure 1 Initial Diagnosis Form [PMoH]

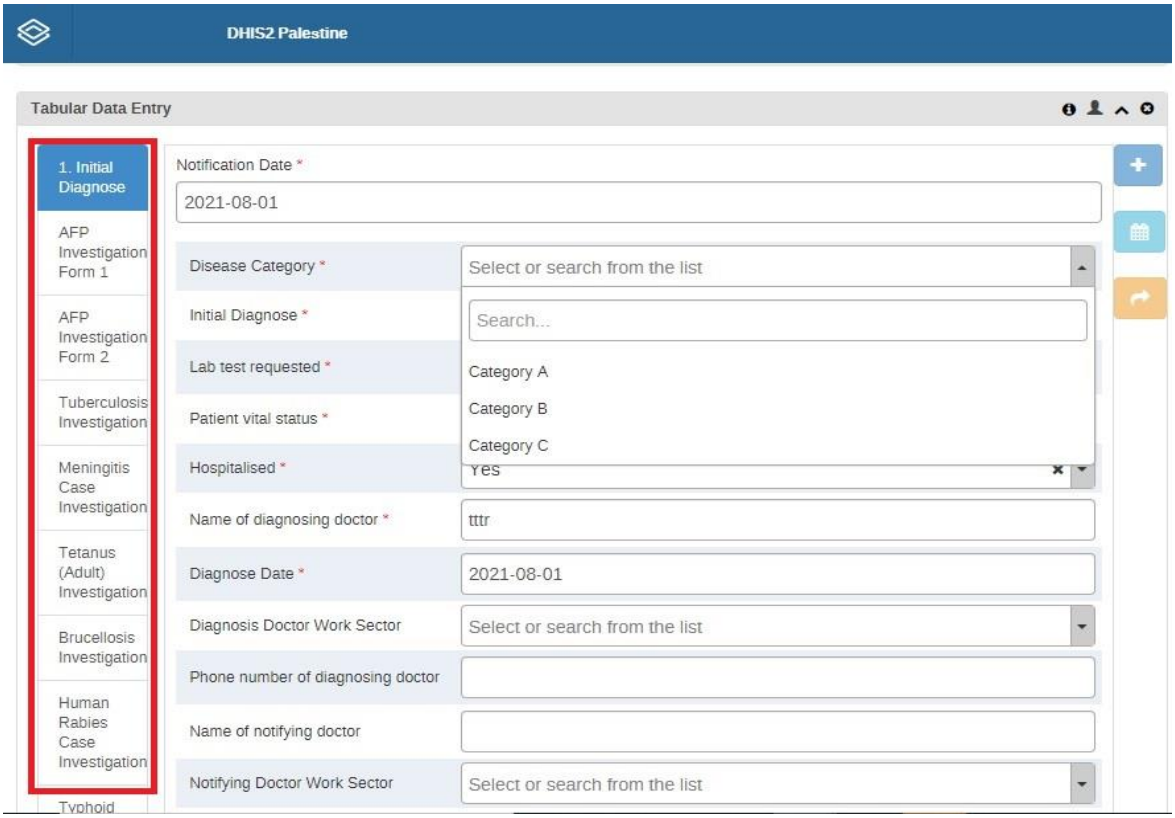


Figure 2 Communicable Disease Programs – 1 [PMoH]

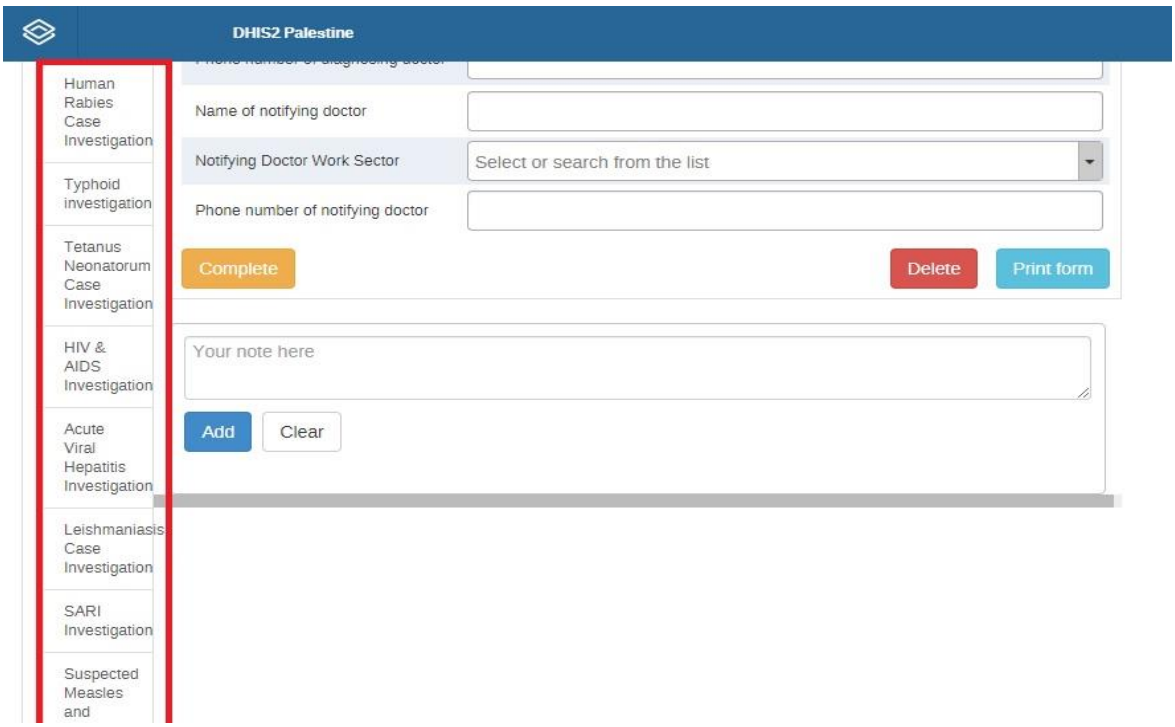


Figure 3 Communicable Disease Programs – 2 [PMoH]

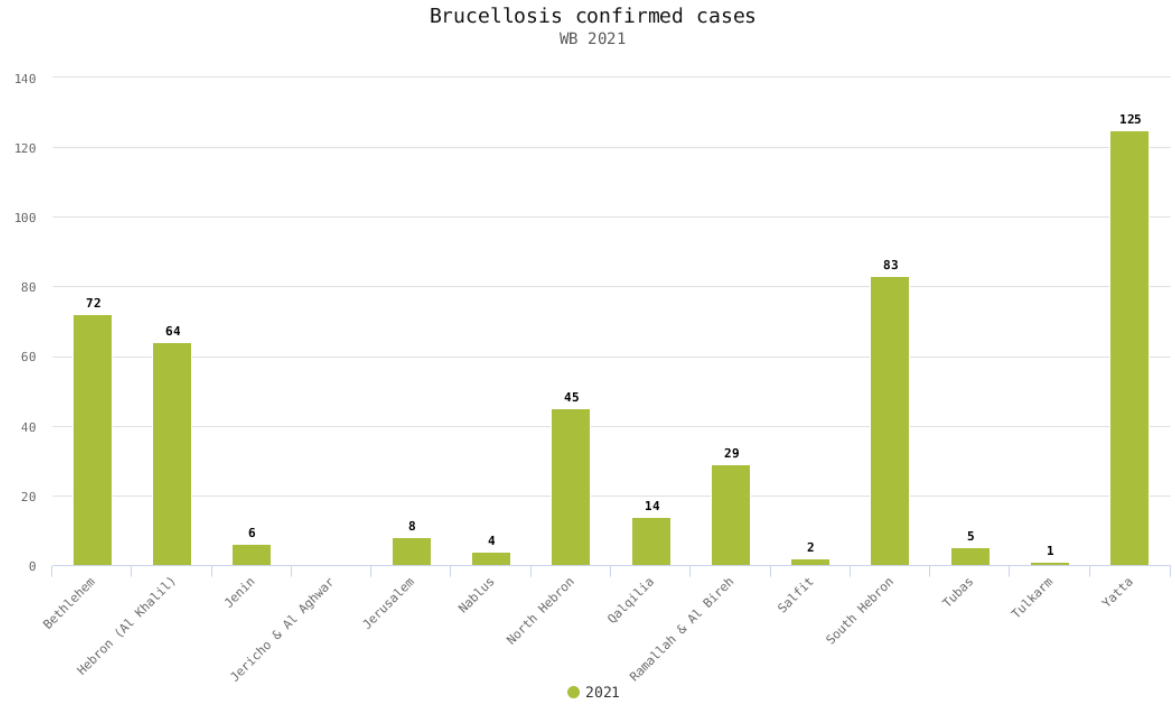


Figure 4 Brucellosis 2021 - West Bank [PMoH]

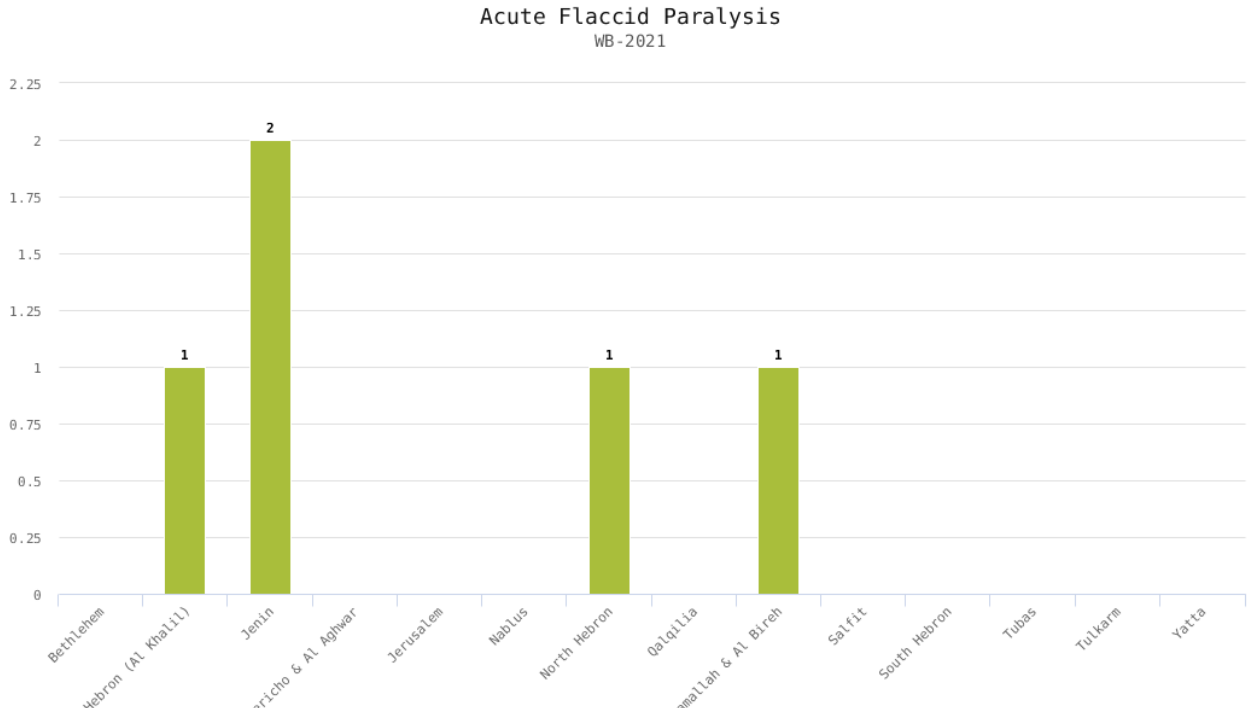


Figure 5 Acute Flaccid Paralysis 2021- West Bank [PMoH]

2.8 Models for Reporting and Documentation of Communicable Disease

Although requirements placed on the communicable diseases reporting process varies in different countries, one of the important universal principles when designing the surveillance system is being accurate and timely (Janati et al., 2015). There are many traditional methods and models used to document and report communicable diseases that have been helpful to some extent in policy and decision making for communicable disease control. An example of one such system is the use of forms and paper reports in Burundi, Tanzania and Zambia, yet this method has been associated with a number of challenges.

One of the most important of these challenges is the process of delivering paper forms to the central public health department, especially in developing countries due to poor roads infrastructure or adverse weather conditions (Mwabukusi et al., 2014). In addition, there is then a need to re-enter these forms and data electronically, which increases the risk of data entry errors. An alternative way to document communicable diseases is by using smart phones to collect and transmit geotagged data and images related to the disease (Mwabukusi et al., 2014).

In Iran, the surveillance system for communicable diseases has been integrated with the overall health system, but in recent years Iranian health officials have studied global surveillance systems to benefit from them in separating and strengthening the communicable disease surveillance system in Iran (Janati et al., 2015). This is due to many challenges that decision-makers faced when trying to use and benefit from epidemiological data and reports including the challenges of stewardship, reporting, information, education and intervention challenges as presented bellow (Moradi et al., 2019):

1. **Stewardship**
    a. Inter-sectoral governance
    b. Intra-sectoral leadership
2. **Reporting**
    a. Comprehensiveness of reporting
    b. Quality of reporting
3. **Information**
    a. Information systems
    b. Interpretation and publication of information
4. **Education**
    a. Status of the CDSS in university education
    b. Orientation of retraining courses
5. **Intervention**

a. Facilities for intervention
b. Intra-sectoral support
c. Cultural response of the community
d. Timely reporting or timely confirmation of the epidemics
e. Assessment of the ability to respond to crises

In Iran, they use Cell Phone Surveillance (CPS) for some epidemic such as cholera, meningitis, measles and poliomyelitis... etc. This technology is rapid, effective, user friendly and cheap. The CPS collects data from regional data points and sends it to the central office using SMS (Safaie et al., 2006). In China, light-powered mobile phones are used as a reporting system for communicable

disease surveillance in emergencies via software loaded to phones designed to record and transmit cases of communicable diseases into a national database for further analysis (Yang et al., 2009).

Saudi Arabia uses the Health Electronic Surveillance Network (HESN) system to monitor communicable diseases electronically and to protect society from their spread. This system monitors infectious and epidemic diseases electronically via the Internet for enabling the control of such diseases (*MOH News - Dr. Al-Rabeeah Launches HESN System*, n.d.). The department of health in New Jersey in the United States has developed the Communicable Disease Reporting and Surveillance System (CDRSS) which is an electronic, web-based system where public health partners statewide can instantly report and track incidences of communicable diseases. The CDRSS facilitates the timely reporting and immediate sharing of pertinent data (*Department of Health | Communicable Disease Service | Communicable Disease Reporting and Surveillance System*, n.d.). Others countries use paper cards and forms, short message services (SMS), email, fax, and the internet (Janati et al., 2015).

From the models mentioned above, the electronic surveillance system is the best tool that can be used to monitor and document communicable diseases and allow health centers to enter data in real-time offer decision makers enough information to take the appropriate timely measures to control the epidemics.

2.9 Assessment of Documentation and Reporting of Communicable Diseases

Since 1978 at the Alma-Ata conference entitled "Health for All by the Year 2000", there has been increased interest at the international level to monitor the performance of health systems, surveillance, and programs and to track progress in improving health and achieving development goals. Hence it is vital to evaluate communicable diseases surveillance systems and programs,

which are an important element in providing effective health services to combat and prevent communicable diseases (David & Haberlen, 2005).

An evaluation should include recommendations for improving the quality and efficiency of the communicable diseases surveillance systems. It must also be done periodically to ensure that the system achieves the goal and purpose for which it was developed.

The WHO conceptual framework of communicable diseases surveillance systems is one of mentioned tools that used to evaluate communicable diseases surveillance systems which contains three important components (core functions, support functions, and surveillance quality) as shown in (Figure 6) (WHO, 2018).

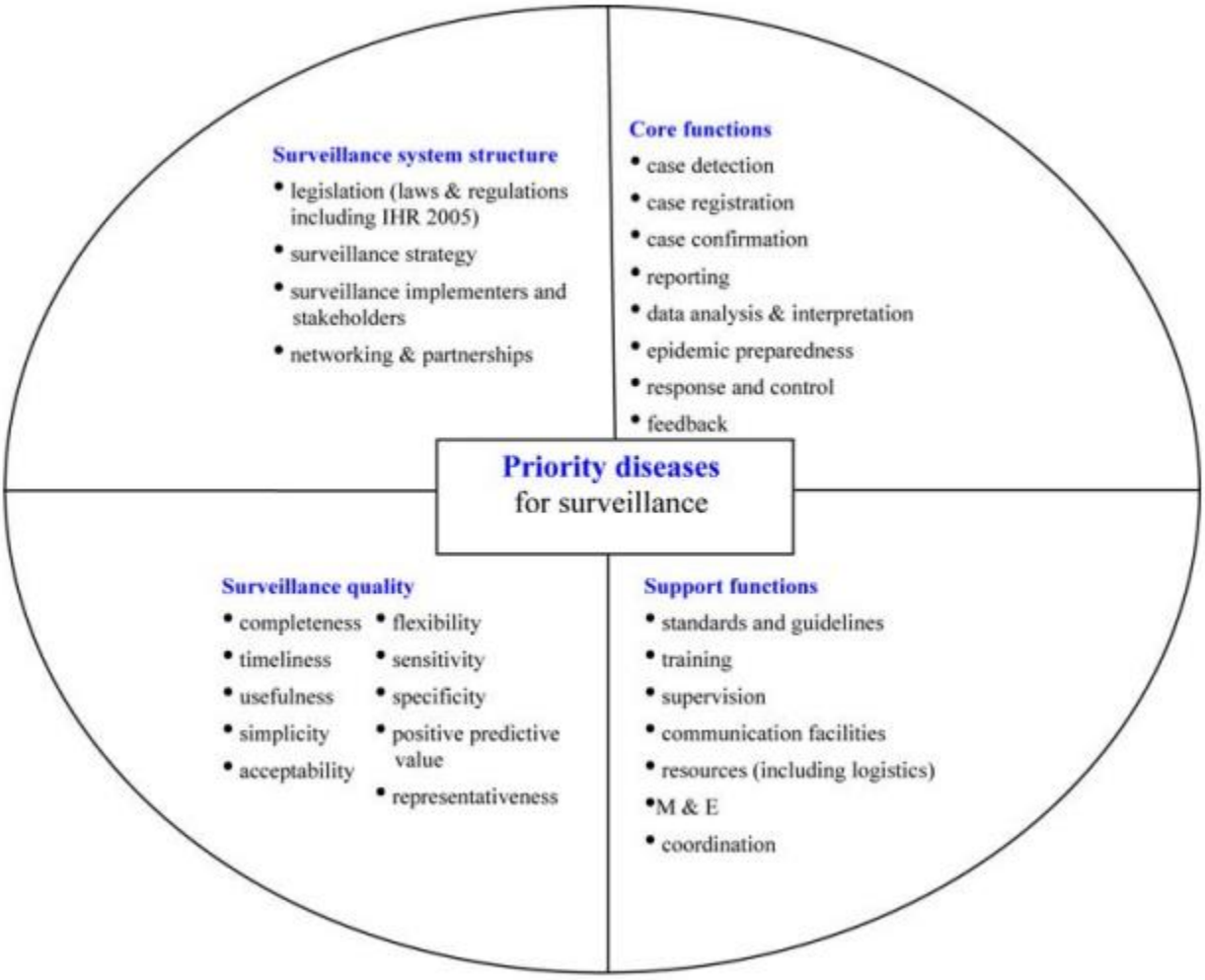


Figure 6 Conceptual framework of surveillance and response systems for communicable [WHO, 2018]

In Sudan 2011, specifically in the city of Khartoum, an assessment of the communicable diseases surveillance system was conducted based on the standards of WHO, where data were collected retrospectively for the period from 2005 to 2007.

In Gazera State in Sudan 2009, the communicable disease surveillance system was assessed by analyzing data, quality indicators, core and support activities to find out if they meet all the system objectives and to check the "*system simplicity, flexibility, acceptability, sensitivity, representativeness, timeliness, and the effectiveness of containment taken*". (Nogoudalla & Mahgoub, 2012).

On the other hand, CDC guidelines is another tool that can be used for evaluating communicable diseases surveillance systems which contains many important components as presented bellow (CDC, 1988):

1. Describe the public health importance of the health event.
2. Describe the system to be evaluated.
3. Indicate the level of usefulness
4. Evaluate the system for each of the following attributes:
    a. Simplicity
    b. Flexibility
    c. Acceptability
    d. Sensitivity
    e. Representativeness
    f. Timeliness
5. Describe the resources used to operate the system.
6. List your conclusions and recommendations.

CDC criteria was used to examine the performance of the Electronic Disease Early Warning System (eDEWS) was la in Yemen. Diseases covered by this application include meningitis, acute flaccid paralysis, ebola, measles, and viral hemorrhagic fevers (Mayad et al., 2019).

2.10 Reporting and Documenting COVID-19

Paul Georg Werthmann, MD, created the item collection checklist for COVID-19 as shown in Appendix 3, Appendix 4 and Appendix 5 that is designed to systematically and accurately collect important clinical data that complies with the CARE15 guidelines found in the “Enhancing the Quality and Transparency of Health Research” network (EQUATOR16). This checklist aligns with the "Lean European Open Survey on SARSCoV-2" (LEOSS) as presented in (Figure 7). (Werthmann et al., 2020).

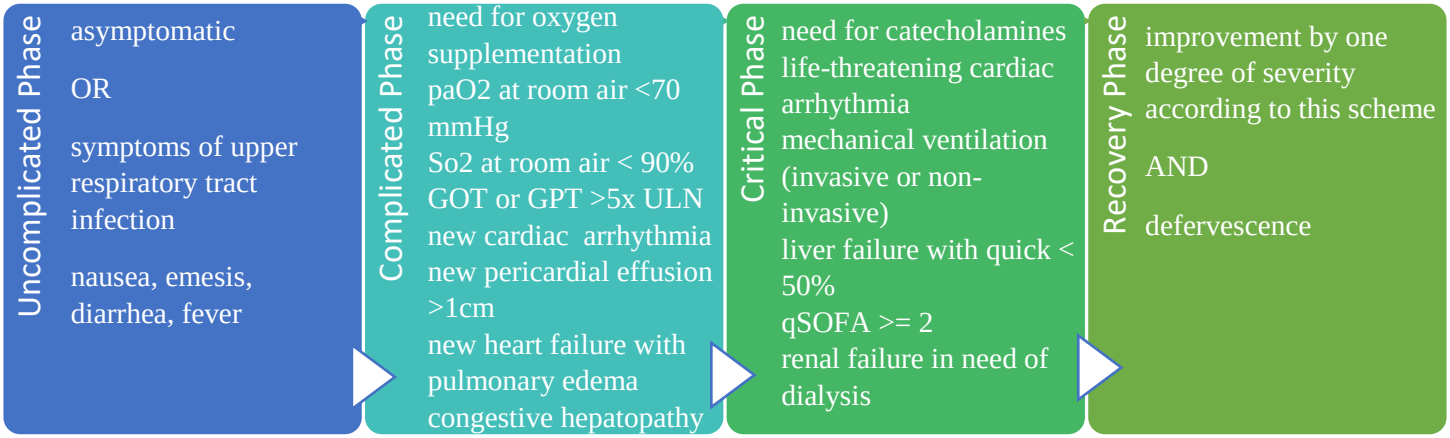


Figure 7 Stages of COVID19 disease according to LEOSS [Werthmann et al., 2020]

In the European Union (EU), member states report the total number of confirmed cases of COVID-19 through the Early Warning and Response System (EWRS) every 24 hours. The overall surveillance system has also been enhanced through The European Surveillance System (TESSy),

and the results of documenting and reporting the COVID-19 cases are published through several sources, including weekly reports and the dashboard (*EU Level Surveillance of COVID-19*, n.d.). In Malaysia, specifically in the Teaching Hospital University Malaya Medical Center (UMMC), which is classified as a COVID-19 hospital, a comprehensive plan has been developed to maintain the safety of healthcare workers (HCWs) in light of the need to maintain medical services continuity based on the development of a COVID-19 surveillance system to monitor HCWs in this hospital (Wan et al., 2021).

Initially, the monitoring team in the hospital used WhatsApp, a smartphone application, to submit the daily symptoms of all Person Under Surveillance (PUS). If the symptoms were not sent every afternoon, the HCW responsible was contacted by the monitoring team by phone or by text messages. This phase proved inefficient due to the need to enter data manually, so it was necessary to update the surveillance system in response to the increasing number of COVID-19 cases and the resulting increased workload for the monitoring team (Wan et al., 2021).

The surveillance team can now easily retrieve the data entered into the electronic surveillance system through a login page (Wan et al., 2021). This surveillance system can auto-generate daily reports, feedback for risk assessment and monitoring of HCWs and PUS as presented in (Figure 8 and Figure 9), and send notifications about PUS who have scores that are categorized as moderate or high risk (Wan et al., n.d.).

Through this electronic portal, a short message (SMS) is sent to the PUS to monitor symptoms at 6 am daily. This message contains an electronic link directing them to the online feedback form to get information about general wellbeing, which in turn is stored in the database. If the system does not receive a response from a PUS, a second SMS is sent at 10 am and a final reminder is sent at 12 pm.

If by 12pm the monitoring team has failed to get a response from any of PUS, the team contacts them via text messages or phone calls. The use of an electronic surveillance system has had a significant impact on the commitment of the PUS to report symptoms, use resources, and improve the efficiency and continuity of the monitoring system (Wan et al., 2021).

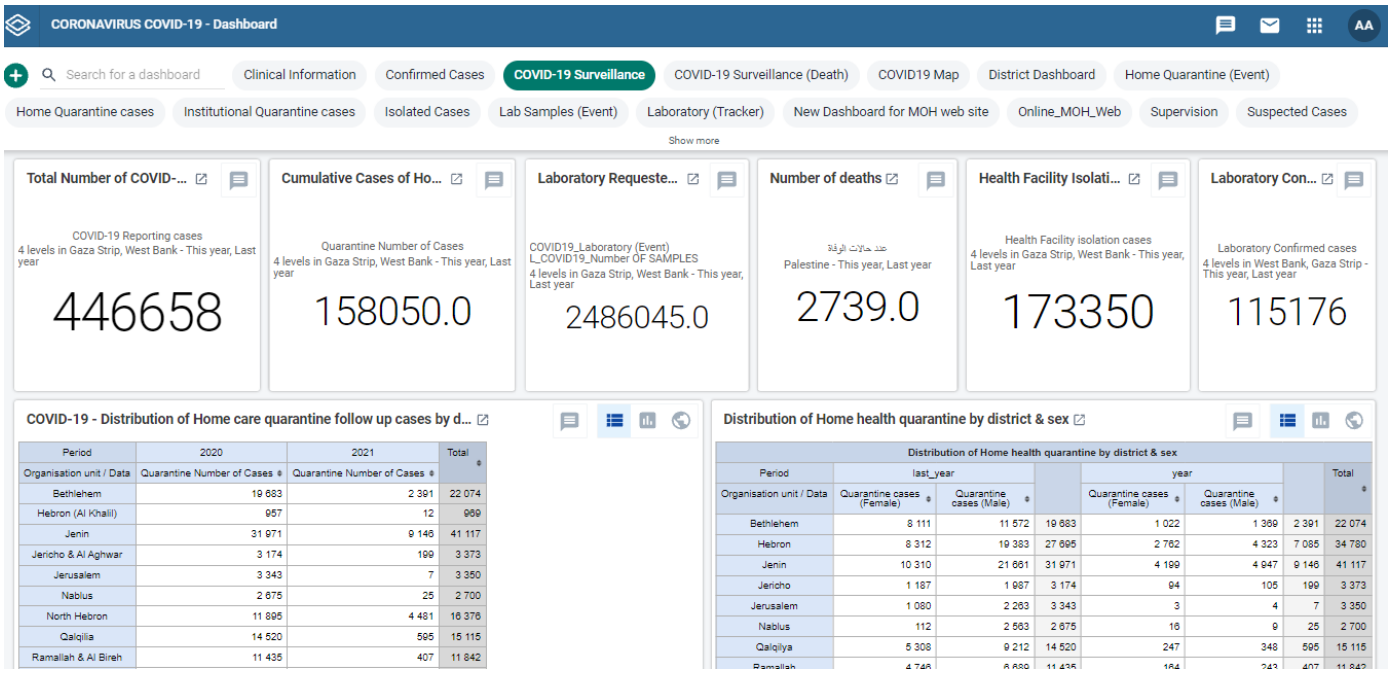
Figure 8 COVID-19 Healthcare Worker Risk Assessment & Surveillance [Wan et al., 2021]

Figure 9 List of Reports (Risk Assessment) [Wan et al., 2021]

2.10.1 Reporting and Documenting COVID-19 in Palestine

In cooperation between PMoH and PNIPH, COVID-19 surveillance system was developed based on a reporting form featuring the definition of the case issued by the WHO in addition to some forms issued by the PMoH using DHIS2. Through this system, decision makers can get the necessary reports and indicators to track cases as presented in (Figure 10).

A website has also been developed with both Arabic and English versions that presents information and indicators about the COVID-19 pandemic in Palestine based on the data from the COVID-19 electronic surveillance system, which is updated on the web site on a daily basis. Through the COVID-19 surveillance system, case-based information is collected, such as the methods of infection, underlying health conditions, health outcomes, and other basic information related to each case separately. More details will be shown in Chapter 5.



Period	2020	2021	Total
Organisation unit / Data	Quarantine Number of Cases	Quarantine Number of Cases	
Bethlehem	19 683	2 391	22 074
Hebron (Al Khalil)	957	12	969
Jenin	31 971	9 146	41 117
Jericho & Al Aghwar	3 174	199	3 373
Jerusalem	3 343	7	3 350
Nablus	2 675	25	2 700
North Hebron	11 895	4 481	16 376
Qalqilia	14 520	595	15 115
Ramallah & Al Bireh	11 435	407	11 842

Distribution of Home health quarantine by district & sex

Period	last_year			year			Total
Organisation unit / Data	Quarantine cases (Female)	Quarantine cases (Male)		Quarantine cases (Female)	Quarantine cases (Male)		
Bethlehem	8 111	11 572	19 683	1 022	1 369	2 391	22 074
Hebron	8 312	19 383	27 695	2 762	4 323	7 085	34 780
Jenin	10 310	21 661	31 971	4 199	4 947	9 146	41 117
Jericho	1 187	1 987	3 174	94	105	199	3 373
Jerusalem	1 080	2 263	3 343	3	4	7	3 350
Nablus	112	2 563	2 675	16	9	25	2 700
Qalqilya	5 308	9 212	14 520	247	348	595	15 115
Ramallah	4 746	6 689	11 435	164	243	407	11 842

Figure 10 Dashboard for Palestine COVID-19 surveillance system [PMoH]

2.11 Assessment for Reporting and Documentation COVID-19

As discussed previously, different countries have used different methods and models to document and report COVID-19 cases, some of which manual and others are electronic systems and to my knowledge, there has yet to be an assessment or evaluation of these models or systems in the Palestinian context. Thus, this is the first research that will assess all programs used for reporting and documentation of the COVID-19 outbreak in Palestine.

2.12 Summary

This chapter has presented a review of literature on communicable disease and tools for documentation and monitoring infectious diseases globally and in Palestine, with emphasis on COVID-19. The review discussed the need for electronic surveillance systems to control and monitor the outbreak of communicable diseases, the importance of making assessments for reporting and documentation models, and methods and systems to enhance and develop surveillance systems.

Chapter 3: Conceptual Framework

3.1 Introduction

This chapter introduces the variables within the conceptual framework for an assessment of reporting and documentation of the Coronavirus (COVID-19) outbreak in Palestine. The COVID-19 reporting and documentation framework is prearranged within three sections: geographical scope (globally, countries and/or areas countries), planning and monitoring needs (alertness, response and overall condition), and readiness and response operations. (World Health Organization, 2020).

3.2 Reporting and Documentation

The COVID-19 reporting and documentation framework focuses on the primary actions of public health attentiveness and response as outlined in the COVID-19 Strategic Preparedness and Response Plan (SPRP): Operational Planning Guidelines to Support Country Preparedness and Response from the WHO (2020).

3.3 Reporting and Documentation Structure

The COVID-19 reporting and documentation framework is organized around three sections:

3.3.1 Geographical Scope

The pandemic affects all countries international, bringing together countries with otherwise varied epidemiological histories, supply accessibility, and data systems. Measures are consequently separated into two separate geographic scopes: global and individual countries. (Ji et al., 2021).

3.3.2 Planning and Monitoring Needs

Indicators aim to inform decision-making for cohesive planning and monitoring programs and assist in developing measures to recuperate in the wake of the pandemic. These indicators fall

within three main categories: attentiveness or the preconditions; response which includes the short-term disaster mitigation, chiefly focusing on actions; and general situational awareness which include fewer sensitive indicators that supply a situational picture at a fixed point in time, including national requirements that are assessed on an yearly or biannual basis, as well as indicators based on delayed reporting (Ji et al., 2021; Varela et al., 2020).

3.3.3 Readiness and Response Operations

Indicators have been organized into nine pillars and one thematic area. The nine pillars of the readiness and response operations are as follows: country-level synchronization, planning and monitoring, communication of risk and society engagement, surveillance, rapid response teams, and case investigation, points of entry and global travel and transport, countrywide laboratories, infection prevention and control, case management, operational support and logistics, maintaining necessary health services and systems. (WHO, 2020).

3.4 Study Outcomes

Usefulness:

In our study, the basic criteria used to determine the usefulness of the COVID-19 surveillance system is identifying the risk groups, determining incidence trends over time, informing appropriate and effective public health responses, illustrating and tracking the disease, determining the distribution and spread of disease, estimate disease burden, measures outcomes and impacts of preventive and public health interventions, evaluates the overall control interventions, dissemination of data to key actors and decision makers occurs on daily basis, whether the data was used for epidemiological daily reports, and whether the data was used to detect spikes in the outbreak in a timely way to permit rapid prevention and control (action taken) to take the necessary

measures and provide the necessary data to evaluate interventions and measures to control the spread of the disease (WHO, 2018).

Flexibility:

In our study, the basic criteria that were used to determine the flexibility of the COVID-19 surveillance system were measuring if the system adapts to accommodate additional information to case definition, to integrate with other systems, and to accommodate to new additional information (e.g. the introduction of data from other system).

Representativeness:

In our study, the basic criteria that were used to determine the representativeness of the COVID-19 surveillance system were measuring if the system covered all governorates, ages and gender, if it can estimate the incidence of COVID-19 for all country and for a specific area, if it covered all facilities (public and private), if it is able to follow COVID-19 cases in the whole community and was used for monitoring the COVID-19 pandemic.

Stability:

In our study, the basic criteria that were used to determine the stability of the COVID-19 surveillance system were measuring if the system has a sustainable trained staff and is rarely exchanged, sustainable even without sponsors support, electrical power outages rarely occur, all facilities have generators, technical issues rarely occurred during the last two months such as data entry and reporting, the system is fully functional with financial support, the database is stable despite regular electricity and power interruption, the system is able to collect, manage and provide data in a timely manner, the system is able to operate at all times, data transfer, entry, and storage is accomplishable daily.

In addition, to measure if there are planned resources for the maintenance of the system, the servers of the system are stable and is continuously backed up and if the internet is always available without interruption in the main data center.

Completeness:

In our study, the basic criteria that were used to determine the completeness of the COVID-19 surveillance system by measuring if the reporting COVID-19 surveillance forms are complete, the case reporting is complete and if the surveillance data is complete. Also, we measure the completeness of data for main variables.

Timeliness:

In our study, the basic criteria that were used to determine the timeliness of the COVID-19 surveillance system were measuring if reporting and entering data and test result are done in real time. Also, by measuring if immediate notification for positive cases is made and if the system was created at the right time. In addition to measure if the development of the system took a long time and if daily reports were sent in a timely manner.

Simplicity:

In our study, the basic criteria that were used to determine the simplicity of the COVID-19 surveillance system were measuring if the reporting form is clear, the phone is always available in your facility, if data follow up is necessary to update data on the cases, if the program provided you with a smartphone/tablet or computer to facilitate entering and sending data and if there is a feedback report about data entry clerks working from governorate level and central level (PHC).

Also, this study measures if data entry into the electronic system is clear and easy, dissemination of data/reports to stakeholders and key actors occurs on a daily basis, Internet access is always available at the place of work, and if the system is easy to use. In addition, the simplicity was

determined by measuring if the data entry clerks took the needed training to enter the data and if the stakeholders took the training in how to extract reports.

Also, if analysis of data describes time, place and person, if standard case definitions for COVID-19 are available, if all capabilities necessary to establish the surveillance system are available, if transferring data to a high level is very easy, if the system is easy to implementation and there is simplicity of information flow from the point of generation to the end-users.

On the other hand, we measure if all the different DBs are complementary to one another, laboratory tests findings for COVID-19 are always reported in the surveillance system on daily basis, there is a need for timely notification of positive cases using the phone, the surveillance system has multiple steps, if any part of the surveillance system is unnecessarily complicated, if it has a complicated workflow and is extremely hard to use.

Acceptability:

In our study, the basic criteria that were used to determine the acceptability of the COVID-19 surveillance system were measuring if the system is appropriate to the MoH's needs, there is ongoing data analysis from the surveillance system and measure if users are satisfied with the surveillance data.

3.5 Conceptual Framework

According to the literature review and following the review of the workflow of electronic COVID-19 surveillance in West Bank / Palestine, a theoretical framework maps out the tasks and duties within the workflow of reporting and documenting COVID-19.

The independent factors are summarized as follows:

- Gender
- Age
- Job title
- District
- Health Facility/Institute
- Working experience in health facility/Institute (yrs.)

(Figure 11) shows the conceptual and operational framework for this study and includes the steps:

1. Assess the current surveillance system workflow based on analysis of surveillance statistics reports and the sequence of filling the different data elements from the different resources in different electronic programs of COVID-19 surveillance (such as the case reporting program, quarantine program, isolation and laboratory programs).
2. Evaluate the surveillance system from perspective of data entry clerks, key stakeholders and developers to examine usefulness, simplicity, flexibility, acceptability, representativeness, timeliness, stability and completeness to identify obstacles and challenges in documenting and reporting COVID-19 and opportunities to strengthen the system through interviews with key stakeholders.

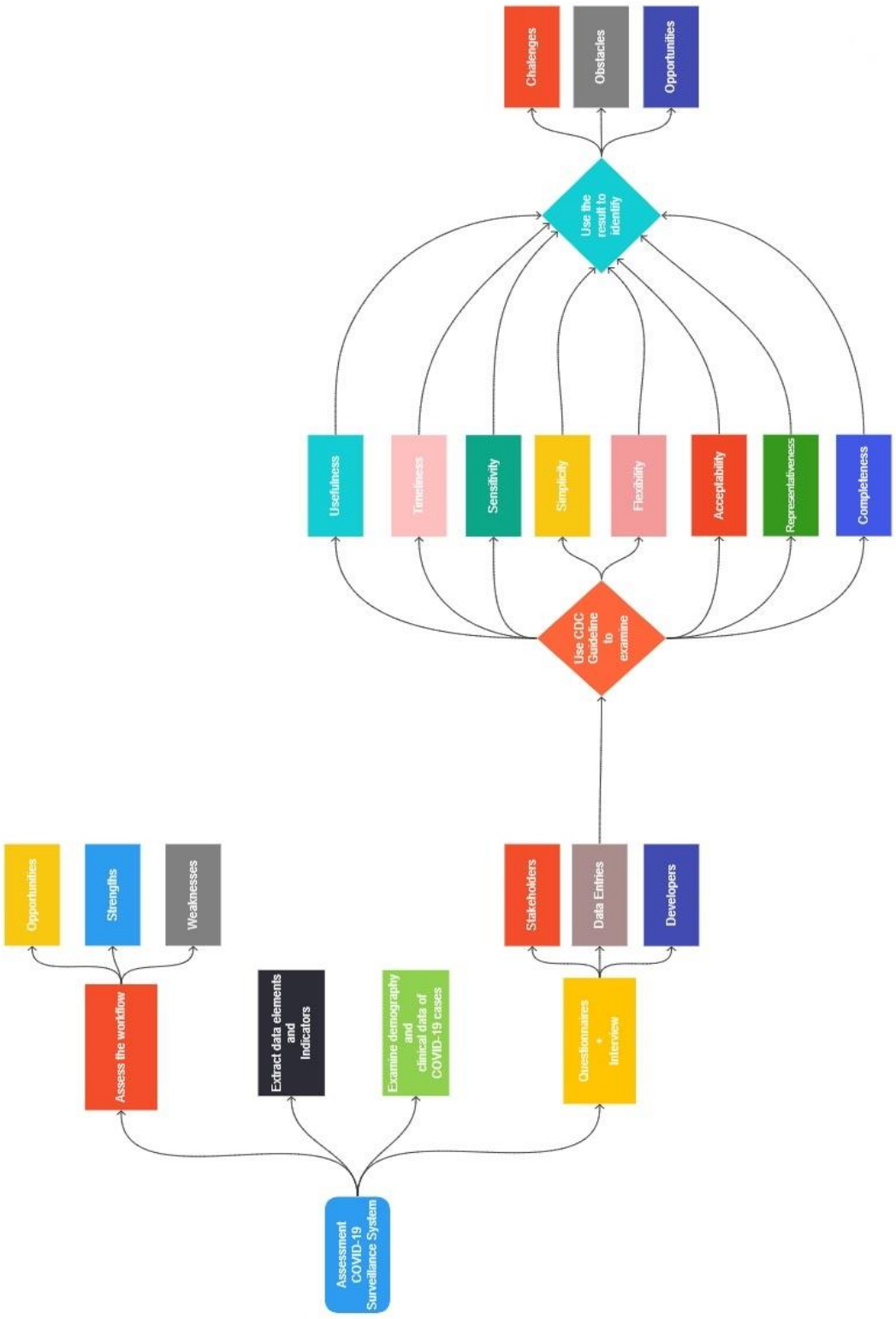


Figure 11 Research Conceptual and Operational Framework

3.6 Summary

In summary this chapter discussed the conceptual and operational framework which will be the foundation for analysis in the forthcoming results, discussion, and conclusion.

Chapter 4: Methodology

4.1 Introduction

This chapter presents the study methodology including the study setting, study population and sample, study subjects, study design overview which contains data collection, interview platform, study tools, validity and reliability, data management and analysis, and ethical consideration.

4.2 Data Elements Used in COVID-19 Surveillance System Programs

The COVID-19 surveillance system includes two types of programs (Tracker and Event). Tracker programs were used to track COVID-19 cases from infection to the health outcome (discharged alive, death, palliative discharge, transferred to other hospital, transferred to isolation center). On the other hand, the event programs were used to collect aggregated data about cases of infection.

The first section in tracker programs is the registration section, which include the following attributes as present in Table 3:

Table 3 Registration section attributes

Registration (Patient information)
Enrolling Organization Unit (Generated automatically)
Reporting Date
Case Identification
Is the reported case is suspected case according to (WHO criteria)?
Source of the reported case
Educational sector (Yes, No)
Sampling date
Sampling reason
Document type
First name
Middle name
Grandfather name
Surname
Full name (filled automatically)
Lab sample code
Age
Sex
Social Status (Civil Status)
Smoking status
Patient usual place of residency (Country)
Current address
Address (GIS)
Phone Number (1)
Phone Number (2)

And present below in Table 4 are the data elements used for the main tracker program **(Case reporting form (COVID-19))** while the remaining programs will be presented in Appendix 25, Appendix 26, and Appendix 27.

Table 4 Data elements for case reporting form COVID-19 program

Clinical Information Stage
Patient Clinical Course / Symptoms at Presentation section
Symptomatic (Yes, No)
Date of onset of symptoms
History of fever / Chills
Cough
Headache
Diarrhea
Sore throat
Shortness of breath
Smell Sense
Taste Sense
Other symptoms
Specify other symptoms
Underlying conditions and comorbidity section
Cardiovascular disease, including hypertension
Immunocompromised
Diabetes
Renal disease
Liver disease
Malignancy
Chronic lung disease
Chronic neurological or neuromuscular disease
Other chronic diseases
Specify other chronic diseases
Exposure and travel information Stage
Occupation section
Working at Jerusalem
Working at Israeli Settlements
Working at 48 Lands (Green Line Area)
Student
Health care worker
Health laboratory worker
Working with animals
Other occupation
Specify other occupation
Has the patient visited any other health care facility (ies)while symptomatic or in the 14 days prior to symptom onset?
Has the patient travelled 14 days prior to the onset of symptoms?
Has the patient had contact with a probable or confirmed cases

Did the patient had any direct or indirect contact with animal?
Case Management Stage
Case Management section
Case management (Health Facility Isolation, Health Quarantine, Hospital Care Admission) (Based to selection, the data element will be listed)
Health Facility Isolation
Isolation district
Place of isolation
Health Quarantine (Home, Institution, other)
Institution: Quarantine district
Institution : Place of quarantine
Hospital Care Admission
Admission date
Hospital name
Did the case receive care in intensive care unit (ICU)?
Did the case receive ventilation?
Did the case received Extra Corporeal Membrane Oxygenation (ECMO)?
Did the case need isolation with infection control practice in place?
Confirmed Cases Stage
Lab Test Result (if the result is positive, then all data elements mentioned previously will be shown in this stage with the data that filled in)
Date of test result
Governorate (Place of result)

4.2.1 Programs of COVID-19 Surveillance System

In addition to the registration page, the workflow process contains 5 programs (Tracker) which include the case reporting form for confirmed and suspected cases, health facility isolation for positive cases, health quarantine for negative cases, the laboratory program, and the hospital COVID-19 patient information program. In addition, the surveillance system includes the following event programs that are used to collect aggregated data:

1. Active Cases Palestine
2. Al-Quds daily confirmed cases (Event)
3. Child Daily Confirmed Cases (Event)
4. Confirmed Cases (Event)
5. Daily Age Group Confirmed Cases (Event)
6. Daily Source of Infection for Confirmed Cases (Event)
7. Daily Total of Confirmed Cases (Event)
8. Daily total samples & positive samples
9. Day Totals without Al-Quds
10. Health Staff Quarantine (Event)
11. Home Quarantine (Event)
12. ICU Cases
13. Institution Quarantine (Event)
14. Isolation (Event)
15. Laboratory (Event)
16. Palestinian Diaspora (Event)
17. School COVID-19 data

4.3 Study Area and Setting

The study was conducted in PMoH centers in the West Bank which are responsible for the detection of COVID-19 cases and use the COVID-19 surveillance system either for entering data or using the reports for making decisions. The study includes centers in all districts of the West Bank (Al Quds, Ramallah, Jericho, Salfeet, Nablus, Tulkarem, Tubas, Qalqilia, Jenin, Hebron (South, Nourth and Yatta) and Bethlahem.

4.4 Study Population and Sample

The study population is comprised of the 150 registered users of the COVID-19 surveillance system including key stakeholders, data entry clerks who enter the data, and developers.

Inclusion Criteria

People who develop the COVID-19 surveillance and those who already have user name on the surveillance system to use or enter the data to this system, and key stakeholders who are members on the COVID-19 national committee.

Exclusion Criteria

Any employees in PMoH/West Bank and PNIPH who already have users on the surveillance system but do not utilize or develop the COVID-19 surveillance system because their contract was ended or they transferred from their department to other and we couldn’t reach them.

4.5 Study Sample

Out of 150 users invited to participate in the study, 132 approved (114 data entry clerks, all the 8 system developers, and 10 stakeholders).

4.6 Study Design Overview

The study mixed method approach using both qualitative and quantitative research methods to assess the COVID-19 electronic surveillance system based on CDC criteria from perspective of key stakeholders, developers, and data entry clerks.

4.7 Study Tools

The key questions of the interviews with key stakeholders at the PMoH were designed in line with the objectives of this study and its conceptual framework to examine and understand the obstacles and challenges in reporting COVID-19 and opportunities to reinforce system and enhance the data. The online questionnaires were created based on some questionnaires that have been used in previous studies in the assessment of communicable disease surveillance systems. Questionnaires were developed in English and then translated to Arabic to suit the targeted group of users who are native Arabic speakers (developers, stakeholders and data entry clerks).

A link containing the questionnaire was sent to all data entry clerks via an official letter coming from the General Directorate of Primary Health Care (Appendix 2) and the researcher followed up with them by calling and by using WhatsApp groups. The questionnaire links for stakeholders and developers were sent using WhatsApp and followed up with a phone call.

In addition to a demographic section, the questionnaire used for data entry clerks contained 8 sections with 45 questions. The questionnaire used for developers contains 8 sections with 52

questions and the one used for stakeholders contains 7 sections with 42 questions. All three questionnaires used the Likert Scale range from 1 to 3 with 1= agree, 2= disagree and 3 Unknown. The questionnaire consists of three parts:

A. Demographic and personal data:

This section of all questionnaires consisted of sex, age, job title, district, health facility/institute and working experience in health facility/institute

B. CDC guideline:

This part of the two questionnaires (data entry clerk and developer) consisted of eight sections based on CDC criteria with each section containing questions the specific criteria which are as follows: usefulness, flexibility, representativeness, stability, completeness, timeliness, simplicity and acceptability. The third questionnaire for stakeholders consisted of the same sections except completeness. Within the sections, the questions in the three questionnaires depending on the target group as presented in Appendix 34, Appendix 35, and Appendix 36.

4.8 Validity and Reliability

Concerning **validity**, the questionnaires were validated by a group of researchers and experts (Appendix 28) from different disciplines related to the subject of the study examining its content and structure and providing comments and opinions about the questionnaire structure. These comments were then taken into consideration and changes were made to the questionnaire accordingly after reviewing and discussing them with the supervisor.

Next the revised questionnaires were tested on a pilot sample of 10 employees which included all the target groups and from which any needed modifications were identified and made.

Cronbach's alpha was used to estimate **reliability** for the data entry clerks' questionnaire, the only questionnaire with a relatively large sample size. For stakeholder and developers' questionnaires, items were individually analyzed.

As shown in the Table 5, the overall reliability of data entry clerks' questionnaire is 0.930 which is very high (> 0.7) and indicates that the questionnaire is reliable. Also shows the reliability of the different attributes.

Table 5 Instruments reliability, Cronbach's alpha test

Section	Cronbach Alpha	Number of Items
Usefulness	0.593	5
Flexibility	0.444	2
Representativeness	0.755	5
Stability	0.597	6
Completeness	0.767	3
Timeliness	0.785	5
Simplicity	0.795	16
Acceptability	0.785	3
Overall Reliability	**0.930**	**45**

4.9 Data Collection

4.9.1 Data Flow

The study assessed the current workflow through analyzing a sample of data in different electronic programs of COVID-19 surveillance by extracting aggregated reports and data for months March 2020, September 2020 and April 2021 from COVID-19 electronic surveillance system for the key data elements and examining the sequence of filling the different data elements from the different resources.

4.9.2 Online Survey

Three different online questionnaires sent using WhatsApp for developers, stakeholders, and data entry clerks. A pilot study was performed on ten participants as a pretest to assess the perceived clarity of the questionnaires and determine the completion time for the questionnaire. The ten pilot questionnaires were excluded from the study due to repetition. Modifications were made to the final questionnaires based on pilot study.

4.9.3 Interviews with Stakeholders

In parallel with data collection using online questionnaires, interviews were conducted with key stakeholders who use the surveillance system to identify obstacles and challenges in documenting and reporting COVID-19 and opportunities to strengthen the surveillance.

A total of 10 key stakeholders agreed to participate in interviews to assess the COVID-19 surveillance system and to discuss how to enhance and improve it. The average time of each interview was 20 minutes (range 20-30 minutes). Not all stakeholders who were interviewed completed the online survey.

The data collection for both the quantitative and qualitative parts was conducted between the 10th of May and 1st of August of 2021.

4.9.4 Assessment of the Completeness of Main Variables Overtime

Data was extracted for the main variables in the system at three-time intervals: March, 2020, September, 2020 and April, 2021.

4.10 Ethical Consideration

The permission to conduct the study was received from the Palestinian Ministry of Health Appendix 1, first from the Minister and then from the General Manager of Primary Health Care Appendix 2. The proposal has been technically and ethically approved by the Arab American University. We did not collect personal data from all interviewees. We took oral consent from all study participants (Appendix 30).

Privacy and confidentially of patients was completely protected as analysis was performed at an aggregated level and not an individual level and is done using a de-identified data file.

4.11 Data Management and Analysis

The **quantitative** data was transferred to excel sheets processed, cleaned, and standardized regarding the names of health centers and job titles, and analyzed data using IBM SPSS Statistics version 20 software. For the **qualitative** section, main themes were extracted by the interviewer. Data was transcribed, coded, and analyzed manually using themes and subthemes.

4.12 Summary

In this chapter, the researcher presented the methodology of the study in detail by explaining the study setting, study population and sample, study design, study tools data analysis and ethical consideration. The next chapter reports the result and findings of the study.

Chapter 5: Results

5.1 Introduction

In this chapter, we present the study findings from the three online questionnaires interviews with key stakeholders, assessment of completeness of main variables over time, and the workflow analysis.

5.2 Demographic and Personal Data – Study Sample

Out of the approached 150 users of the electronic COVID-19 surveillance, 132 agreed to participate in this study (114 data entry clerks, 8 developers and 10 stakeholders) with a response rate of 87%. Table 6, Table 7, and Table 8 bellow show the demographic characteristics of the data entry clerks, stakeholders, and developers respectively who participated in this study. Among the data entry clerks most were female while the developers and stakeholders were mostly male. The median of age for data entry clerks was 31.5, for stakeholders 41.5 and for developers 36.

Participants in all questionnaires were from different districts with different job titles, work places and working experience in healthcare facilities/institutes, (Appendix 17) shows working experience in health facility-institute (yrs.) / job title. The data entry clerks, stakeholders and developers were from different districts in the WB though most of them were from Ramallah, Bethlehem and Hebron.

Data entry clerks entering the data to the surveillance system and participated in this research had different jobs: doctors, nurses, data enterers, preventive medicine employees, statisticians, public health officers, radiology technicians, laboratory technicians, data managers, pharmacists and midwives. The occupations of stakeholders who participated in this research were also varied as the stakeholder occupations included doctors, nurses and statisticians. As for surveillance

developers, their occupations varied between computer programmers, database administrators, project coordinators and computer engineers.

The workplaces in the WB for data entry clerks included different primary health care centers, preventive medicine departments, the national center for skin diseases, PNIPH, Jorat Al-Shamaa - Bethlehem, Al-Ubaidiya clinic - Bethlehem, CPHL, Al-Dhahiriya Center for Emergency and Safe Birth - Hebron, PHIC, Iktaba Center - Tulkarem, Halhul Hospiatal - North Hebron, Keshda Center - Tubas and Quarantine Center – Jericho.

The stakeholders who participated in this study worked at Salfeet PHC, Jericho PHC, preventive medicine departments and the PMoH. As for developer, the workplaces also vary and were divided between the PMoH and the PHNIPH.

Years of work experience for all targeted groups was different from one job to other in the current health facility / institute as shown in Appendix 18, Appendix 19 and Appendix 20.

Table 6 Demographic Characteristics of Data entry clerks

Variable	Classification	N (%)
Sex	Male	30 (26.3)
	Female	84 (73.7)
	Total	**114 (100)**
Job Title	Doctor	2 (1.8)
	Nurse	54 (47.4)
	Data Entry	20 (17.5)
	Preventive Medicine Employee	5 (4.4)
	Statistician	13 (11.4)
	Public Health Officer	1 (0.9)
	Radiology Technician	1 (0.9)
	Laboratory Technician	15 (13.2)
	Data Manager	1 (0.9)
	Pharmacist	1 (0.9)
	Midwife	1 (0.9)
	Total	**114 (100)**
District	Bethlehem	16 (14)
	Ramallah	19 (16.7)
	Nablus	10 (8.8)
	Jenin	5 (4.4)
	Salfeet	9 (7.9)
	Jericho	3 (2.6)
	Quds	2 (1.8)
	Hebron	10 (8.8)
	North Hebron	11 (9.6)
	South Hebron	3 (2.6)
	Yatta	5 (4.4)
	Qalqilia	4 (3.5)
	Tubas	7 (6.1)
	Tulkarem	10 (8.8)
	Total	**114 (100)**
Work Place	Bethlehem PHC	13 (11.4)
	Ramallah PHC	2 (1.8)
	Nablus PHC	6 (5.3)
	Jenin PHC	5 (4.4)
	Salfeet PHC	9 (7.9)
	Jericho PHC	2 (1.8)
	Quds PHC	2 (1.8)
	Hebron PHC	5 (4.4)
	North Hebron PHC	12 (10.5)

	South Hebron PHC	4 (3.5)
	Yatta PHC	5 (4.4)
	Qalqilia PHC	4 (3.5)
	Tubas PHC	3 (2.6)
	Tulkarem PHC	9 (7.9)
	Preventive Medicine Department	6 (5.3)
	National Center for Skin Diseases	4 (3.5)
	PNIPH	6 (5.3)
	Jorat Al-Shamaa - Bethlehem	1 (0.9)
	Al-Ubaidiya clinic - Bethlehem	1 (0.9)
	CPHL	1 (0.9)
	Al-Dhahiriya Center for Emergency and Safe Birth - Hebron	1 (0.9)
	PHIC	4 (3.5)
	Iktaba Center - Tulkarem	1 (0.9)
	Halhul Hospiatal - North Hebron	3 (2.6)
	Keshda Center - Tubas	4 (3.5)
	Quarntine Center - Jericho	1 (0.9)
	Total	**114 (100)**
Age	Minimum	21
	Maximum	55
	Median	31.5
Work experience in health facility-institute / Job title	Minimum	1
	Maximum	30
	Median	4

Table 7 Demographic Characteristics of Stakeholders

Variable	Classification	N (%)
Sex	Male	6 (60)
	Female	4 (40)
	Total	**10 (100)**
Job Title	Doctor	7 (70)
	Nurse	2 (20)
	Statistician	1 (10)
	Total	**10 (100)**
District	Ramallah	7 (70)
	Salfeet	1 (10)
	Jericho	2 (20)
	Total	**10 (100)**
Work Place	Salfeet PHC	1 (10)
	Jericho PHC	2 (20)
	Preventive Medicine Department	1 (10)
	PMoH	6 (60)
	Total	**10 (100)**
Age	Minimum	32
	Maximum	50
	Median	41.5
Work experience in health facility-institute / Job title	Minimum	3
	Maximum	20
	Median	15

Table 8 Demographic Characteristics of Developers

Variable	Classification	N (%)
Sex	Male	5 (62.5)
	Female	3 (37.5)
	Total	**8 (100)**
Job Title	Computer Programmer	5 (62.5)
	Data Base Administrator	1 (12.5)
	Project Coordinator	1 (12.5)
	Computer Engineer	1 (12.5)
	Total	**8 (100)**
District	Ramallah	6 (75)
	Nablus	2 (25)
	Total	**8 (100)**
Work Place	PMoH	4 (50)
	PNIPH	4 (50)
	Total	**8 (100)**
Age	Minimum	26
	Maximum	39
	Median	36
Work experience in health facility-institute / Job title	Minimum	3
	Maximum	12
	Median	4.5

5.3 Surveillance Components Assessed Based on CDC Guidelines

5.3.1 Assessment of the Overall Performance of the COVID-19 Surveillance System

The following chart (Figure 12) shows the summary results for this assessment from the perspective of 114 data entry clerks, 8 developers, and 10 stakeholders who participated in this research. Based on the analysis, most of the targeted groups agreed that the system is simple, acceptable, representative, flexible, useful, stable, and provides data in a timely manner. The least satisfaction reported was for completeness of data from the perspective of data entry clerks and developers. The highest percentage of satisfaction from perspective of data entry clerks was for representativeness and flexibility, acceptability and flexibility from developers' perspective, and timeliness and acceptability from stakeholders' perspective.

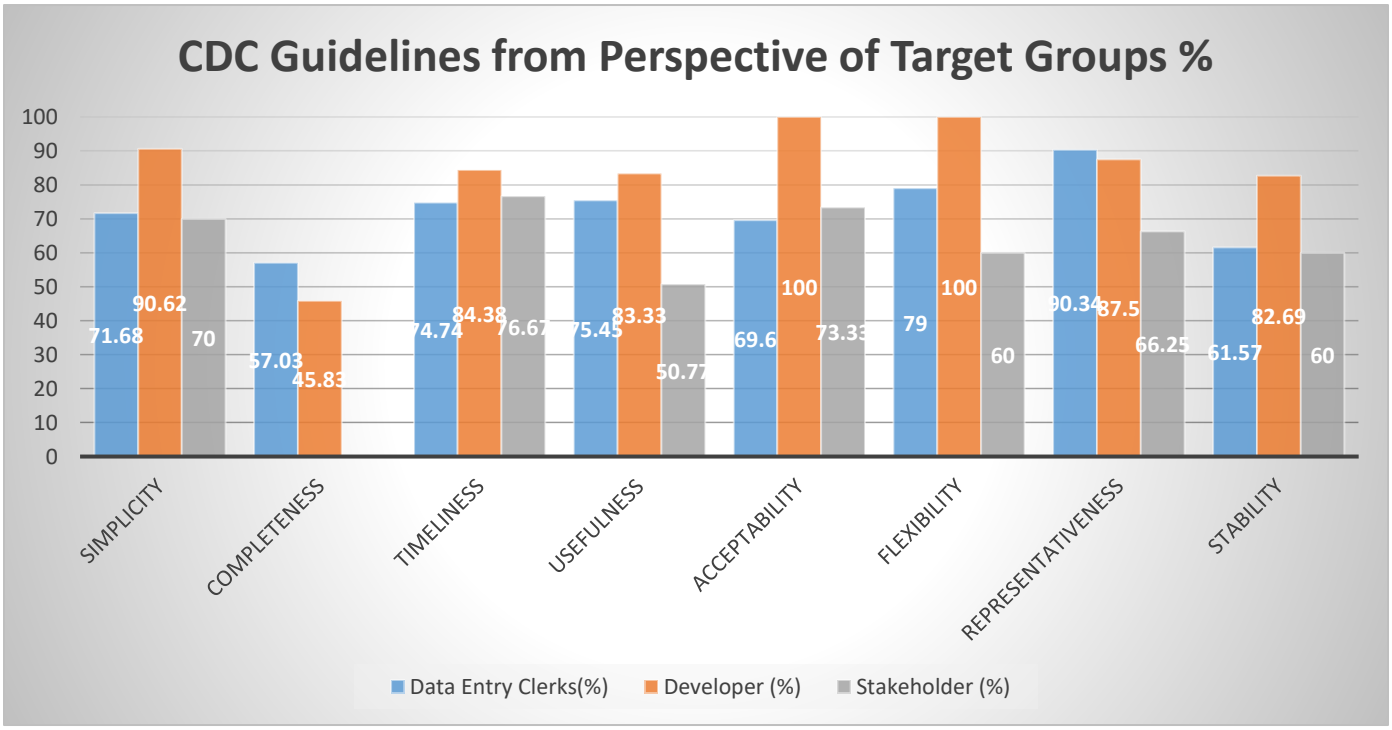


Figure 12 Assessment of COVID-19 surveillance from perspective of data entry clerks, developers and stakeholders

5.3.2 Adherence to CDC Guidelines from Data Entry Clerks, Developers and Stakeholder's Perspective

5.3.2.1 Usefulness

The usefulness of the COVID-19 surveillance system was measured using 5 items for data entry clerks, 6 items for developers, and 13 items for stakeholders as shown in (Table 9). The overall percentage is 75.45% for data entry clerks, 83.33% for developers, and 50.77% for stakeholders. Most of the targeted groups confirmed that the surveillance system can identify risk groups, determine incidence trends over time and the data was used for epidemiological daily reports. While most of them did not confirmed that the data was used to detect spikes in the outbreak in a timely way to permit rapid prevention and control (action taken).

Table 9 Frequency and percentage of usefulness items

Usefulness	Agree* N (%)		
	Data entry clerks	Developers	Stakeholders
The surveillance system determines the distribution and spread of disease	98 (86)	-	7 (70)
The surveillance system identifies risk groups	93 (81.6)	8 (100)	5 (50)
The surveillance system determines incidence trends over time	90 (78.9)	8 (100)	5 (50)
The data was used for epidemiological daily reports	98 (86)	8 (100)	5 (50)
The data was used to detect spikes in the outbreak in a timely way to permit rapid prevention and control (action taken)	51 (44.74)	0 (0)	2 (20)
The surveillance system informs appropriate and effective public health responses	-	8 (100)	5 (50)
The surveillance system provides data to evaluate control measures	-	-	6 (60)
The surveillance system estimates the disease burden	-	-	5 (50)
The surveillance system measures outcomes and impacts of preventive and public health interventions	-	-	7 (70)
The surveillance system evaluates the overall control interventions	-	-	4 (40)
The surveillance system illustrates and tracks the disease	-	-	7 (70)
Dissemination of data to key actors and decision makers occurs on daily basis	-	-	4 (40)
The surveillance system determines the groups most at risk of death by COVID-19	-	8 (100)	4 (40)

* No response means that these questions were not included in this user questionnaire

5.3.2.2 Flexibility

The flexibility of the COVID-19 surveillance system was measured using 2 items for data entry clerks, 6 items for developers, and 1 item for stakeholders as shown in (Table 10). The overall percentage is 79% from the data entry clerks' perspective, 100% from the developers' perspective and 60% from the key stakeholders' perspective as most of them agreed that the surveillance system is flexible.

Most of the data entry clerks and developers agreed that the system can adapt to accommodate additional information to the case definition and that the staff who use the electronic surveillance were well trained. While most of the developers and key stakeholders agreed that the current reporting formats can be used for other newly occurring health events (diseases) without much difficulty.

On the other hand, all 8 developers disagreed that the surveillance system was affected by fund variation which means that making any changes or customization to the system will not depend on the presence of financial support, making the system more flexible overall be able to change and add additional information.

Table 10 Frequency and percentage of flexibility items

Flexibility	Agree* N (%)		
	Data entry clerks	Developers	Stakeholders
The system can adapt to accommodate additional information to the case definition	90 (79)	8 (100)	-
Staff are well trained	90 (79)	8 (100)	-
The system adapts to integrate with other surveillance	-	8 (100)	-
The system adapted to accommodate to new additional information (e.g. the introduction of data from other system)	-	8 (100)	-
The current reporting formats can be used for other newly occurring health event (disease) without much difficulty	-	8 (100)	6 (60)
Flexibility	**Disagree N (%)**		
	Data entry clerks	**Developers**	**Stakeholders**
The system is affected by fund variation	-	8 (100)	-

* No response means that these questions were not included in this user questionnaire

5.3.2.3 Representativeness

The representativeness of COVID-19 surveillance system was measured using 5 items for data entry clerks, 7 items for developers and 8 items for stakeholders as shown in (Table 11). The overall percentage is 90.34% from the data entry clerks' perspective, 87.5% from the developers' perspective and 66.25% from the key stakeholders' perspective as most of targeted groups agreed that the surveillance system representative.

Most of data entry clerks, developers and key stakeholders agreed that the surveillance system covered all governorates, all ages, gender and that it can estimate the incidence of COVID-19 in across the country as well as for specific geographic area. While the system does not cover all public and private health facilities from perspective of developers and key stakeholders as most of them agree that.

Table 11 Frequency and percentage of representativeness items

Representativeness	Agree * N (%)		
	Data entry clerks	Developers	Stakeholders
The surveillance system covered all governorates	104 (91.2)	8 (100)	7 (70)
The surveillance system covered all ages	101 (88.6)	8 (100)	8 (80)
The surveillance system covered gender	112 (98.2)	8 (100)	8 (80)
The surveillance system can estimate incidence of COVID-19	96 (84.2)	8 (100)	7 (70)
The surveillance system can estimate incidence for specific geographic area	102 (89.5)	8 (100)	7 (70)
All public and private health facilities are covered	-	4 (50)	2 (20)
The surveillance system is able to follow COVID-19 cases in the whole community	-	5 (62.5)	7 (70)
The surveillance system can be used for monitoring the COVID-19 pandemic	-	-	7 (70)

* No response means that these questions were not included in this user questionnaire

5.3.2.4 Stability

The stability of the COVID-19 surveillance system was measured using 6 items for data entry clerks, 13 items for developers and 7 items for stakeholders as shown in (Table 12). The overall percentage is 61.57% from the data entry clerks' perspective, 76.92% from the developers' perspective and 60% from the key stakeholders' perspective.

Most of data entry clerks, developers and key stakeholders agreed that the surveillance system is able to operate at all times and the data transfer, entry, and storage are accomplishable daily. While the minimum score was for item "all facilities have generators" from perspective of data entry clerks and developers and the minimum score from key stakeholders' perspective was for the statement "there are planned resources for maintenance of the system".

Table 12 Frequency and percentage of stability items

Stability	Agree * N (%)		
	Data entry clerks	Developers	Stakeholders
The COVID-19 surveillance system has sustainable trained staff and they are rarely exchanged	48 (42.1)	2 (25)	4 (40)
Technical issues (e.g. data entry and reporting) rarely occurred during the last two months	75 (65.8)	7 (87.5)	-
Electrical power outages rarely occur	81 (71.1)	8 (100)	-
All facilities have generators	35 (30.7)	0 (0)	-
The system is able to operate at all times	88 (77.2)	8 (100)	8 (80)
Data transfer, entry, and storage are accomplishable daily	94 (82.5)	8 (100)	7 (70)
The system is sustainable even without sponsors support	-	5 (62.5)	7 (70)
The system is fully functional with financial support	-	7 (87.5)	7 (70)
The database is stable despite regular electricity and power interruption	-	7 (87.5)	-
The surveillance system can collect, manage and provide data in a timely manner	-	8 (100)	8 (80)
There are planned resources for maintenance of the system	-	-	1 (10)
The servers of the surveillance system are stable	-	6 (75)	-
The surveillance system is continuously backed up	-	7 (87.5)	-
Internet is always available without interruption in the main data center	-	7 (87.5)	-

* No response means that these questions were not included in this user questionnaire

5.3.2.5 Completeness

The completeness of the COVID-19 surveillance system was measured using 3 items for data entry clerks and 3 items for developers as shown in (Table 13). The overall percentage is 57.03% from the data entry clerks' perspective and 45.83% from the developers' perspective as most of them agreed that the data in the surveillance system is incomplete for several reasons, including incomplete data received from health centers or from doctors.

Table 13 Frequency and percentage of completeness items

Completeness	Agree * N (%)		
	Data entry clerks	**Developers**	**Stakeholders**
Reporting COVID-19 surveillance forms are complete	76 (66.7)	7 (87.5)	-
Case reporting is complete	59 (51.8)	2 (25)	-
Surveillance data is complete	60 (52.6)	2 (25)	-

* No response means that these questions were not included in this user questionnaire

5.3.2.6 Timeliness

The timeliness of the COVID-19 surveillance system was measured using 5 items for data entry clerks, 4 items for developers and 3 items for stakeholders as shown in (Table 14). The overall percentage is 74.74% from the data entry clerks' perspective, 84.38% from the developers' perspective and 76.67% from the key stakeholders' perspective as most of target groups agree that the system send the daily reports in a timely manner.

On the other hand, all developers agree that the surveillance system was created at the right time and the creation and development of it did not take long a long time which means that it was created and implemented at the right time. However, there was a difference of opinion about whether positive cases were immediately notified or not. As most of the key stakeholders and data entry clerks agreed that while most of developers disagree that.

And this difference is explained by the fact that the preventive medicine employee call the infected cases immediately as soon as the test result appears, while this notification not done through the surveillance system.

Table 14 Frequency and percentage of timeliness items

Timeliness	Agree* N (%)		
	Data entry clerks	Developers	Stakeholders
Reporting is timely	80 (70.2)	-	8 (80)
Entering data in real time	83 (72.8)	-	-
Immediate notification for positive cases is made	93 (81.6)	3 (37.5)	7 (70)
The test result are entered in real time	86 (75.4)	-	-
Daily reports are sent in a timely manner	84 (73.7)	8 (100)	8 (80)
The surveillance system was created at the right time	-	8 (100)	-
Timeliness	**Disagree* N (%)**		
	Data entry clerks	**Developers**	**Stakeholders**
The creation and development of the surveillance system took a long time	-	8 (100)	-

* No response means that these questions were not included in this user questionnaire

5.3.2.7 Simplicity

The simplicity of the COVID-19 surveillance system was measured using 16 items for entry clerks, 12 items for developers and 7 items for stakeholders as shown in (Table 15). The overall percentage is 71.68% from the data entry clerks' perspective, 90.63% from the developers' perspective as most developers agreed that the surveillance system is simple and 70% from the key stakeholders' perspective.

Most of targeted groups agreed that the analysis of data describes time, place and person, while most of the data entry clerks and key stakeholders confirmed that the reporting form is clear. And the minimum score from data entry clerks' perspective was for items "you receive a feedback report on your work from a governorate level or from central level (PHC).

On the other hand, most of participants disagreed that the surveillance system is extremely hard to use, has unnecessarily complicated parts, multiple steps, and complicated workflow, which means that the surveillance has clear workflow, simple and easy to use it.

Table 15 Frequency and percentage of simplicity items

Simplicity	Agree * N (%)		
	Data entry clerks	Developers	Stakeholders
The reporting form is clear	98 (86)	-	7 (70)
A phone is always available in your facility	84 (73.7)	-	-
Data follow up is necessary to update data on the cases	95 (83.4)	-	-
Took a training in data entry for COVID-19 surveillance	88 (77.2)	-	-
The program provided you with a smart phone / tablet or computer to facilitate entering and sending data	71 (62.3)	-	-
You receive a feedback report on your work from a governorate level	67 (58.8)	-	-

Simplicity	Agree * N (%)		
	Data entry clerks	Developers	Stakeholders
Data entry in the electronic system is clear	103 (90.4)	-	-
Data entry in the electronic system is easy	98 (86)	-	-
Internet access is always available at your site	84 (73.7)	8 (100)	-
Analysis of data describes time, place, and person	104 (91.2)	8 (100)	7 (70)
You receive feedback from a central level (PHC)	62 (54.4)	-	-
Easy to use	98 (86)	-	-
Dissemination of data / reports to stakeholders and key actors occurs on daily basis	80 (70.2)	7 (87.5)	-
Standard case definitions for COVID-19 are available	-	5 (62.5)	8 (80)
All capabilities necessary to establish surveillance system are available	-	8 (100)	-
Transferring data to high level is very easy	-	8 (100)	-
The system is easy to implementation	-	8 (100)	-
There is simplicity of information flow from the point of generation to the end users	-	8 (100)	-
All the different DBs are complementary to one another	-	8 (100)	-
Laboratory tests findings for COVID-19 are always reported in the surveillance system on daily basis	-	-	7 (70)
Took a training in how to extract reports from the COVID-19 surveillance	-	-	8 (80)
There is a need for timely notification of positive cases using phone	-	-	6 (60)

Simplicity	Disagree * N (%)		
	Data entry clerks	Developers	Stakeholders
In your experience/judgment do you believe any part of the surveillance system is unnecessarily complicated	67 (58.8)	-	-
The surveillance system has multiple steps	33 (29)	3 (37.5)	-
The surveillance system has a complicated workflow	75 (65.8)	8 (100)	-
The surveillance system is extremely hard to use	-	8 (100)	6 (60)

* No response means that these questions were not included in this user questionnaire

5.3.2.8 Acceptability

The acceptability of the COVID-19 surveillance system was measured using 3 items for data entry clerks and stakeholders and 1 item for developers as shown in (Table 16). The overall percentage is 69.60% from the data entry clerks' perspective, 100% from the developers' perspective and 73.33% from the key stakeholders' perspective. Most of targeted groups agreed that users are satisfied with the surveillance data.

Table 16 Frequency and percentage of acceptability items

Acceptability	Agree * N (%)		
	Data entry clerks	Developers	Stakeholders
The surveillance system is appropriate to the MoH's needs	79 (69.3)	-	7 (70)
There is ongoing data analysis from the surveillance system	84 (73.7)	-	8 (80)
Users are satisfied with the surveillance data	75 (65.8)	8 (100)	7 (70)

* No response means that these questions were not included in this user questionnaire

5.4 Overall Performance of COVID-19 Electronic Surveillance

Based on the result of the analysis of the questionnaires presented in the aforementioned sections and as stated in the objectives of this study, the COVID-19 electronic surveillance system meets the standard quality requirements based on CDC criteria as presented in Table 17 and Figure 13 below:

Table 17 Surveillance Performance

CDC Guidelines	Data Entry Clerks (%)	Developer (%)	Stakeholder (%)
Simplicity	71.68	90.62	70
Completeness	57.03	45.83	-
Timeliness	74.74	84.38	76.67
Usefulness	75.45	83.33	50.77
Acceptability	69.60	100	73.33
Flexibility	79.00	100	60
Representativeness	90.34	87.5	66.25
Stability	61.57	82.69	60
Overall Performance	72.36	83.89	62.2

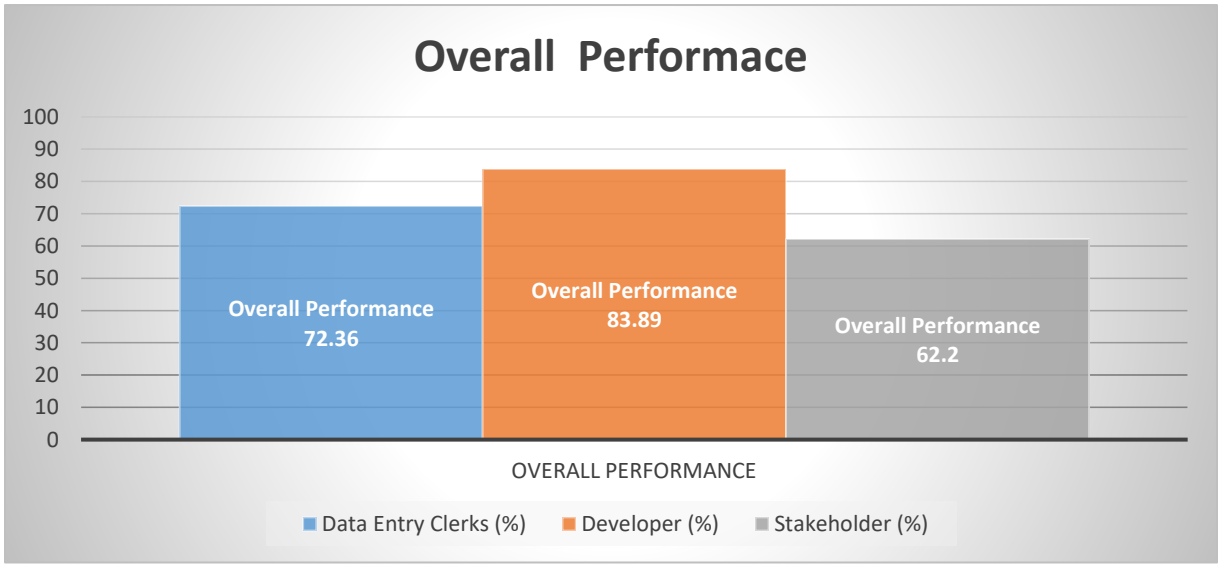


Figure 13 Overall Performance

Based on the reports and indicators extracted from the surveillance system as well as the result of the analysis of the questionnaires presented in the sections above, the COVID-19 electronic surveillance system represents the characteristics of cases (gender, age) and covers all districts in WB. Additionally, the system shows the classification of cases based on criteria as source of infection, governorate, health status, occupation, and others. Figure 14 shows an example from charts extracted from the surveillance system which present the classification of cases based on gender.

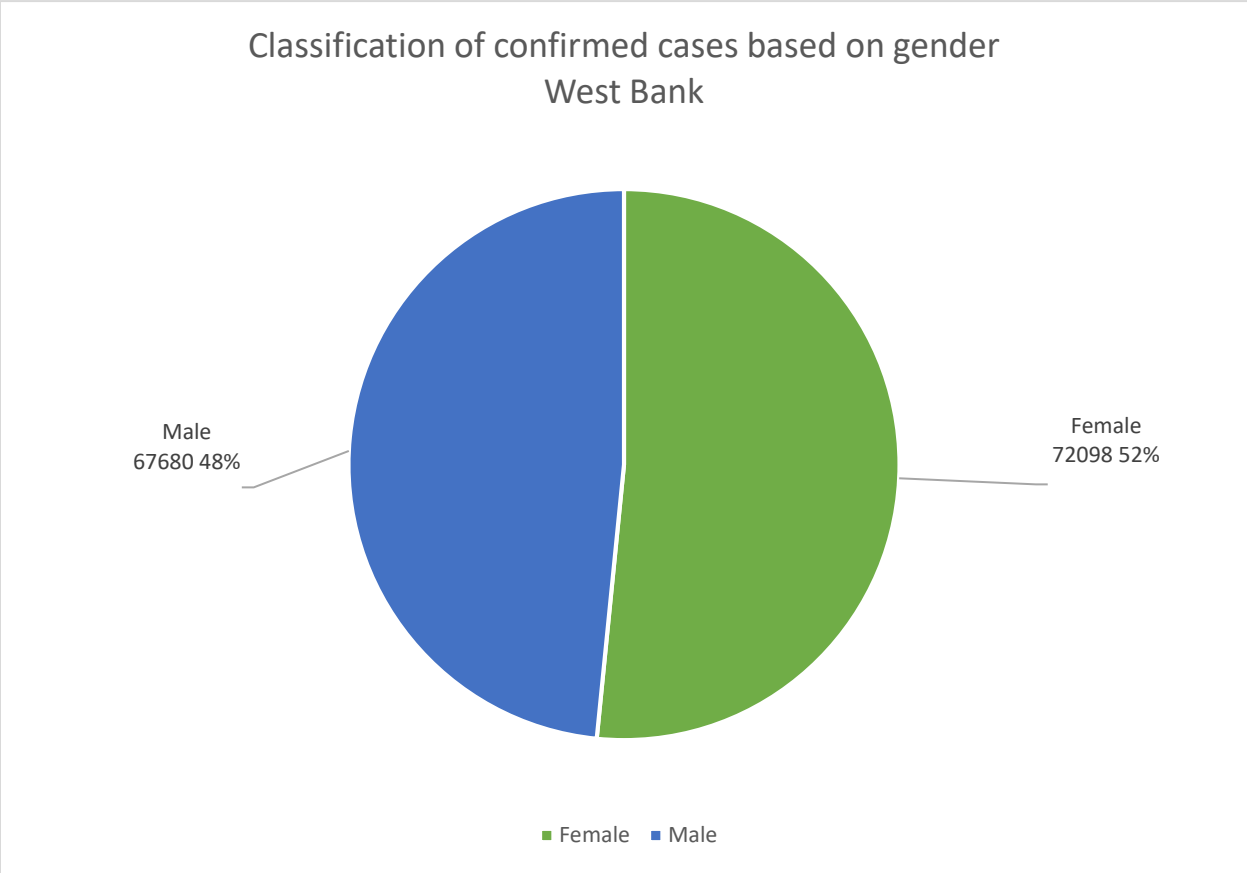


Figure 14 Classification of cases based on gender till 9.2021

5.5 Completeness of Data in Surveillance System

In addition to questionnaires, the researcher measured completeness by examining extracted data from the COVID-19 surveillance system for the key and main data elements for the event (aggregated) and tracker programs that were used to track coronavirus cases for the months of March 2020, September 2020, and April 2021.

The chart below shows the completeness of key data elements in the registration page and the remaining program is presented in the Appendix 21, Appendix 22, Appendix 23, and Appendix 24.

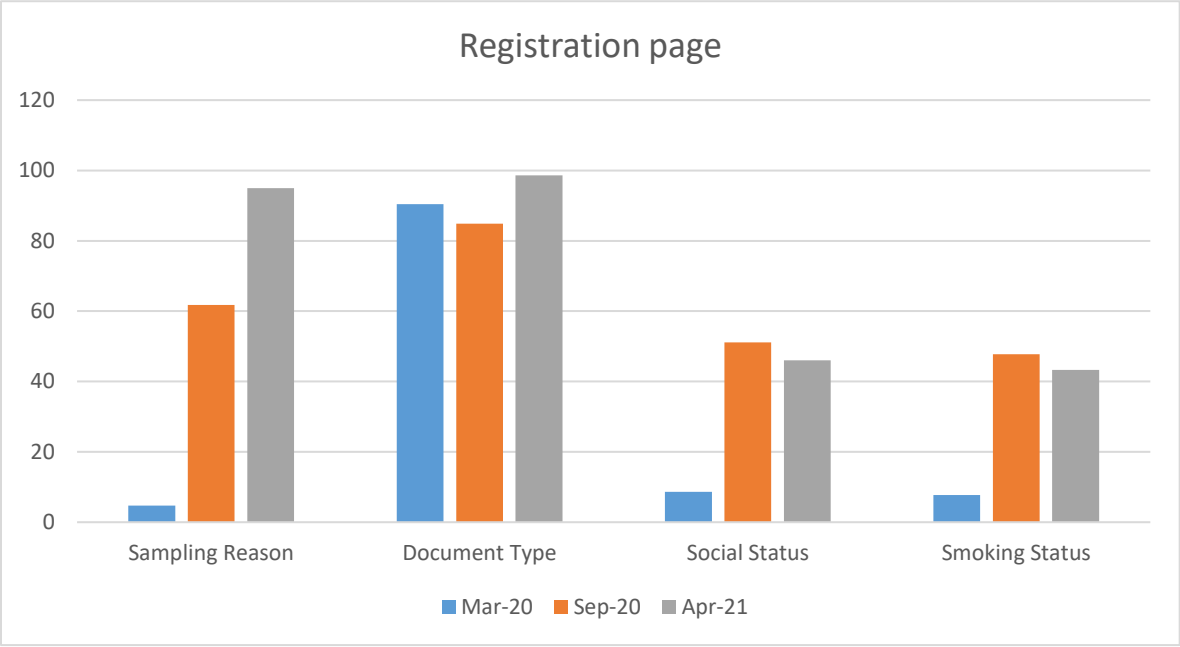


Figure 15 Completeness of key variables in registration page

(Figure 15) shows that the completeness of the data improving and getting better with time and that the most complete variables among those examined are sampling reason and document type while social status and smoking status are the least complete, but the overall data still incomplete.

5.6 Main Findings of the Qualitative Study

Key stakeholders who participated in the interview from the PMoH were from different specialties include doctors, medical laboratory workers, nurses, and information technologists. The participants' ages ranged between 35 and 58 years old and 70% were male.

5.6.1 Major Issues Raised by Stakeholders Regarding the COVID-19 Surveillance System

The Table 18 below presents the themes and sub-themes extracted from the interviews with stakeholders. Most of them request to integrate different systems in PMoH with COVID-19 surveillance system and to add some missing variables to the surveillance. In addition to that, rotation of employees is one of the challenges that affects reporting and documentation COVID-19 cases using the system. Also, needs to analyse the data by public health experts as an opportunity to reinforce the system.

Table 18 Themes and sub-themes with the total number of participants

Themes/ Sub- themes		Participants	Percentage of individuals in the defined category
1. Changes to the system do you believe would make it easier to implement while still achieving its purpose to strengthen and reinforce the system		10	100
1.	Integrate it with MOI	10	100
2.	Integrate it with web site “https://result.moh.ps” to avoid entering data twice	10	100
3.	Integrate it with Avicenna system which implemented in hospitals	10	100
4.	Integrate it with vaccine portal	10	100
5.	Integrate it with cause of death application	10	100
6.	Remove the stage of home quarantine from the surveillance and replace it with total number of home quarantine people	7	70
7.	Create file for each family in the surveillance to identify contacts and chances of infection	8	80
8.	Update it to be in one stage instead of multiple stages	7	70

Themes/ Sub- themes		Participants	Percentage of individuals in the defined category
2. Missing variables that should be routinely collected to strengthen documentation and reporting of COVID-19 and to inform policy makers		10	100
1.	Entering the type of virus / spikes	10	100
2.	Medical history for patient	6	60
3.	Enter the vaccination status, type and date of vaccine to see if the infection occurred after or before receiving the vaccination	9	90
3. Challenges and obstacles in documentation and reporting COVID-19		10	100
1.	Difficulties in collecting data from Gaza and Al Quds because of the occupation	10	100
2.	Rotation of employees due to lack of staff in medical centers	10	100
3.	Remote training is not enough	6	60
4.	Demographic data is not entered directly into the surveillance in sampling centers	5	50
5.	Entering all clinical and demographic data for negative cases and replace it with the total number of tests	4	40

	Themes/ Sub- themes	Participants	Percentage of individuals in the defined category
6.	Missing information received from doctors in medical centres	5	50
7.	The slowness of internet speed	7	70
4. Opportunities to reinforce system and enhance the data to inform policy makers		10	100
1.	Analyse the data by public health experts and specialized statisticians	7	70
2.	External control: an evaluation process by external groups, for example, lecturers from different universities and international supporting institutions	2	20
3.	Appointing volunteers and training them on data entry to reduce the workload on other staff	6	60
4.	Integrate it with private sectors	8	80

5.6.1.1 Missing Data

As shown in Table 18, the major issues that were raised by stakeholders when asking about missing data.

1. Entering the type of virus/spikes: while at the beginning of the pandemic, there was no diversity in virus types, it is necessary now to enter the type of virus so that the medical staff are aware of effectiveness of the vaccines and can determine the appropriate treatment for patients.
2. Medical history is missing: it is not enough to include only chronic diseases for the patients, the medical staff should know the entire medical history, the treatments he/she receives, allergies he/she has, and other complications that the patient experienced due to the infection. This problem could be solved by integrating the COVID-19 surveillance system with Avicenna system mentioned in first theme.
3. Missing vaccine information: the vaccination status, type and date of vaccine is important to see if the infection occurred before or after receiving the vaccine and this can be solved by integrating the COVID-19 surveillance with the vaccine web application as mentioned in first theme.

5.6.1.2 Challenges and Obstacles in Documentation and Reporting COVID-19

We have challenges and obstacles in documentation and reporting COVID-19 and there are many opportunities to strengthen the system as presented below:

1. Challenges in collecting COVID-19 data from Gaza and Jerusalem. The Preventive Medicine Unit in PMoH collects the aggregated number of cases from Gaza and Al Quds without any details about coronavirus cases.
2. Rotation of employees due to lack of staff in medical centers as shown in previous sections, the interviewee said: *"after giving training to staff who work to enter data into the COVID-19 surveillance system, the PMoH center is forced to rotate employees/staff due to shortage of staff in other PMoH centers, this constitutes an obstacle in the process of data entry and documentation on the electronic surveillance. As employee rotation causes the data to be filled out in paper form and then re-entered into the electronic surveillance system until the new employees are trained".*
3. Remote training rather than face-to-face: Online training is not enough from the point of view of some key stakeholders, the training taken remotely on how to use the surveillance system was not sufficient, and there is a need to retrain the staff face to face as the interviewee said: *"Due to the closure that was imposed on Palestine at the beginning of the spread of the coronavirus, it was necessary to train the staff that will work on the electronic surveillance system remotely, but after returning to work normally, employees/staff must be retrained face to face in small groups".*
4. The demographic data is not entered directly into the surveillance system in sampling centers: the staff in these centers filled the demographic data on paper forms and send it

with samples to the laboratory. This challenge can be solved by integrating the surveillance system with the MoI system as presented in the previous theme.

5. Entering negative cases: it is enough to enter the aggregate number of negative tests instead of entering the clinical and demographic data for the person who made the COVID-19 test "*because the negative cases will not be followed up and tracked as it happens with the positive cases"* as the interviewer said.
6. Missing information received from doctors in medical centers: *"because doctors are filing paper forms and sent them to data entry clerks. Some of these forms are not filled with all needed data about patients"* as the interviewer said.
7. The slow internet connection is one of the important challenges that affects data entry in the surveillance system, *"as it delays and hinders the data entry process"* as the interviewer said.

5.6.1.3 Perceived Opportunities to Strengthen the Surveillance System

The qualitative analysis was generally focused four areas which are: the changes to the system that would make it easier to implement, the missing variables that are needed to be routinely collected, identifying the challenges and obstacles in the documentation, and reporting of COVID-19, and opportunities to reinforce the system and enhance the data. The researcher divided the interview questions and answers into themes and sub-themes.

The main topics discussed with decision-makers in the PMoH and their suggestions to improve and develop the mechanism and technique used for documenting and reporting COVID-19 in the electronic surveillance system are shown in Table 18.

The change most key stakeholders agreed on was that the COVID-19 surveillance system has to be integrated with other systems and applications which will reinforce and strengthen the COVID-19 surveillance system and will make it easier to implement while still achieving its purpose.

The suggested systems that need to be integrated with COVID-19 surveillance system are:

a. The application used in the Ministry of Interior (PMoI) which would help in bringing all demographic data for patients based on their identification number without the need to enter these data manually.

"All electronic systems must be integrated with MoI especially the COVID-19 surveillance system because the results of the tests do not bear the error in data for individuals, and to save the time needed to enter the data, specifically during the period when the pandemic spread widely in Palestine"

b. Integrate it with the web application (https://result.moh.ps) that is used to enter COVID-19 test results to enable individuals, institutions, agencies in different countries and borders between countries to access the result of an individual's examination.

   "Instead of entering the demographic data and test result to COVID-19 surveillance system and re-enter it to the web application "https://result.moh.ps/", it must find a way to integrate the surveillance with web application to reduce the numbers of data entries, save time and prevent data duplication".

c. Integrate it with the Avicenna system, which is implemented in hospitals to enable doctors to access the medical history of patients who were diagnosed with COVID-19, and their condition necessitated admission to the hospital specifically to the intensive care units (ICU).

This will make it easier for doctors to plan appropriate treatment and make health decisions for their patients especially in the case of the hospitals that have been designated to receive COVID-19 patients and are working on the Avicenna system.

d. Integrate it with the vaccine web application "https://vaccine.moh.ps" which is used to enter the details of vaccine given to people (type, dose number, date of giving the dose, batch number) and the demographic data. The integration would reinforce the COVID-19 surveillance system to follow COVID-19 cases before and after the vaccine has been administered.

e. Integrate it with the cause of death application to facilitate data transfer for those who died by COVID-19 to the COD application which would strengthen the COVID-19 surveillance system and allow users to extract death certificates without the need to re-enter the data shared between the two applications again.

"The process of integration between the different systems and applications applied in PMoH centers will support the work and allow medical staff to give better services to the patient due to the availability of all the necessary data in one integrated application without the need to take information from each application separately.

Therefore, it is necessary to integrate all applications, specifically with the COVID-19 surveillance system, so that we can track patients and know their medical history and the vaccinations they received, and their impact on them so that we can combat the pandemic and reduce its risks as much as possible on Palestinian society"

On the other hand, some key stakeholders who participated in this study suggested removing the stage of home quarantine from the case reporting form program in the COVID-19 surveillance system and replacing it with the total number of home quarantine patients. This is because of the increased number of cases and the fact that the PMoH team cannot follow the home quarantined patients due to the shortage of staff tasked with entering patients' data into the COVID-19 surveillance. This issue is compounded by the fact that staff rotate continuously which was already presented in questionnaire result for the statement "the COVID-19 surveillance system has sustainable trained staff, and they are rarely exchanged" as presented in previous sections.

Also, others suggested creating a file for each family in the surveillance to identify contacts and chances of infection which would help draw the epidemiological map.

Additionally, an update to the surveillance system to condense it into one stage instead of multiple stages was suggested, but some stakeholders explained the reason behind designing the surveillance based on stages to facilitate following and tracking the patients based on their status (isolated, quarantined, positive and negative cases).

Below are policy recommendations from the perspective of key stakeholders at the PMoH:

1. Data analysis by public health experts and specialized statisticians will help PMoH decision-makers to inform policies and take appropriate decisions in limiting the spread of the pandemic.

   "Data analysis will help us reach the appropriate treatment based on the existing data for the infected cases within the electronic surveillance system, determining the efficacy of vaccinations, determining the best among them, and conducting many studies and other research that would protect citizens from the pandemic".

2. Need for external control.

   "There must be an external body that monitors and evaluate the performance of the work of the reporting and documenting COVID-19 through the electronic surveillance system, ensuring that the surveillance system collects all needed data and making sure about the surveillance system's effectiveness and its achievement of all standards that are subject to the WHO and CDC especially since COVID-19 is a new pandemic and there's no clear treatment for it all over the world. Examples for these control bodies are lecturers from different universities and international supporting institutions ".

3. Appointing volunteers and training them to enter data to reduce the workload on other employees/staff due to the small number of employees in the ministry and the need to rotate them on an ongoing basis.
4. Integrating the surveillance system with private sectors to update the data about patients continually "*because some coronavirus cases are admitted to private hospitals and then continue their treatment in governmental hospitals*".

5.7 Workflow on the COVID-19 Surveillance System

In this study, the researcher assessed the current workflow by analyzing COVID-19 surveillance statistics and aggregated reports. This was done by examining the sequence of filling out the various data elements in the COVID-19 surveillance programs from the different resources that facilitate tracking patients as presented in chart below (Figure 16) and from some questions added to the data entry workers and developers' questionnaires.

From the perspective of developers, 100% agree that the surveillance system is extremely easy and simple to use, and it has an uncomplicated and clear work flow. Moreover, 58.8% of data entry workers agree that the surveillance system does not has any unnecessarily complicated parts and 65.8% agree that the surveillance system has an uncomplicated and clear work flow.

The researcher presents below in Figure 17, Figure 18, Table 19, Table 20, Table 21, Table 22, Table 23, Table 24 and Table 25 some of aggregated reports for period 2020 until September 2021 extracted from the COVID-19 surveillance system and compares it with the actual results and reports that were announced by the PMoH; this show that the surveillance system has a clear workflow as shown in the reports.

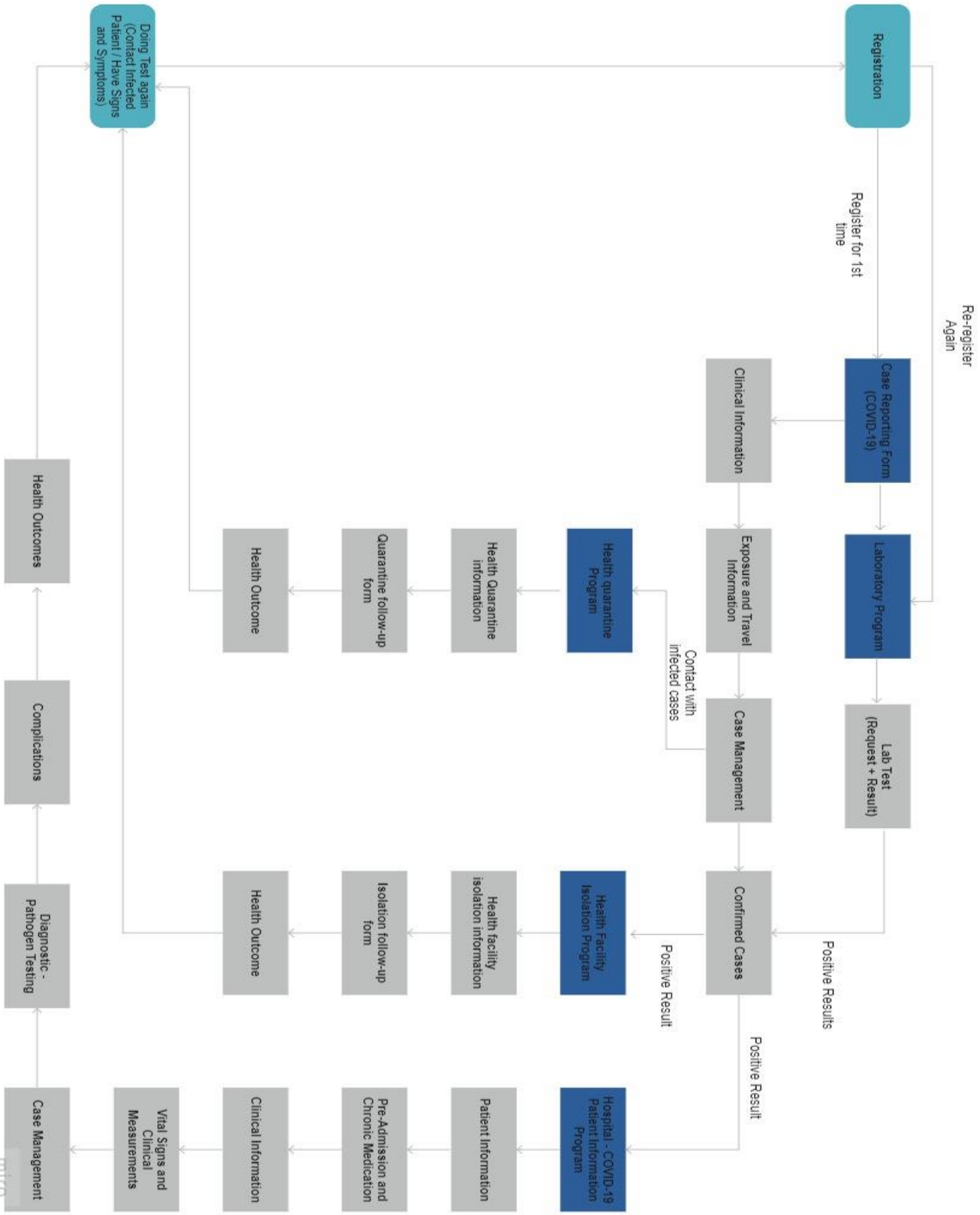


Figure 16 work flow chart

Table 19 Number of ICU cases / district

District Name	Number of ICU cases
Bethlehem	2210
Dair Albalah	0
Gaza	0
Hebron	6822
Jenin	1959
Jericho	333
Jerusalem	792
Khan Younes	0
Nablus	6800
North Gaza	0
Qalqilya	1176
Rafah	0
Ramallah	3895
Salfit	488
Tubas	879
Tulkarem	2144
Total	**27498**

Table 20 Total of new cases / district

District	2020	2021 (till 9.2021)
	Total Number of New Positive Cases	**Total Number of New Positive Cases**
Bethlehem	9302	8649
Deir al Balah	0	0
Gaza(district)	40501	128554
Hebron (Al Khalil)	10202	9754
Jenin	8828	15695
Jericho & Al Aghwar	2725	2259
Jerusalem	23065	17896
Khan Yunis	0	0
Nablus	14819	28695
North Gaza	1	0
North Hebron	4158	2858
Qalqilia	3857	7045
Rafah	1	0
Ramallah & Al Bireh	13329	23367

District	2020	2021 (till 9.2021)
	Total Number of New Positive Cases	Total Number of New Positive Cases
Salfit	2767	6442
South Hebron	7130	6538
Tubas	2014	3894
Tulkarem	6368	15872
Yatta	1206	1191
Total	**150273**	**278709**

Table 21 Total number of tests / laboratory

Laboratory	2020	2021 (till 9.2021)	Total
Sample Number (Caritas Baby Hospital)	73,872	68,602	**142,474**
Sample Number (CPHL)	203,853	248,699	**452,552**
Sample Number (Hebron Lab)	122,000	155,073	**277,073**
Sample Number (Jenin Lab)	70,500	101,995	**172,495**
Sample Number (Nablus Lab)	176,105	349,419	**525,524**
Sample Number (Jericho Lab)	23,331	26,874	**50,205**
Sample Number (AAUL Lab)	810	99,296	**100,106**
Sample Number (Gaza Lab)	217,338	540,181	**757,519**
Total	**887,809**	**1,590,139**	**2,477,948**

Table 22 Total of death cases / district

District	2020	2021 (till 9.2021)
	Total Number of Death Cases	Total Number of Death Cases
Bethlehem	101	137
Deir al Balah	0	0
Gaza(district)	370	1016
Hebron (Al Khalil)	196	296
Jenin	124	159
Jericho & Al Aghwar	19	29
Jerusalem	173	191
Khan Yunis	0	0
Nablus	157	347
North Gaza	1	0
North Hebron	43	0
Qalqilia	46	133
Rafah	0	0
Ramallah & Al Bireh	132	194
Salfit	22	78
South Hebron	36	1
Tubas	21	45
Tulkarm	84	197
Yatta	18	0
Total	**1543**	**2823**

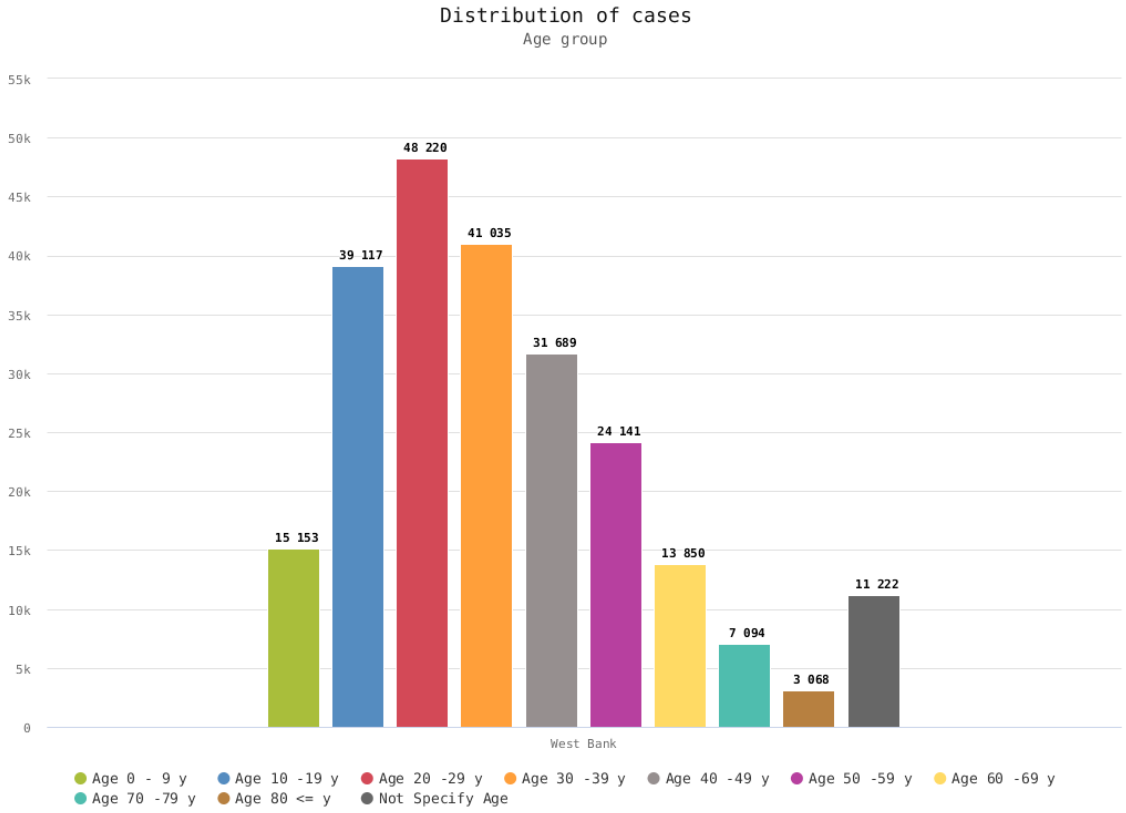


Figure 17 Distribution of cases in WB by age group

Table 23 Total of pregnant who has COVID-19/district

District	Pregnant Cases (Positive)
Yatta	57
Salfit	8
Jerusalem	6
Qalqilia	116
Ramallah & Al Bireh	37
Tulkarm	30
Jenin	226
North Hebron	112
Nablus	119
Tubas	14
South Hebron	187
Hebron (Al Khalil)	296
Bethlehem	128
Jericho & Al Aghwar	1
Total	**1337**

Table 24 Total number of health staff quarantine/district

District	Health Staff Quarantine		
	Male	Female	N/A
Yatta	30	33	-
Salfit	12	21	-
Jerusalem	35	37	-
Qalqilia	66	76	-
Ramallah & Al Bireh	278	320	1
Tulkarm	168	232	1
Jenin	223	196	1
North Hebron	120	122	-
Nablus	140	149	-
Tubas	44	38	-
South Hebron	67	63	-
Hebron (Al Khalil)	148	137	-
Bethlehem	132	99	1
Jericho & Al Aghwar	28	32	
Total	**1491**	**1555**	**4**

Table 25 Child confirmed cases by gender/district

District	Child confirmed cases by gender (WB)				
	2020		2021 (till 9.2021)		Total
	Female (0-18 y)	Male (0-18 y)	Female (0-18 y)	Male (0-18 y)	
Bethlehem	1105	1651	959	1178	**4893**
Hebron (Al Khalil)	1114	1032	650	822	**3618**
Jenin	855	889	1804	1793	**5341**
Jericho & Al Aghwar	388	339	244	249	**1220**
Jerusalem	699	674	422	486	**2281**
Nablus	1291	1219	3153	3054	**8717**
North Hebron	610	544	261	273	**1688**
Qalqilia	632	508	1116	1025	**3281**
Ramallah & Al Bireh	1038	872	1841	1854	**5605**
Salfit	446	337	990	877	**2650**
South Hebron	1194	1067	807	886	**3954**
Tubas	265	187	431	438	**1321**
Tulkarm	259	232	2283	2069	**4843**
Yatta	230	217	102	119	**668**
Total	**10126**	**9768**	**15063**	**15123**	**50080**

Figure 18 show the classification of COVID-19 cases / district on map (Palestine) from 2020 till 23.10.2021.

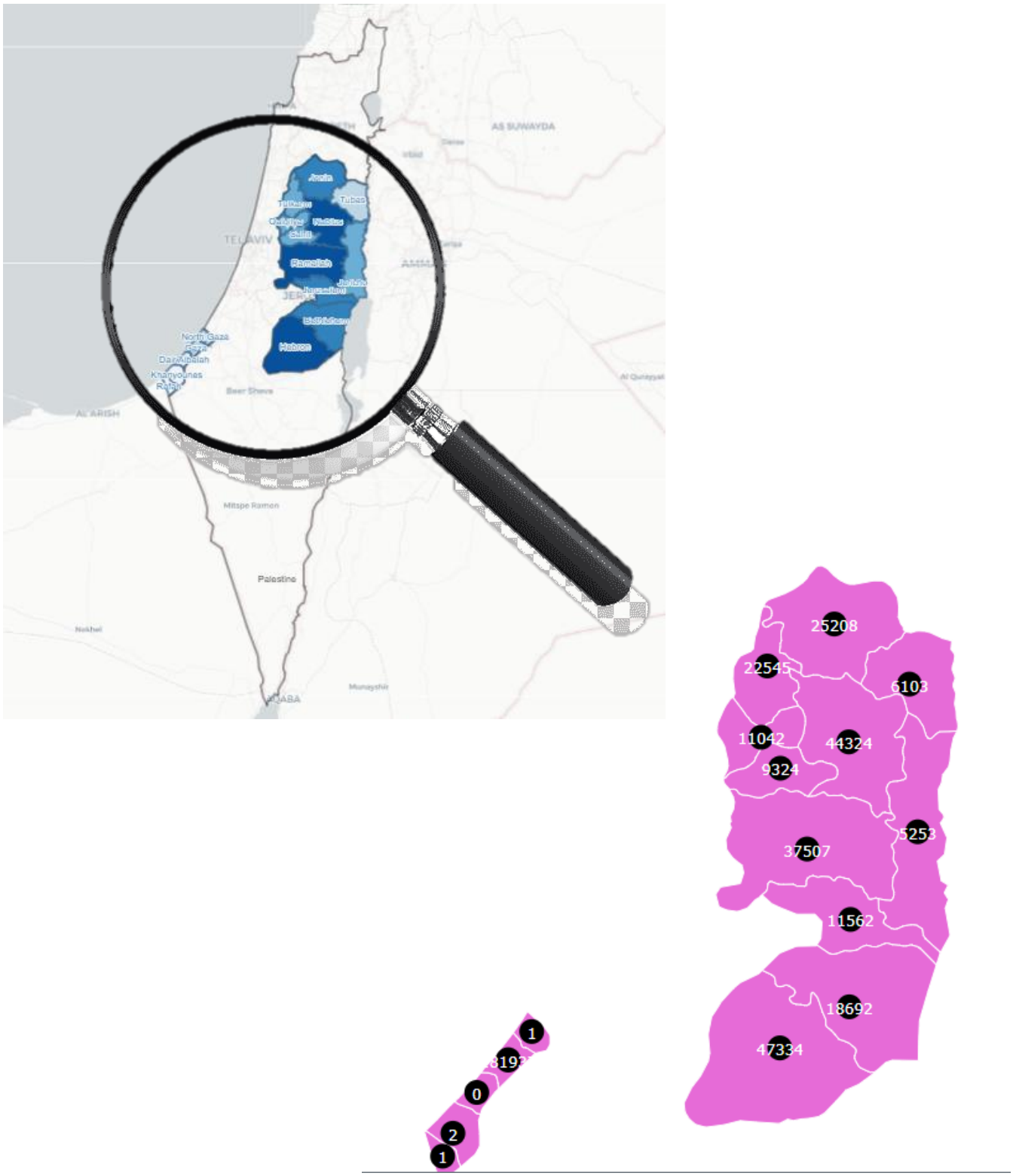


Figure 18 Confirmed cases / district

5.8 Summary

This chapter presented the results of the quantitative data analysis to examine COVID-19 adherence to CDC guidelines from perspective of data entry workers, developers, and key stakeholders. It also discusses the findings from the qualitative interviews with key stakeholder to identify opportunities, challenges and obstacles in documentation and reporting COVID-19 cases in order to enhance and reinforce the system. In addition, it presented findings from the assessment of the surveillance work flow and from the assessment of the data completeness.

The coming final chapter of this study will contain the discussion and interpretation of the main study findings. It will clarify the strengths, limitations, and recommendation of the study.

Chapter 6: Discussion and Conclusion

6.1 Introduction

In this chapter, the findings of the study will be discussed in light of the hypotheses and compared to previous assessments of communicable disease registries. In addition, I will discuss recommendations, study strengths, limitations, challenges, and study conclusion.

6.2 Discussion

6.2.1 Assessment of the Overall Performance of the COVID-19 Surveillance System

The reports and indicators extracted from the system indicate a high-quality system in terms of how it reflects the actual numbers of infections of COVID-19, the number of tests done, and the distribution of infected cases in governorates according to age groups and many other indicators that will be clarified in the Appendix 29 and which serve to help stakeholders in making appropriate decisions. This level of quality is likely due to the experience of the developers who worked with the other surveillance systems such as communicable diseases system.

The performance of the COVID-19 electronic surveillance system can be enhanced and developed by integrating it with all electronic systems related to the patient and his or her care as presented in the previous chapter and promoting work towards a more integrated response.

Thus, generally we found that the surveillance system has clear workflow, and it is useful, simple, flexible, representative, stable, timely and acceptable and yet needs to improve the completeness of data in the system and the routine evaluation.

6.3 Surveillance Components Assessed Based on CDC Guidelines

6.3.1 Usefulness

Based on study findings, as expected, the surveillance system is perceived as useful for setting policies and strategies to the control spread of COVID-19 by different users/stakeholders.

The usefulness of our surveillance system was demonstrated to be similar to that of previous assessment studies of the usefulness of other communicable diseases surveillances such as: the malaria surveillance system that was conducted in Adaklu District, Volta Region, Ghana to inform policy (Agbemafle et al., 2020), the surveillance system used for measles in Kaduna State, Nigeria (Ameh et al., 2016) which helped inform public health actions such as a vaccination campaign based on data extracted from measles surveillance system (Owusu & Dam-Park, 2021) and the surveillance system used for yellow fever in Adaklu District, Volta Region, Ghana (Ceesay & Kaburi, 2019) which proved to be beneficial and helped reduce the number of yellow fever cases.

However, regarding the ability to detect spikes, most of users agreed that the data in the surveillance system is not useful for detecting spikes in the outbreak in a timely way to allow for prevention and control measures. This can be explained by the fact that the surveillance was developed at the beginning of the pandemic in Palestine and before the mutations and spikes that occurred later.

Additionally, there have been no modifications to the system to be able to detect spikes in the outbreak, as stated in the interviews with key stakeholders who pointed to the need for modifications to the electronic surveillance system to allow users to enter the type of mutation and the vaccination that the individual received.

6.3.2 Flexibility

Based on study findings, as expected, the surveillance system is perceived as flexible from the different users/stakeholders.

Most users agreed that our COVID-19 surveillance system can adapt to accommodate additional information to case definition and the current reporting formats that are computerized through the COVID-19 electronic surveillance system.

In addition, the system can be integrated with other electronic systems such as MoI system, the Avicenna system which implemented in hospitals, the “https://result.moh.ps” website, the vaccine portal, and the CoD application.

Our study results on flexibility of the system are in line with the results of previous assessment studies of other communicable diseases such as: the measles surveillance system in Southeast Ethiopia in Ginnir district, which confirmed that the measles system was flexible to accommodate change in the existing procedure, case definition, data sources and reporting format (Kalil et al., 2021), the viral hepatitis A surveillance system in Egypt that was found to be highly flexible allowing for additional modifications to diseases and variables (Wessam Einahry, 2016), and the plague surveillance system in the Pasuruan Regency is also flexible (Malikhatin & Hendrati, 2017).

6.3.3 Representativeness

Based on study findings, as expected, from perspective of different users/stakeholders, the data in the surveillance system is representative, accurately measuring the epidemiology of the pandemic in Palestine.

Our findings on the representativeness for the surveillance system are in contrast to findings of most previous assessment studies of other communicable diseases including: an assessment of the measles surveillance systems that was conducted in Ginnir District, Bale Zone, Southeast Ethiopia which found that the measles system was partially representative as although it covers all health facilities in the Ginnir district due to its reporting format, it does not cover important variables like sex and age (Kalil et al., 2021). Another assessment study of the surveillance system used for viral hepatitis A in Egypt found that the system is partially representative as it needs to expand reports in order to enhance representativeness of the general population (Wessam Einahry, 2016).

Additionally, a malaria surveillance system in Kano State was donor-driven and the data were not representative of all health facilities although it could present the distribution of malaria cases in terms of age, sex ,location, outcome of disease and date of diagnosis (Visa et al., 2020).

On the other hand, a measles surveillance system in Asutifi North District, Ahafo Region, Ghana was found to be representative because it covered all health facilities in the district and "*captured information on socio-demographics, outcomes and geographical location from all reporting facilities*" (Owusu & Dam-Park, 2021).

In our study, results are mixed regarding whether the electronic surveillance system covers health centers in the private and public sectors. While 4 out of 8 developers reported that the system includes both the public and private sectors, and only 2 out of 10 stakeholders confirmed that and

the rest requested to integrate the surveillance system with data from the private sectors as an opportunity to reinforce the system and enhance the data to inform policy makers.

However, although the private sector works on different systems and they provide the PMoH with total COVID-19 cases on a daily basis. All the above shows that the system is highly representative and helps in estimating the burden of disease and the groups most vulnerable to infection and death.

6.3.4 Stability

Based on study findings, as expected, the surveillance system is perceived to be stable by the different users/stakeholders. This can be explained by the fact that the developers used the same platform that had previously been used to develop other communicable disease systems and had already been implemented in different facilities thus solving problems such as power outages. This is in contrast to the result of previous evaluation studies on surveillance systems of other communicable diseases. The review of the influenza sentinel surveillance system that was implemented in the Democratic Republic of Congo found that the stability of the influenza sentinel system was moderate due to "*elevated frequencies of electricity cuts and generator failures, in addition the influenza sentinel surveillance system is mainly funded by international agencies*" (Babakazo et al., 2019).

Furthermore, most developers, key stakeholders and data entry clerks confirmed that the Palestinian surveillance system is able to operate at all times and automatically performs data transfer, entry, and storage daily, and this allowing policy makers to extract reports and craft policies that are commensurate with the situation of the pandemic in Palestine. This finding is in contrast with the findings of the previous assessment study of malaria surveillance system in Thailand where the researchers found a technical problem in synchronizing data (Ma et al., 2016).

Moreover, most of developers and stakeholders agreed that the surveillance system is able to collect, manage, and provide data in a timely manner and is sustainable even without sponsors support, which was not the case for the malaria surveillance system in Thailand which "*is primarily supported by the Global Fund and requires long-term ongoing funding*" (Ma et al., 2016).

However, from perspective of key stakeholders, developers and data entry clerks, financial support would allow the system to be better and fully functional and which allow the PMoH to provide all health facilities who use surveillance system with generators and the required staff to enter the data into the surveillance system. This result is based in the analysis of the questionnaires, which show that only a small percentage of participants agreed that generators were available in all facilities and that that all facilities had a trained and sustainable staff that were rarely exchanged.

This point was confirmed by key stakeholders in the interviews when they requested volunteers to be trained on data entry to reduce the workload on other staff as an example of an opportunity to reinforce the system. The interviewees also mentioned that the rotation of employees was due to lack of staff in medical centers.

In addition, our surveillance system has stable servers and databases despite regular electricity and power interruption and that the PMoH does not yet have a planned resource for maintenance of the system as the electronic malaria information system in Thailand that has a server that never had a downtime due to the advanced technical strategies and careful maintenance which enforces the stability of the system (Ma et al., 2016).

Another result suggesting stability, is that most of the developers confirmed that the internet is always available without interruption in the main data center and the system is backed up continuously. The DC includes servers for all applications implemented in PMoH facilities and so it is equipped with all the prerequisites needed to keep servers safe and continually backed-up.

All of the above point to a stable surveillance system which makes users more satisfied and confident in the safety of the data.

6.3.5 Completeness

Based on study findings, as expected, the data in the COVID-19 surveillance system is perceived to be incomplete from the perspective of different users/stakeholders. This is further supported by the analysis where I examined the completeness of data by counting the missing data for the key variables collected from each program at different time intervals. This analysis showed that the data completeness is getting better with time but there is still missing data. The missing data can be explained by the lack of daily monitoring of the data entered to the surveillance system, lack of feedback from the high level of the PMoH, and staff turnover.

Our finding is in line with the evaluation results for other communicable disease surveillance systems. In an assessment study of a measles surveillance system in Asutifi North District, Ahafo Region, Ghana it was found that the surveillance system has "*incomplete case-based investigation forms and some columns wrongly filled*" (Owusu & Dam-Park, 2021). Additionally the evaluation of a measles surveillance system in Afar Region, Ethiopia showed incompleteness (Debela et al., 2019) as did the findings on the completeness of data in a tuberculosis register surveillance system in Eden District, Western Cape, South Africa (Mlotshwa et al., 2017). Correspondingly, in Tunisia, the influenza-like illness surveillance system has "*gaps in completeness of data affected the ability to objectively assess quality of data*" (Yazidi et al., 2019).

Data completeness remains a major challenge for many electronic systems including the electronic surveillance system for COVID-19 in Palestine. However, the increasing percentages of data completeness over time for key variables in our surveillance system are encouraging. This shows the high quality of the surveillance system, as most data entry clerks and developers in our study agreed that the completeness of reporting from COVID-19 surveillance forms was high and after reviewing the reports, we found that the surveillance system gives all needed reports and indicators and thus can guide policies and procedures regarding the situation of the pandemic in Palestine.

On the other hand, key stakeholders identified some challenges in the documentation and reporting of COVID-19 related to the completeness of data such as missing information received from doctors in medical centers and demographic data not entered directly into the surveillance system in COVID-19 examination centers, which specifically affects the completeness of the data because the data from examination centers is sent on paper and re-entered to the electronic surveillance system in medical centers.

6.3.6 Timeliness

Based on study findings, as expected, most users/stakeholders confirmed that the data was entered in real time in to the COVID-19 surveillance system.

Timeliness is also measured by the speed between steps in the surveillance process (Fahey, 2015) and the time needed to transmit the data from one program to another within the electronic surveillance system which we found to be at an adequate speed as the data is transferred directly from one program to another and simultaneously transmitted from all programs to stakeholders and decision-makers. This in turn ensures the high quality of data and reports that are extracted and makes it easier to take the necessary actions and make decisions based on the indicators extracted from the surveillance system.

In addition, most users agreed that daily reports are sent in a timely manner and all developers confirmed that the COVID-19 surveillance system was created at the appropriate time and did not take an extensive time to create and develop it which allowed the Preventive Medicine Department in the PMoH to collect all needed and vital data and help control spread of the pandemic by developing timely interventions.

The feature of seamless and quick maneuvering within the system is due to the periodic meetings held by the developers of the system with the responsible departments in the PMoH during the system development to identify the most important requirements needed to control the pandemic.

This is in line with the evaluation of a yellow fever surveillance system conducted in Adaklu District, Volta Region, Ghana which stated that timely feedback needs to be improved but there has been an increase in the timing of weekly reports over time (Ceesay & Kaburi, 2019). Also, the timeliness was found to be less than ideal in a measles surveillance systems in the study conducted

in Ginnir District, Bale Zone, Southeast Ethiopia (Kalil et al., 2021). The results of an evaluation of the plague surveillance system in the Pasuruan Regency showed that the timeliness of the surveillance system was low (Malikhatin & Hendrati, 2017).

However, in a study conducted in the Democratic Republic of Congo evaluating the influenza sentinel surveillance system showed that the system provided "*reliable and timely data about influenza*" and the overall timeliness of the system was considered satisfactory being classified as moderate to good (Babakazo et al., 2019).

6.3.7 Simplicity

Based on study findings, as expected, the surveillance system is perceived as being simple from the perspective of different users/stakeholders.

Most users agreed that the process of entering data into the surveillance system and reporting form is clear. This is largely the case because the developers coordinated with responsible departments and key actors to computerize the WHO forms (Appendix 6, Appendix 7, Appendix 8, Appendix 9, Appendix 10, and Appendix 11) in addition to forms approved by the PMoH (Appendix 12, Appendix 13, Appendix 14, Appendix 15, and Appendix 16) for the purposes of monitoring communicable diseases in Palestine. Additionally, it is easy to implement and use the surveillance system as whole system for different users engaged in entering data, extracting reports or any other procedure which can be done through the system due to the user-friendly platform.

This is in line with an evaluation done for a malaria surveillance system in Yemen, which features suitable simplicity while the other program used for malaria in Yemen has poor simplicity (Anam et al., 2019).

In addition, most of data entry workers and developers emphasized that the surveillance system has a simple workflow without any complicated parts but with multiple steps which could be revised and reduced to enhance the system stability. As the evaluation of the rabies surveillance system conducted in Sunyani West District – Ghana showed, the system was also simple which affected its stability (Guri, 2020). Furthermore, the evaluation done in Egypt for the viral hepatitis A electronic surveillance system showed that it is simple regarding structure and dataflow (Wessam Einahry, 2016). Finally, the results of the evaluation of the plague surveillance system

in the Pasuruan Regency showed that the surveillance system was simple but with low acceptability (Malikhatin & Hendrati, 2017).

Most key stakeholders confirmed that they took a training on how to extract reports from the COVID-19 surveillance despite some of them saying in the interview that the electronic training was not enough, and they need to take another training face to face. Because of the emergency that the country faced because of the pandemic, the training was carried out using electronic technology and videos sent to users, a fact which was confirmed by the data entry clerks.

Likewise, most of the data entry clerks confirmed that they took a training on how to enter data into the COVID-19 surveillance system. Thus, the simplicity of the COVID-19 surveillance system has contributed to its stability which explains why the system is also stable as explained earlier (Babakazo et al., 2019).

Because COVID-19 is new and based on the clinical history of patients, it was necessary for timely notification of positive cases especially for those who have chronic disease and to follow up over the phone with them to take the necessary isolation measures and seek any needed treatment. This cannot be done without daily documentation and reporting of the result of laboratory tests into the surveillance system which was emphasized by most key stakeholders.

The majority of developers and stakeholders also confirmed that the system provides standard case definitions for COVID-19, which makes it easier for surveillance system users to enter data and handle cases easily.

Most of the data entry workers emphasized the importance of the availability of the internet and the necessary devices to work on the surveillance system for the purposes of data entry. They also emphasized the availability of phones in their work centers, which makes it easier for them to

follow up with the infected cases, as follow-up is necessary in order to update the data on the cases and facilitate feedback from central (PHC) and governorate levels.

All the developers confirmed that all of the databases within the system are complementary to each other and that the internet was always available in offices in addition to the availability of all the necessary capabilities to establish and develop the system. This made it easy to develop the system according to the requirements of the PMoH and the WHO and train users remotely because they used the same infrastructure previously used when developing the communicable disease surveillance system. Taken together this shows how simple is the COVID-19 surveillance system from the perspective of different users.

6.3.8 Acceptability

Based on study findings, as expected, using the surveillance system was found to be acceptable by various users/stakeholders because it is simple, clear, flexible, stable, useful, and able to produce the necessary reports and indicators that help in setting policies and decision making.

This is in line with a study conducted in Asutifi North District, Ahafo Region, Ghana to evaluate a measles surveillance system and its acceptability which found that the "*majority of the respondents felt the system was acceptable and they were willing to continue participating in the system*" (Owusu & Dam-Park, 2021).

Also, a study conducted in Guinea Bissau to evaluate the cholera surveillance system showed that the users generally accepted and were satisfied with the surveillance system and agreed that it is a useful tool (Elisabeth et al., 2009).

6.4 Workflow of the COVID-19 Surveillance System

Based on the study findings and examining the sequence of filling out the various data elements in the COVID-19 surveillance programs and moving between fields and programs within the electronic surveillance system, as well as the analysis of questionnaires, we found that the workflow in the surveillance is easy, clear and allows tracking the patient without any undue effort or time taken.

This workflow has been modified more than once between the beginning of the pandemic up until the current work flow was approved. This was documented through the electronic surveillance system and was based features agreed upon between all users, whether data entry clerks, laboratory technicians, doctors, preventive medicine staff and other responsible persons in the PMoH, which explains why the current workflow is easy and clear for all users.

6.5 Study Limitations

1. Due to the COVID-19 pandemic, all data entry clerks were busy working on the system had limited time for participation. Stakeholders were also busy and thus were not able to conduct face to face interviews, due to their tight schedules and because they were routinely busy in the meetings of the epidemiological committee to assess the general situation of the pandemic in Palestine and develop the necessary policies to limit its spread.
2. The online survey took 3 months for all target groups to complete instead of planed 1 month as they were overwound with work.
3. No other research was found about assessing the documentation and reporting COVID-19.
4. The small number of stakeholders who participated in this research.
5. It was challenging to select data entry clerks for the study from the list extracted from the surveillance system as not all of those registered work in data entry and some of them stopped working as their contracts ended / rotation.

6.6 Strengths of the Study

Despite the study limitations, it has several strengths:

1. This is the first study to evaluate and assess all programs of the COVID-19 surveillance system in the world and especially in Palestine.
2. Used mixed approach to collect data, both quantitative and qualitative methods.
3. The study covers all districts in the WB.
4. The study assessed the COVID-19 surveillance system based on CDC guidelines.
5. This research can help the PMoH to enhance and reinforce the COVID-19 surveillance system.
6. This research may encourage other countries to use the same system to collect data about COVID-19 cases.
7. This study provides the perceptions and views of the COVID-19 surveillance system users, which is important as they have a vital role in delivering high quality health services.
8. Practical recommendations were suggested by key stakeholders.
9. This research represents different levels of users of the COVID-19 surveillance system, including data entry workers, developers and stakeholders.

6.7 Conclusion

This study was conducted in the West Bank to evaluate the COVID-19 surveillance system based on CDC guidelines using qualitative and quantitative methods. Overall, based on the study participants' perception, the COVID-19 surveillance system achieves its objective as an effective platform that meets the disease surveillance recommendations of the CDC guidelines including usefulness, flexibility, representativeness, stability, completeness, timeliness, simplicity, and acceptability. The surveillance system has also improved the performance and quality of the COVID-19 pandemic control program because the electronic surveillance system has enabled decision makers to manage cases where they have faster access to individual and aggregated data for a rapid response to the outbreak of the pandemic. However, the surveillance system needs to be monitored and the completeness of the data should be enhanced which will improve the data quality and lead decision makers to respond in a timelier manner to the situation.

6.8 Study Recommendations

Based on study findings and from perspective of key stakeholders, data entry clerks and developers, these are the recommendation that may enhance and improve the surveillance system:

1. Integrate all medical programs and application implemented in health centers related to the PMoH with each other and especially with the COVID-19 surveillance system. This will improve the medical services given to patients, make obtaining good indicators to improve health policies easier and reduce the effort and time required to enter demographic data or other medical data as this data is already in other applications especially Avicenna which is applied in all government hospitals which some of these hospitals allocated to treat Coronavirus patients.
2. Integrate the electronic surveillance system with the Ministry of Interior, which will provide all demographic data without having to re-enter it again.
3. Develop the COVID-19 surveillance system to be sensitive to the emergence of new spikes.
4. Apply the same system in the Gaza Strip and re-evaluating it.
5. Make data available to public health experts and specialized statisticians to analyse the data.
6. Apply the same system in the private sector with the aim of obtaining a unified and comprehensive system that serves COVID-19 patients in all health facilities in Palestine.
7. Remove the home quarantine program from the surveillance system and replace it with a total number of home quarantine patients, as they are not monitored on a daily basis, and this affects the completeness of the data for this program, which in turn will positively affect and reinforce the system.

8. Enter the total number of tests for negative cases instead of entering all clinical and demographic data because these cases are not followed
9. Develop a mobile application to facilitate entering data in hospitals and different medical centers.
10. Re-training COVID-19 surveillance system users face to face.
11. Need for an expert to monitor the overall performance of the COVID-19 surveillance system.
12. Need to monitor and enhance the data completeness in the COVID-19 surveillance.

6.9 Future Research

Based on study findings, future study should investigate reasons behind dissatisfaction with certain attributes of the surveillance system through a qualitative study among all users, stakeholders and data entry clerks.

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Appendices

Appendix1 Approval from Minister of the PMoH

STATE OF PALESTINE Ministry of Health Engineering & Computer Unit		دولـــــة فلســـــطين وزارةالصحـــــة وحدةالهندسة و الحاسوب

Date: ..23.9.2020..... التاريخ:

Ref :.E & C U / 80 الرقم:

معالي وزيرة الصحة حفظها الله

د.مـي سـالم الكيـلة المحترمـة

تحية طيبة و بعد ،،

الموضوع : تقييم توثيق حالات الإصابة بفايروس كورونا (COVID-19) في فلسطين و توثيق التدخلات و المتابعة (تحليل الوضع الراهن)

يرجى علم معاليكم بأن الموظفة آلاء أبو عيشة من وحدة الهندسة و الحاسوب ملتحقة ببرنامج الدراسات العليا في الجامعة العربية الأمريكية ضمن تخصص المعلوماتية الصحية ، حيث تقوم بعمل دراسة تهدف إلى تقييم توثيق حالات الإصابة بفايروس كورونا في فلسطين و توثيق التدخلات و المتابعة (تحليل الوضع الراهن).

و عليه يرجى من معاليكم الموافقة على توزيع استبيان على ذوي العلاقة لتحقيق الهدف المرجو من الدراسة الخاصة برسالة الماجستير للطالبة المذكورة ، بالإضافة لتحليل البيانات المخزنة على المرصد الإلكتروني الخاص بفايروس COVID-19 مع الأخذ بعين الاعتبار حفظ خصوصية و سرية المرضى و دون التطرق لأي بيانات شخصية مثل رقم الهوية و الإسم ، علماً انها كانت عضو أساسي في تصميم و تطوير هذا المرصد .

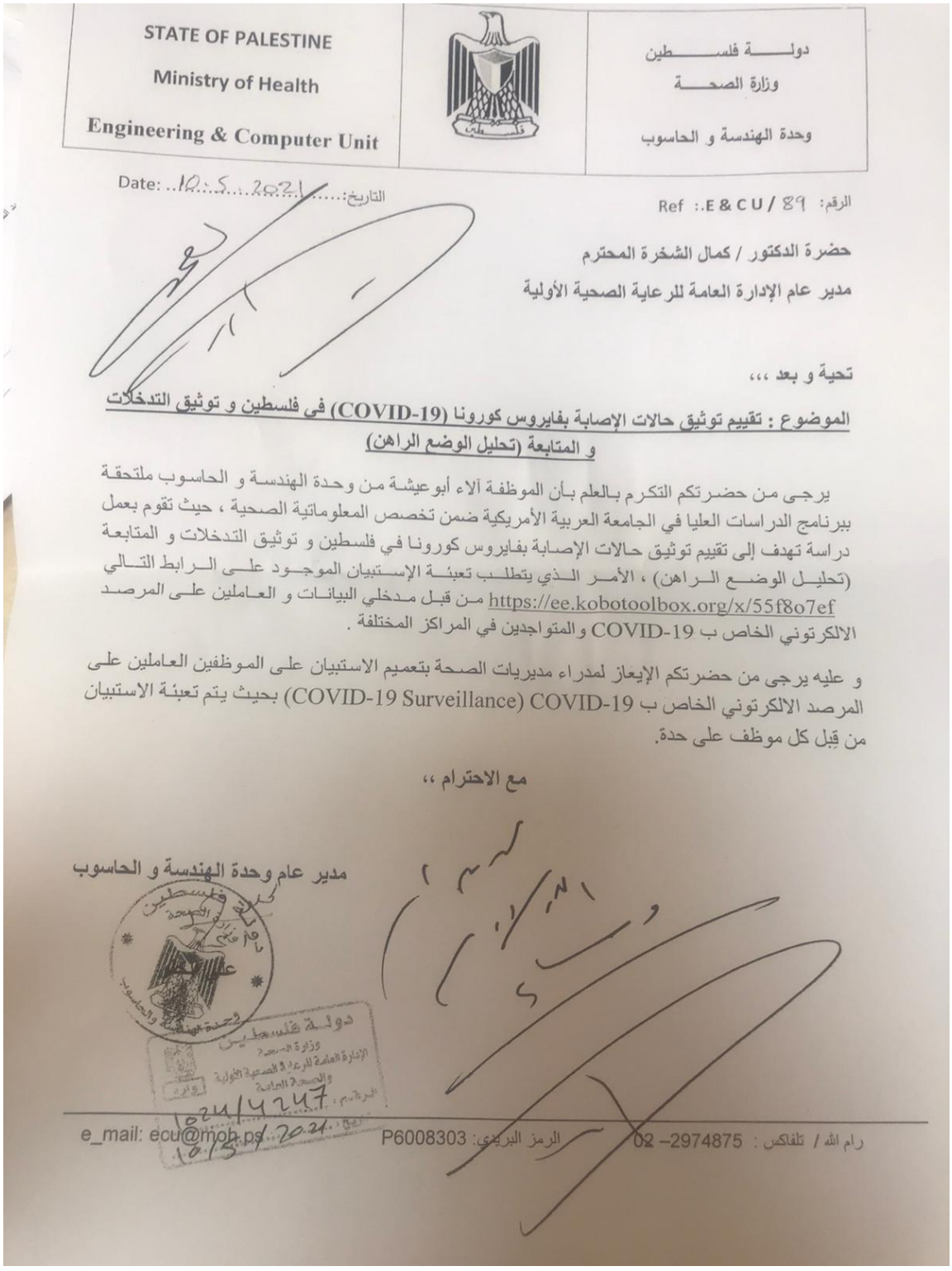
مع الاحترام ،،

مدير عام وحدة الهندسة و الحاسوب

علي الحلق

رام الله / تلفاكس : 02 –2974875 e_mail: ecu@moh.ps

Appendix2 Letter from General Directorate of PHC to the target groups to fill out the questionnaire



STATE OF PALESTINE
Ministry of Health
Engineering & Computer Unit

دولـــــة فلســـــطين
وزارة الصحـــــة
وحدة الهندسة و الحاسوب

Date: 10/5/2021 التاريخ:

Ref :E & C U / 89 الرقم:

حضرة الدكتور / كمال الشخرة المحترم
مدير عام الإدارة العامة للرعاية الصحية الأولية

تحية و بعد ،،،

الموضوع : تقييم توثيق حالات الإصابة بفايروس كورونا (COVID-19) في فلسطين و توثيق التدخلات و المتابعة (تحليل الوضع الراهن)

يرجى من حضرتكم التكرم بالعلم بأن الموظفة آلاء أبوعيشة من وحدة الهندسة و الحاسوب ملتحقة ببرنامج الدراسات العليا في الجامعة العربية الأمريكية ضمن تخصص المعلوماتية الصحية ، حيث تقوم بعمل دراسة تهدف إلى تقييم توثيق حالات الإصابة بفايروس كورونا في فلسطين و توثيق التدخلات و المتابعة (تحليل الوضع الراهن) ، الأمر الذي يتطلب تعبئة الإستبيان الموجود على الرابط التالي https://ee.kobotoolbox.org/x/55f8o7ef من قبل مدخلي البيانات و العاملين على المرصد الالكتروني الخاص ب COVID-19 والمتواجدين في المراكز المختلفة .

و عليه يرجى من حضرتكم الإيعاز لمدراء مديريات الصحة بتعميم الاستبيان على الموظفين العاملين على المرصد الالكتروني الخاص ب COVID-19 (COVID-19 Surveillance) بحيث يتم تعبئة الاستبيان من قِبل كل موظف على حدة.

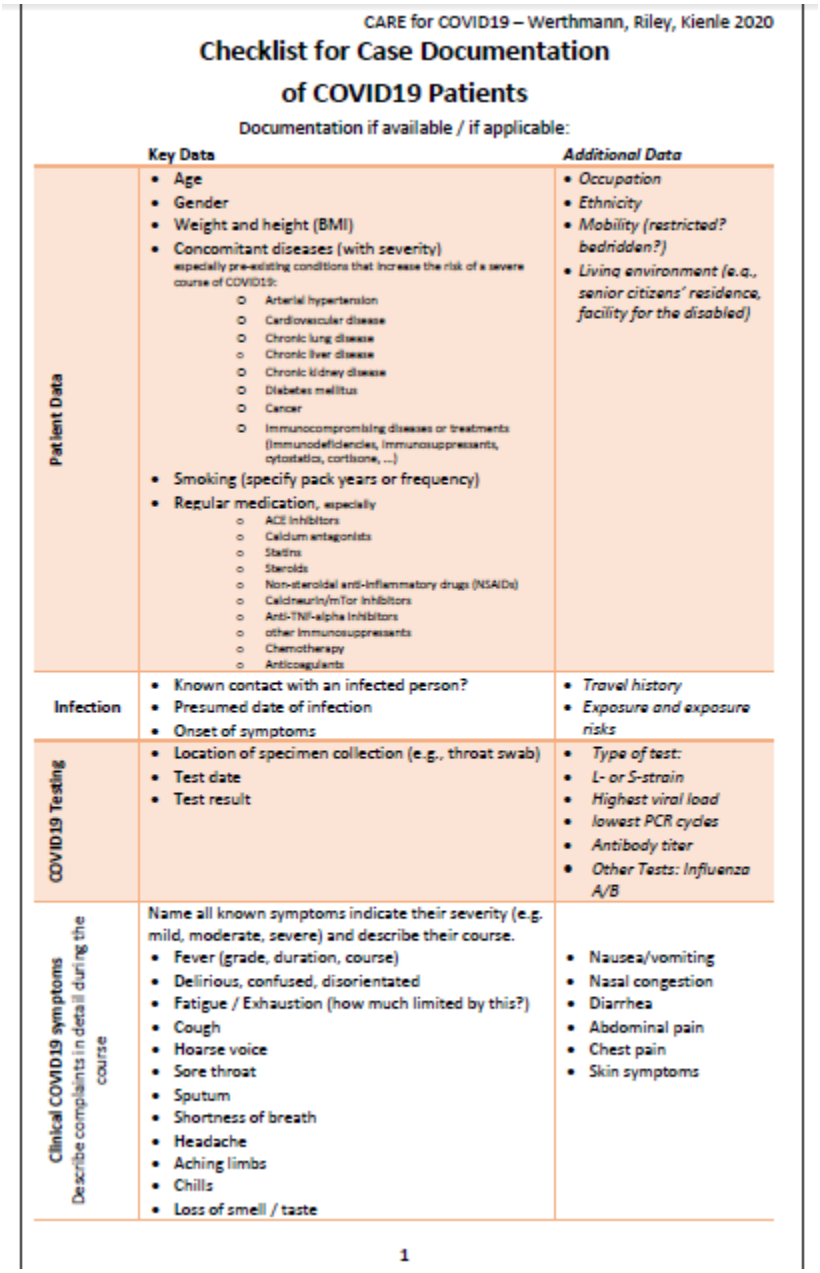
مع الاحترام ،،

مدير عام وحدة الهندسة و الحاسوب

دولة فلسطين
وزارة الصحة
الإدارة العامة للرعاية الصحية الأولية
والصحة العامة
الرقم: 1224/4247
10/5/2021

e_mail: ecu@moh.ps الرمز البريدي: P6008303 رام الله / تلفاكس : 02 –2974875

Appendix3 Checklist for case documentation of COVID-19 patients created by Paul Georg Werthmann (1)



CARE for COVID19 – Werthmann, Riley, Kienle 2020

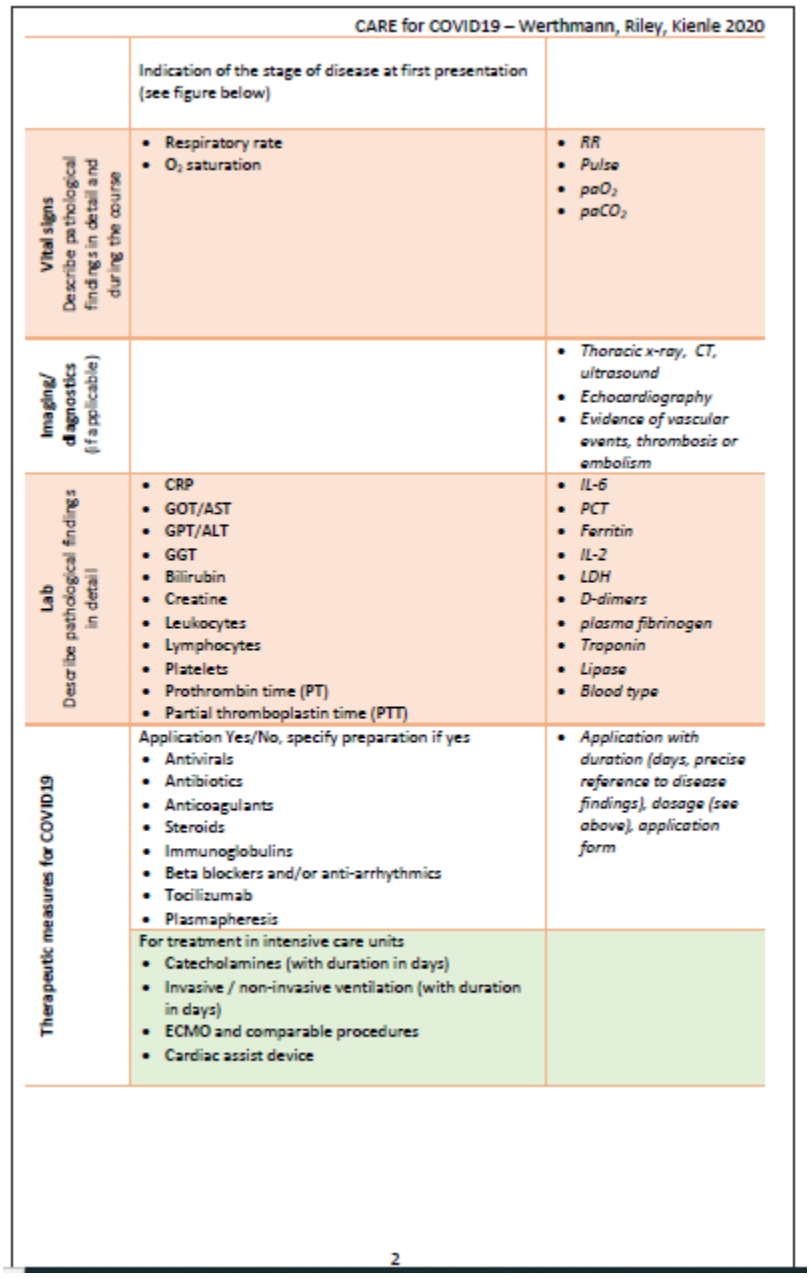
Checklist for Case Documentation of COVID19 Patients

Documentation if available / if applicable:

	Key Data	*Additional Data*
Patient Data	• Age • Gender • Weight and height (BMI) • Concomitant diseases (with severity) especially pre-existing conditions that increase the risk of a severe course of COVID19: ○ Arterial hypertension ○ Cardiovascular disease ○ Chronic lung disease ○ Chronic liver disease ○ Chronic kidney disease ○ Diabetes mellitus ○ Cancer ○ Immunocompromising diseases or treatments (immunodeficiencies, immunosuppressants, cytostatics, cortisone, ...) • Smoking (specify pack years or frequency) • Regular medication, especially ○ ACE inhibitors ○ Calcium antagonists ○ Statins ○ Steroids ○ Non-steroidal anti-inflammatory drugs (NSAIDs) ○ Calcineurin/mTor inhibitors ○ Anti-TNF-alpha inhibitors ○ other immunosuppressants ○ Chemotherapy ○ Anticoagulants	• *Occupation* • *Ethnicity* • *Mobility (restricted? bedridden?)* • *Living environment (e.g., senior citizens' residence, facility for the disabled)*
Infection	• Known contact with an infected person? • Presumed date of infection • Onset of symptoms	• *Travel history* • *Exposure and exposure risks*
COVID19 Testing	• Location of specimen collection (e.g., throat swab) • Test date • Test result	• *Type of test:* • *L- or S-strain* • *Highest viral load* • *lowest PCR cycles* • *Antibody titer* • *Other Tests: Influenza A/B*
Clinical COVID19 symptoms Describe complaints in detail during the course	Name all known symptoms indicate their severity (e.g. mild, moderate, severe) and describe their course. • Fever (grade, duration, course) • Delirious, confused, disorientated • Fatigue / Exhaustion (how much limited by this?) • Cough • Hoarse voice • Sore throat • Sputum • Shortness of breath • Headache • Aching limbs • Chills • Loss of smell / taste	• Nausea/vomiting • Nasal congestion • Diarrhea • Abdominal pain • Chest pain • Skin symptoms

1

Appendix4 Checklist for case documentation of COVID-19 patients created by Paul Georg Werthmann (2)

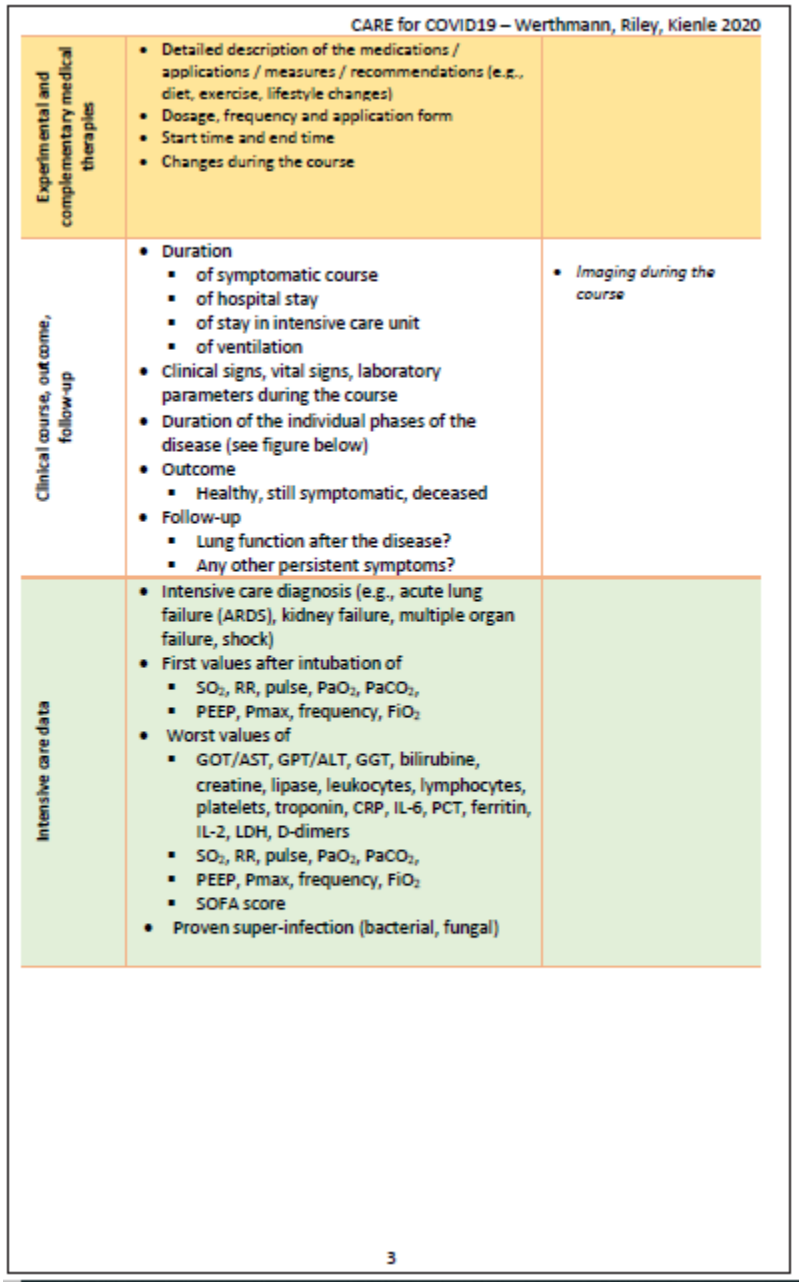


CARE for COVID19 – Werthmann, Riley, Kienle 2020

	Indication of the stage of disease at first presentation (see figure below)	
Vital signs Describe pathological findings in detail and during the course	• Respiratory rate • O_2 saturation	• *RR* • *Pulse* • *paO_2* • *$paCO_2$*
Imaging/ diagnostics (if applicable)		• *Thoracic x-ray, CT, ultrasound* • *Echocardiography* • *Evidence of vascular events, thrombosis or embolism*
Lab Describe pathological findings in detail	• CRP • GOT/AST • GPT/ALT • GGT • Bilirubin • Creatine • Leukocytes • Lymphocytes • Platelets • Prothrombin time (PT) • Partial thromboplastin time (PTT)	• *IL-6* • *PCT* • *Ferritin* • *IL-2* • *LDH* • *D-dimers* • *plasma fibrinogen* • *Troponin* • *Lipase* • *Blood type*
Therapeutic measures for COVID19	Application Yes/No, specify preparation if yes • Antivirals • Antibiotics • Anticoagulants • Steroids • Immunoglobulins • Beta blockers and/or anti-arrhythmics • Tocilizumab • Plasmapheresis	• *Application with duration (days, precise reference to disease findings), dosage (see above), application form*
	For treatment in intensive care units • Catecholamines (with duration in days) • Invasive / non-invasive ventilation (with duration in days) • ECMO and comparable procedures • Cardiac assist device	

2

Appendix5 Checklist for case documentation of COVID-19 patients created by Paul Georg Werthmann (3)



CARE for COVID19 – Werthmann, Riley, Kienle 2020

Experimental and complementary medical therapies	• Detailed description of the medications / applications / measures / recommendations (e.g., diet, exercise, lifestyle changes) • Dosage, frequency and application form • Start time and end time • Changes during the course	
Clinical course, outcome, follow-up	• Duration ▪ of symptomatic course ▪ of hospital stay ▪ of stay in intensive care unit ▪ of ventilation • Clinical signs, vital signs, laboratory parameters during the course • Duration of the individual phases of the disease (see figure below) • Outcome ▪ Healthy, still symptomatic, deceased • Follow-up ▪ Lung function after the disease? ▪ Any other persistent symptoms?	• *Imaging during the course*
Intensive care data	• Intensive care diagnosis (e.g., acute lung failure (ARDS), kidney failure, multiple organ failure, shock) • First values after intubation of ▪ SO_2, RR, pulse, PaO_2, $PaCO_2$, ▪ PEEP, Pmax, frequency, FiO_2 • Worst values of ▪ GOT/AST, GPT/ALT, GGT, bilirubine, creatine, lipase, leukocytes, lymphocytes, platelets, troponin, CRP, IL-6, PCT, ferritin, IL-2, LDH, D-dimers ▪ SO_2, RR, pulse, PaO_2, $PaCO_2$, ▪ PEEP, Pmax, frequency, FiO_2 ▪ SOFA score • Proven super-infection (bacterial, fungal)	

3

Appendix6 WHO case reporting form that used in COVID-19 surveillance system (1)

World Health Organization

Case reporting form for 2019 Novel Coronavirus (2019-nCoV) of

WHO Minimum Data Set Report Form

Date of reporting to national health authority: [_D_][_D_]/[_M_][_M_]/[_Y_][_Y_][_Y_][_Y_]

Reporting institution: ______________________________

Reporting country: ______________________

Reason for testing:	□ Suspected [WHO criteria]: □No □Yes □Unknown	
Detected at point of entry	□No □Yes □Unknown	If yes, date [_D_][_D_]/[_M_][_M_]/[_Y_][_Y_][_Y_][_Y_]

Section 1: Patient information			
Unique Case Identifier	Ps	WB	
Document Type: □ National ID		ID Number	
□ Passport		Passport Number	
Full name: First Name: _______________		Family Name: _______________	
Date of Birth: : [__][__]/[__][__]/[__][__][__][__] or estimated age: [ ][ ][ ] in years			
if < 1 year old, [ ][ ] in months or if < 1 month, [ ][ ] in days			
Sex : □ Male □ Female Wight(Kg): _______ Height (cm): __________ Nationality: ____________			
Social Status (Civil Status) : □ Single □ Married □ Divorced □ Separated □ Widowed			
Smoking Status : □ Non Smoker □ Passive Smoker □ Currently smoker □ Quit Smoker			
Phone Number			
Phone Number			
Patient usual place of residency: Country ____________ Province: __________ District: ______________			
Patient current address in reporting: Country __________ Province: __________ District: ______________			

Section 2: Clinical information	
Patient clinical course	
Symptomatic: □ Yes □ No If Yes Date of onset of symptoms: [__][__]/[__][__]/[__][__][__][__]	
Patient symptoms at presentation (check all reported symptoms):	
☐ History of fever / chills	☐ Sore throat
☐ Cough	☐ Shortness of breath
☐ Diarrhea	☐ Other, Specify ______________________
Patient signs at first presentation to hospital: (check all reported symptoms):	
☐ Temperature: [_][_][_] □°C / □ F	☐ Abnormal radiographic findings
☐ Pharyngeal exudate	☐ Dyspnea/ tachypnea
☐ Conjunctival infection	☐ Abnormal auscultation ______________________
☐ Other, Specify ______________________	
Underlying conditions and comorbidity (check all that apply):	
☐ Pregnancy (trimester:)	☐ Post-partum (< 6 weeks)
☐ Cardiovascular disease, including hypertension	☐ Immunocompromised
☐ Diabetes	☐ Renal disease
☐ Liver disease	☐ Chronic lung disease
☐ Chronic neurological or neuromuscular disease	☐ Malignancy
☐ Other, Specify ______________________	

Appendix 7 WHO case reporting form that used in COVID-19 surveillance system (2)

Section 3: Exposure and travel information in the 14 days prior to symptom onset				
Occupation: (tick any that apply)				
☐ Student	☐ Health care worker	☐ Health laboratory worker	☐ Working with animals	☐ Other, Specify
☐ Working at Israeli Settlements		☐ Working at 48 Lands	☐ Working at Jerusalem	_____
Has the patient travelled in the 14 days prior to symptom onset? ☐ Yes ☐ Unknown				
If yes, please specify the places the patient travelled:				
Country _____ **City** _____		**Country** _____ **City** _____		
Has the patient **visited any health care facility(ies)** in the 14 days prior to symptom onset? ☐ No ☐ Yes ☐ Unknown **Name of health facility:** _____				
Did the patient have any **direct or indirect contact with animal**? ☐ No ☐ Yes ☐ Unknown If Yes, specify animal species: _____				
If Yes, animal contact setting (check all that apply)				
☐ **Health care setting** ☐ **Family setting** ☐ **Work place** ☐ **Unknown** ☐ **Other, specify:** _____				
Has the patient had **contact with a probable or confirmed case** in the 14 days prior to symptom onset? ☐ No ☐ Yes ☐ Unknown				
Contact details				

#	Name	Address	Phone number		
1					
2					
3					
4					
5					

Section 4: Laboratory Information		
Place of lab test request: _____	Person (Name & Job title)who order the test: _____	
Name of confirming laboratory: _____	Specimen ID * _____	
Type of Specimen _____		
Date & Time of Specimen Collected: [__][_ _]/[_ _][_ _]/[_ _][__][__][_ _]	**Time :** [__][_ _]/[_ _][_ _]	
Date & Time of Specimen sent to Laboratory: [__][_ _]/[_ _][_ _]/[_ _][__][__][_ _]	**Time :** [__][_ _]/[_ _][_ _]	
Type of Test: ☐ **SARS-CoV-2** ☐ **Other, Specify**		

Section 5: Case Management/Patient status and health outcome				
Case management details				
☐ Hospital admission	☐ Health Quarantine	☐ Health facility isolation		
If Hospital admission				
Date of admission : [__][_ _]/[_ _][_ _]/[_ _][__][__][_ _]		**Hospital name :** _____		
Patient received which of the following management at hospital				
☐ **Care in intensive care unit (ICU)**	☐ **Ventilation**	☐ **Isolation with infection control practice in place**		
If Health Quarantine	Date of quarantine : [_][_]/[_][_]/[_][_][_][_]		Quarantine place: _____	
If Health facility isolation	Date of isolation : [_][_]/[_][_]/[_][ ][_][_]		Isolation Place : _____	
Patient status and final health outcome				
☐ **Recovered/ Discharge**	☐ **Not recovered**	☐ **Death**	☐ **Unknown**	☐ **Other, specify**
Date of health outcome: [__][_ _]/[_ _][_ _]/[_ _][__][__][_ _]				

Appendix 8 WHO case report of hospitalized COVID-19 cases that used in COVID-19 surveillance system (1)

World Health Organization

Case report of Hospitalized Covid 19 cases

Date of reporting to national health authority: [_D_][_D_]/[_M_][_M_]/[_Y_][_Y_][_Y_][_Y_]

Reporting institution: _____ File number_____

Section 1: Patient information			
Date of Admission: [__][__]/[__][__]/[__][__][__][__]			
Unique Case Identifier	Ps	WB	
Document Type: ☐ National ID ☐ Passport	ID Number		
	Passport Number		
Full name: First Name:_____ Middle name:_____ Family Name:_____			
Date of Birth: [__][__]/[__][__]/[__][__][__][__] or estimated age: [ ][ ] in years			
if < 1 year old, [ ][ ] in months or if < 1 month, [ ][ ] in days			
Sex : ☐ Male ☐ Female Nationality:_____			
Social Status (Civil Status) : ☐ Single ☐ Married ☐ Divorced ☐ Separated ☐ Widowed			
Smoking Status : ☐ Non Smoker ☐ Passive Smoker ☐ Currently smoker ☐ Quit Smoker			
Phone Number			
Patient usual place of residency: Country_____ District:_____ Locality:_____			
Years of Education: ( ) Employment status: No ( ) Yes ( ), If yes , specify_____			

Section 2: Clinical information		
Patient clinical course		
Symptomatic: ☐ Yes ☐ No If Yes Date of onset of symptoms: [_][_]/[_][_]/[_][_][_][_]		
Clinical Picture (check all reported symptoms):		
☐ History of fever / chills	☐ Muscle aches	☐ Altered consciousness/confusion
☐ Temperature (°C) [_][_].[_] ☐°C	☐ Joint pain (arthralgia)	☐ Abdominal pain
☐ Cough	☐ Fatigue/ Weakness	☐ Nausea/ vomiting
☐ Cough with sputum production	☐ Loss of smell Sense	☐ Diarrhea
☐ Sore throat	☐ Loss of taste sense	☐ Conjunctivitis
☐ Runny nose	☐ Shortness of Breath	☐ Sign/Symptoms skin rash
☐ Chills	☐ Lower chest indrawing	☐ Skin ulcers
☐ Wheezing	☐ Headache	☐ Lymphadenopathy
☐ Chest pain	☐ Seizures	☐ Inability to walk
☐ Stroke: ischaemic stroke	☐ Bleeding , f bleeding, specify site(s):	
☐ Stroke: intracerebral hemorrhage	Other, Specify _____	
Vital signs & clinical measurement Date: [__][__]/[__][__]/[__][__][__][__]		
☐ Temp (°C)	[__][__] (°C)	☐ Severe dehydration
☐ Heart Rate (beats/min)	[__][__]beats/min	☐ Sternal capillary refill time > 2 seconds
☐ Respiratory rate [_][__]breaths/min	[__][__]breaths/min	☐ Malnutrition
☐ Blood pressure Systolic mmHg	[__][__]mmHg	☐ Glasgow Coma Score (GCS/15) [__][__]
☐ Blood pressure Diastolic mmHg	[__][__]mmHg	
☐ Oxygen saturation [__][__] (%)	Oxygenation status when Oxygen saturation measurement	☐Room air ☐Oxygen therapy ☐Unknown
AVPU scale ☐A (Alert) ☐V (Verbal) ☐ P (Pain) ☐U(unresponsive)	☐ Height [__][__](cm)	☐ Weight [__][__](Kg)
Section 3: Pregnancy status & Postpartum If the sex of patient is Female:		
Last Menstrual period date (LMP)	[__][__]/[__][__]/[__][__][__][__]	Pregnancy trimester: ☐1st ☐2nd ☐3rd
Expected date of delivery (EDD)	[__][__]/[__][__]/[__][__][__][__]	Place of delivery: ☐Home ☐Hospital

Appendix 9 WHO case report of hospitalized COVID-19 cases that used in COVID-19 surveillance system (2)

Date of delivery	(__ |__ |__ /__ |__ |__ /__ |__ |__ |__ |__)	Mode of delivery: ☐Vaginal ☐Assisted ☐CS
Duration of pregnancy - Weeks (Pregnancy gestation)	(__ |__ |__)	Outcome of Pregnancy: ☐Alive ☐Dead ☐Still birth
post-partum <6wks	☐Yes ☐No ☐Unknown	
Newborn COVID 19 status	☐Positive ☐Negative ☐Not being tested ☐Unknown	

Section 4: PRE-ADMISSION AND CHRONIC MEDICATION	
Were there any medication taken within 14 days of admission	☐Yes ☐No ☐Unknown
Angiotensin converting enzyme inhibitors (ACE inhibitors)?	☐Yes ☐No ☐Unknown
Angiotensin II receptor blockers (ARBs)?	☐Yes ☐No ☐Unknown
Non-steroidal anti-inflammatory (NSAID)?	☐Yes ☐No ☐Unknown
Antiviral?	☐Yes ☐No ☐Unknown
Antiviral drug name: ☐Chloroquine/hydroxychloroquine ☐Azithromycin ☐Lopinavir/Ritonavir ☐Other:	

Section 5: Comorbidity - underlying health conditions	
Cardiovascular Disease (not hypertension)	☐Yes ☐No ☐Unknown
Hypertension	☐Yes ☐No ☐Unknown
Chronic Lung Disease	☐Yes ☐No ☐Unknown
Bronchial Asthma	☐Yes ☐No ☐Unknown
Diabetes	☐Yes ☐No ☐Unknown
immunocompromising conditions	☐Yes ☐No ☐Unknown
Chronic Liver Disease	☐Yes ☐No ☐Unknown
Malignancy, Cancer	☐Yes ☐No ☐Unknown
Chronic Neurological/Neuromuscular	☐Yes ☐No ☐Unknown
Chronic Renal Disease	☐Yes ☐No ☐Unknown
Cerebrovascular disease, (Stroke/ TIA)	☐Yes ☐No ☐Unknown
Tuberculosis	☐Yes ☐No ☐Unknown
Disability	☐Yes ☐No ☐Unknown
Type of Disability	

Section 6: Management/ Care	
Diagnoses	
Management Plan	☐ Supportive Care ☐ Medications ☐ Laboratory Investigation
	☐ Radiological Investigation☐ Diagnostic/ Pathogen testing
(If Supportive Care selected): Supportive Care performed	
	☐ Airway suctioning☐ Prone position☐ Inotropes/vasopressors
	☐ Extracorporeal Membrane Oxygenation (ECMO)
	☐ Non-invasive ventilation (e.g. BIPAP/CPAP)
	☐ Renal replacement therapy (RRT) or dialysis
	☐ Oxygen therapy
	☐ Invasive ventilation (any)
	☐ ICU or high dependency unit admission
If Oxygen therapy provided, complete all below	
O2 flow:	☐1–5 L/min ☐6–10 L/min ☐11–15 L/min ☐> 15 L/min ☐Unknown
Source of oxygen:	☐Piped ☐Cylinder ☐Concentrator ☐Unknown
Interface:	☐Nasal prongs ☐HF nasal cannula ☐Mask ☐Mask with reservoir ☐CPAP/NIV mask ☐Unknown

Appendix 10 WHO case report of hospitalized COVID-19 cases that used in COVID-19 surveillance system (3)

If Invasive ventilation provided, what were the following values closest to 08:00:	
PEEP (cm H2O)	[___][___]
FiO2 (%)	[___][___]
Plateau pressure (cm H2O)	[___][___]
PaCO2	[___][___]
PaO2	[___][___]
If Admission for ICU or high dependency unit, complete the following details:	
Date of ICU/HDU admission	[___][___]/[___][___]/[___][___][___][___]
ICU/HDU discharge date	[___][___]/[___][___]/[___][___][___][___]
MEDICATION:	
Did the patient receive any of the following:	☐ Oral/orogastric fluids☐ Intravenous fluids
	☐ Antibiotics, specify _____
	☐ Antifungal agent, Specify _____
	☐ Antimalarial agent, Specify _____
	☐ Experimental agent, Specify _____
	☐ Non-steroidal anti-inflammatory (NSAID)
	☐ Angiotensin converting enzyme inhibitors (ACE inhibitors)
	☐ Angiotensin II receptor blockers (ARBs)
	☐ Systemic anticoagulation
	☐ Antiviral
If Antiviral given, specify: Antiviral agent	
Antiviral agent given	☐Ribavirin ☐Lopinavir/Ritonavir ☐Neuraminidase inhibitor ☐Interferon alpha ☐Interferon beta ☐Other, specify: _____
	☐ Corticosteroids
If Corticosteroids given, specify the following	
Corticosteroids given Route:	☐Oral ☐Intravenous ☐Inhaled
Corticosteroids Agent name:	
Corticosteroids maximum daily dose:	

Section 7: DIAGNOSTIC/PATHOGEN TESTING	
Chest X-ray/CT performed	☐Yes ☐No ☐Unknown
Was pathogen testing done during this illness episode If yes, complete all below:	☐Yes ☐No ☐Unknown
Influenza virus	☐Positive ☐Negative ☐Not done
Coronavirus	☐Positive ☐Negative ☐Not done
Other respiratory pathogen:	☐Positive ☐Negative ☐Not done
If positive: Specify	
Other pathogen of public health interest detected	☐Yes ☐No ☐Unknown
If yes, specify	

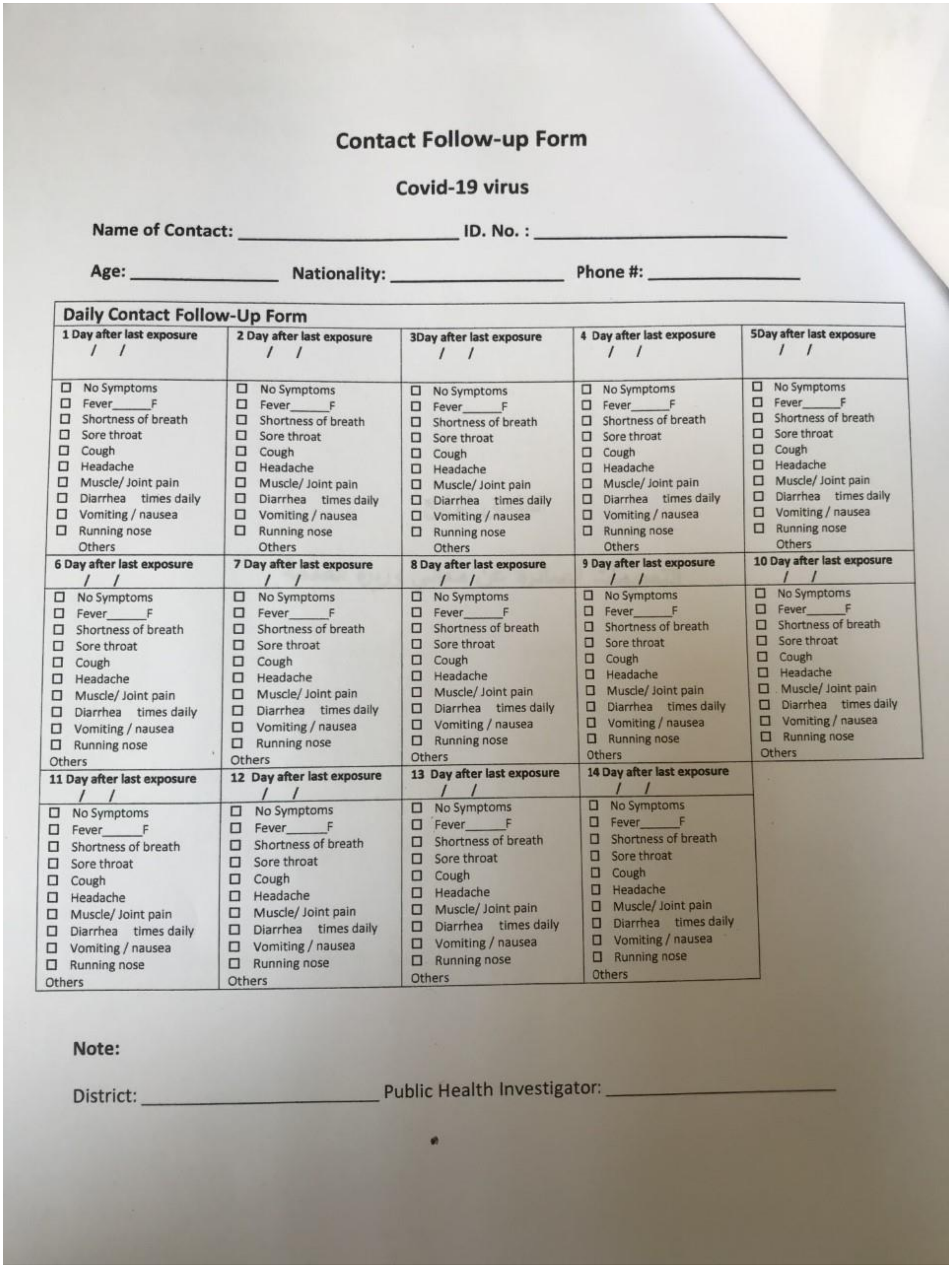
Appendix 11 WHO case report of hospitalized COVID-19 cases that used in COVID-19 surveillance system (4)

Section 8: Laboratory Investigation/ Lab Results					
Parameter	Value (on admission)	Value (on Discharge)	Parameter	Value (on admission)	Value (on Discharge)
Hemoglobin			Sodium		
Hematocrit			Potassium		
WBC count			CRP		
RBC Count			LDH		
Platelets			Creatinine Kinase		
APTT/APTR			Troponin		
PT (seconds)			ESR		
INR			D-dimer		
ALT/SGPT			Ferritin		
AST/SGOT			Urea (BUN)		
Total bilirubin			Creatinine		

Section 9: COMPLICATIONS: At any time during hospitalization, did the patient experience:			
Shock	☐Yes ☐No ☐Unknown	Myocarditis/pericarditis	☐Yes ☐No ☐Unknown
Bacteremia	☐Yes ☐No ☐Unknown	Cardiac arrhythmia	☐Yes ☐No ☐Unknown
Seizure	☐Yes ☐No ☐Unknown	Acute renal injury	☐Yes ☐No ☐Unknown
Bleeding	☐Yes ☐No ☐Unknown	Cardiac arrest	☐Yes ☐No ☐Unknown
Meningitis/encephalitis	☐Yes ☐No ☐Unknown	Pancreatitis	☐Yes ☐No ☐Unknown
Endocarditis	☐Yes ☐No ☐Unknown	Pneumonia	☐Yes ☐No ☐Unknown
Anemia	☐Yes ☐No ☐Unknown	Liver dysfunction	☐Yes ☐No ☐Unknown
Bronchiolitis	☐Yes ☐No ☐Unknown	Other, Specify	
Cardiomyopathy	☐Yes ☐No ☐Unknown		

Section 10: Health Outcomes	
Outcome	☐Discharged alive ☐Death ☐Palliative discharge ☐ Transferred to other hospital/ Isolation center
Date of the Health Outcome	___ ___ / ___ ___/__ __ __ __
If Transfer to Other hospital	Date of transfer to other Hospital: ___ ___ / ___ ___/__ __ __ __ Name of hospital transferred for: .....
If Transferred to Isolation center	Date of transfer to other Hospital: ___ ___ / ___ ___/__ __ __ __ Name of Isolation center transferred for: .....
If discharged alive, Ability to self-care at discharge versus before illness	☐Same as before illness ☐Worse ☐Better ☐Unknown

Appendix 12 PMoH form to follow up contact



Contact Follow-up Form

Covid-19 virus

Name of Contact: ____________________ **ID. No. :** ________________________

Age: ______________ **Nationality:** ________________ **Phone #:** ______________

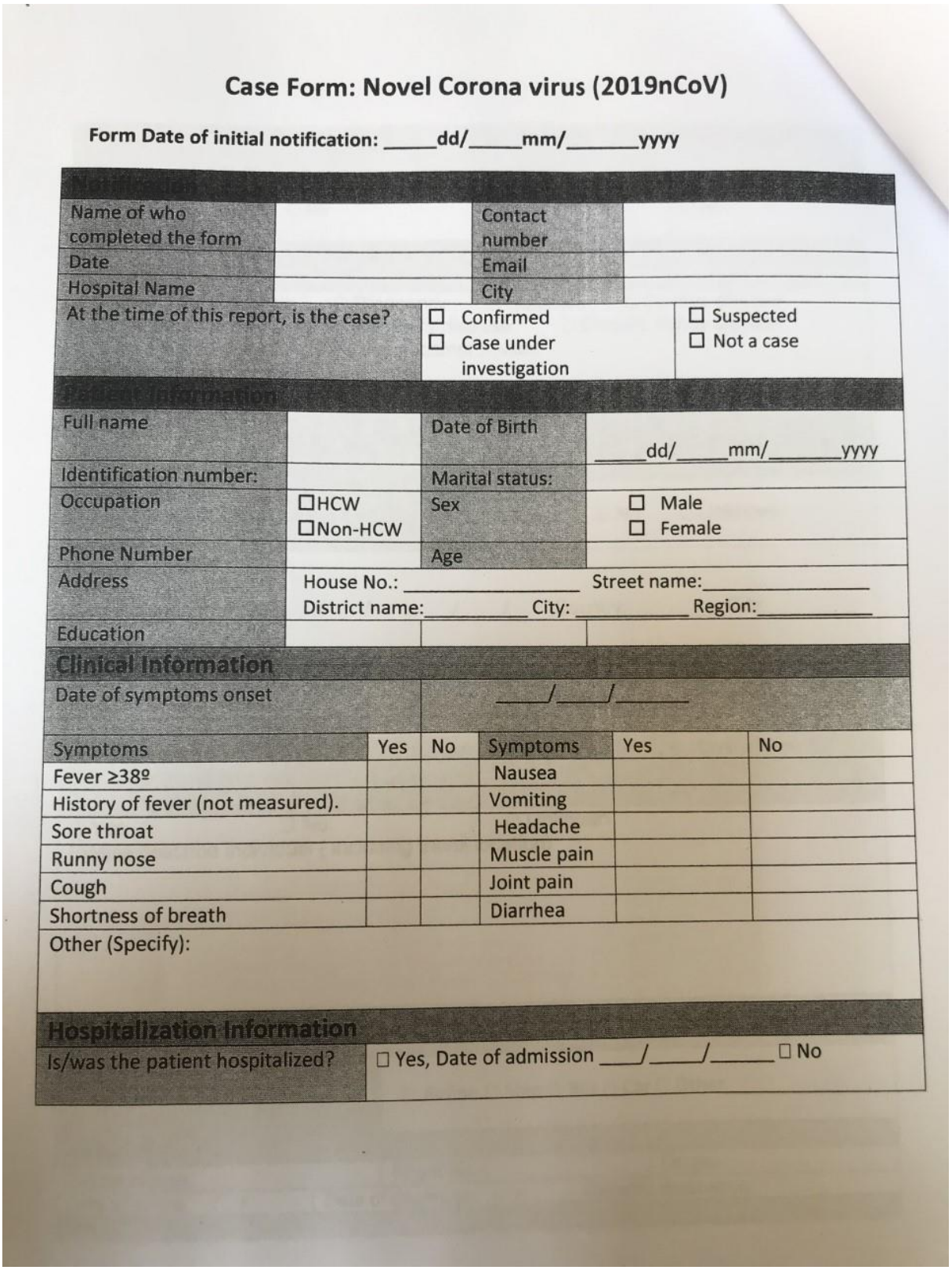
Daily Contact Follow-Up Form

1 Day after last exposure / /	2 Day after last exposure / /	3Day after last exposure / /	4 Day after last exposure / /	5Day after last exposure / /
☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others
6 Day after last exposure / /	**7 Day after last exposure** / /	**8 Day after last exposure** / /	**9 Day after last exposure** / /	**10 Day after last exposure** / /
☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others
11 Day after last exposure / /	**12 Day after last exposure** / /	**13 Day after last exposure** / /	**14 Day after last exposure** / /	
☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	☐ No Symptoms ☐ Fever_____F ☐ Shortness of breath ☐ Sore throat ☐ Cough ☐ Headache ☐ Muscle/ Joint pain ☐ Diarrhea times daily ☐ Vomiting / nausea ☐ Running nose Others	

Note:

District: ______________________ Public Health Investigator: ______________________

Appendix 13 PMoH form for COVID-19 (1)



Case Form: Novel Corona virus (2019nCoV)

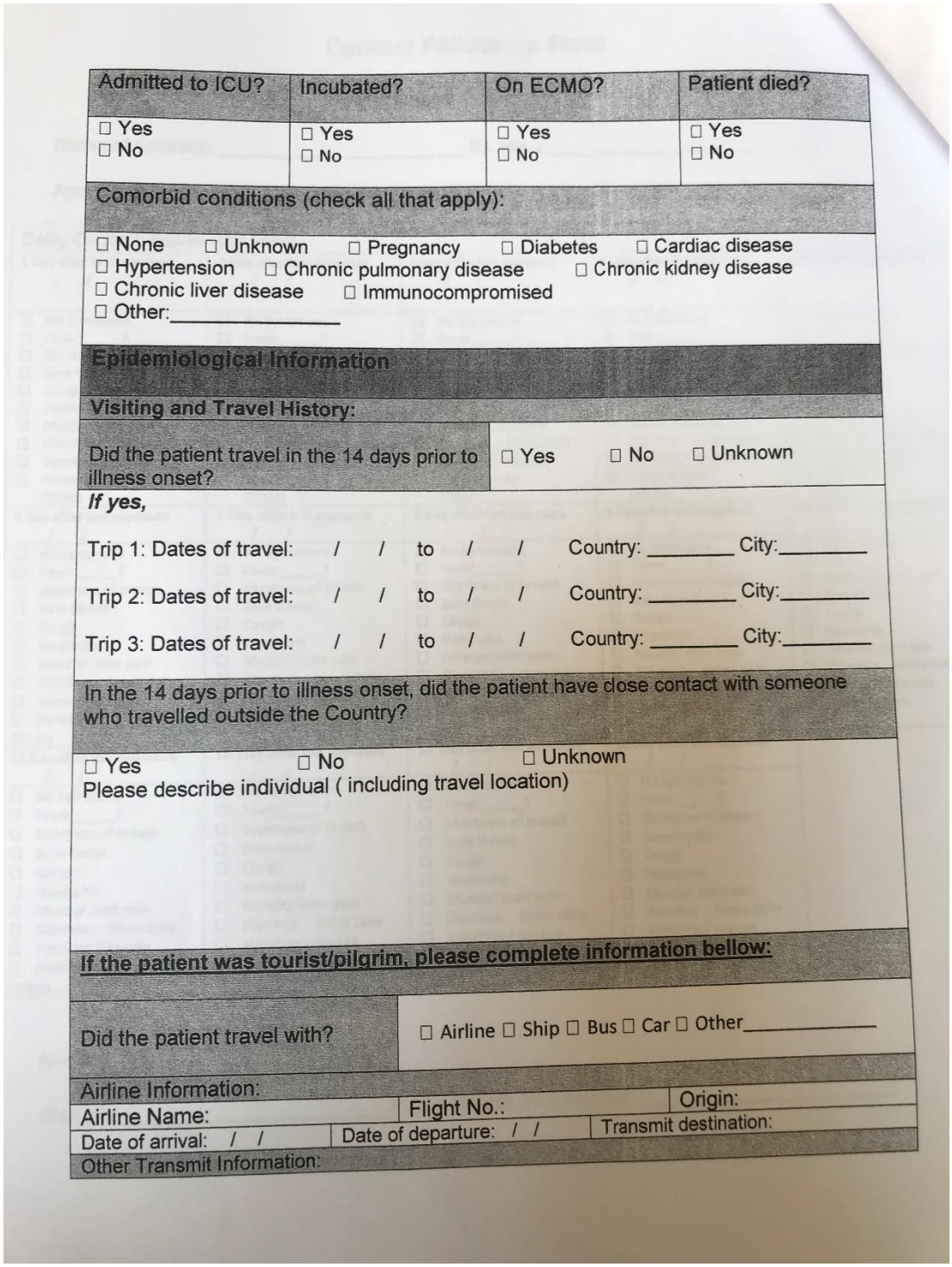
Form Date of initial notification: _____dd/_____mm/_____yyyy

Notification			
Name of who completed the form		Contact number	
Date		Email	
Hospital Name		City	
At the time of this report, is the case?	☐ Confirmed ☐ Case under investigation	☐ Suspected ☐ Not a case	
Patient Information			
Full name		Date of Birth	_____dd/_____mm/_____yyyy
Identification number:		Marital status:	
Occupation	☐HCW ☐Non-HCW	Sex	☐ Male ☐ Female
Phone Number		Age	
Address	House No.: _____ Street name:_____ District name:_____ City: _____ Region:_____		
Education			

Clinical Information					
Date of symptoms onset	_____/_____/_____				
Symptoms	Yes	No	Symptoms	Yes	No
Fever ≥38º			Nausea		
History of fever (not measured).			Vomiting		
Sore throat			Headache		
Runny nose			Muscle pain		
Cough			Joint pain		
Shortness of breath			Diarrhea		
Other (Specify):					

Hospitalization Information	
Is/was the patient hospitalized?	☐ Yes, Date of admission ____/_____/_____ ☐ No

Appendix 14 PMoH form for COVID-19 (2)



Admitted to ICU?	Incubated?	On ECMO?	Patient died?
☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

Comorbid conditions (check all that apply):

☐ None ☐ Unknown ☐ Pregnancy ☐ Diabetes ☐ Cardiac disease
☐ Hypertension ☐ Chronic pulmonary disease ☐ Chronic kidney disease
☐ Chronic liver disease ☐ Immunocompromised
☐ Other:_____

Epidemiological Information

Visiting and Travel History:

Did the patient travel in the 14 days prior to illness onset?	☐ Yes ☐ No ☐ Unknown

If yes,

Trip 1: Dates of travel: / / to / / Country: _____ City:_____

Trip 2: Dates of travel: / / to / / Country: _____ City:_____

Trip 3: Dates of travel: / / to / / Country: _____ City:_____

In the 14 days prior to illness onset, did the patient have close contact with someone who travelled outside the Country?

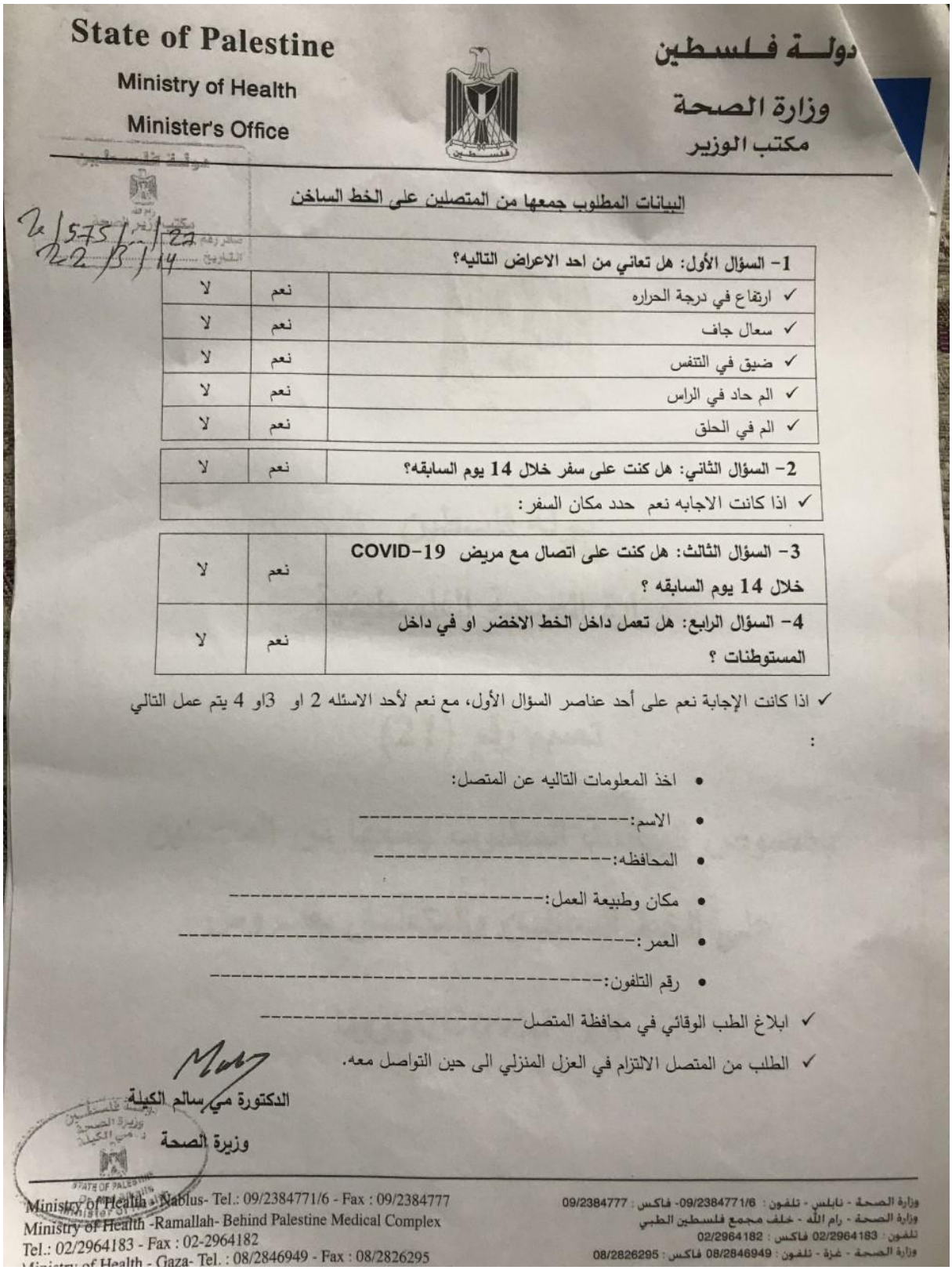
☐ Yes ☐ No ☐ Unknown
Please describe individual (including travel location)

If the patient was tourist/pilgrim, please complete information bellow:

Did the patient travel with?	☐ Airline ☐ Ship ☐ Bus ☐ Car ☐ Other_____

Airline Information:		
Airline Name:	Flight No.:	Origin:
Date of arrival: / /	Date of departure: / /	Transmit destination:
Other Transmit Information:		

Appendix 15 PMoH follow up form via phone



State of Palestine
Ministry of Health
Minister's Office

دولـــة فـلـسـطين
وزارة الصحة
مكتب الوزير

البيانات المطلوب جمعها من المتصلين على الخط الساخن

1- السؤال الأول: هل تعاني من احد الاعراض التاليه؟		
✓ ارتفاع في درجة الحراره	نعم	لا
✓ سعال جاف	نعم	لا
✓ ضيق في التنفس	نعم	لا
✓ الم حاد في الراس	نعم	لا
✓ الم في الحلق	نعم	لا

2- السؤال الثاني: هل كنت على سفر خلال 14 يوم السابقه؟	نعم	لا
✓ اذا كانت الاجابه نعم حدد مكان السفر:		

3- السؤال الثالث: هل كنت على اتصال مع مريض COVID-19 خلال 14 يوم السابقه ؟	نعم	لا
4- السؤال الرابع: هل تعمل داخل الخط الاخضر او في داخل المستوطنات ؟	نعم	لا

✓ اذا كانت الإجابة نعم على أحد عناصر السؤال الأول، مع نعم لأحد الاسئله 2 او 3او 4 يتم عمل التالي :

- اخذ المعلومات التاليه عن المتصل:
- الاسم:----------
- المحافظه:----------
- مكان وطبيعة العمل:----------
- العمر :----------
- رقم التلفون:----------

✓ ابلاغ الطب الوقائي في محافظة المتصل----------

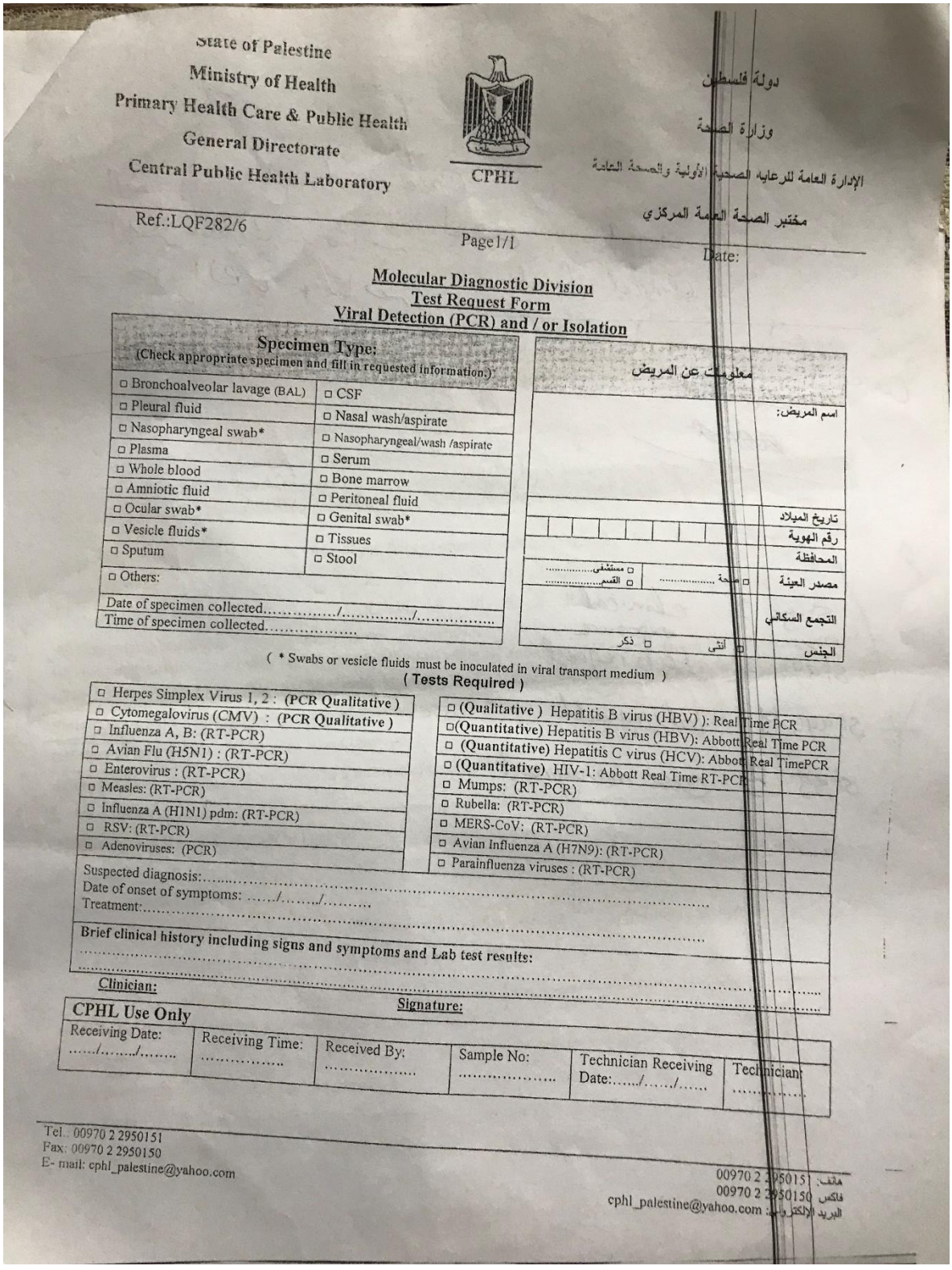
✓ الطلب من المتصل الالتزام في العزل المنزلي الى حين التواصل معه.

الدكتورة مي سالم الكيلة
وزيرة الصحة

Ministry of Health -Nablus- Tel.: 09/2384771/6 - Fax : 09/2384777
Ministry of Health -Ramallah- Behind Palestine Medical Complex
Tel.: 02/2964183 - Fax : 02-2964182
Ministry of Health - Gaza- Tel. : 08/2846949 - Fax : 08/2826295

وزارة الصحة - نابلس - تلفون : 09/2384771/6- فاكس : 09/2384777
وزارة الصحة - رام الله - خلف مجمع فلسطين الطبي
تلفون : 02/2964183 فاكس : 02/2964182
وزارة الصحة - غزة - تلفون : 08/2846949 فاكس : 08/2826295

Appendix 16 PMoH test request form



State of Palestine
Ministry of Health
Primary Health Care & Public Health
General Directorate
Central Public Health Laboratory

CPHL

دولة فلسطين
وزارة الصحة
الإدارة العامة للرعاية الصحية الأولية والصحة العامة
مختبر الصحة العامة المركزي

Ref.:LQF282/6 Page1/1 Date:

Molecular Diagnostic Division
Test Request Form
Viral Detection (PCR) and / or Isolation

Specimen Type: (Check appropriate specimen and fill in requested information:)	
□ Bronchoalveolar lavage (BAL)	□ CSF
□ Pleural fluid	□ Nasal wash/aspirate
□ Nasopharyngeal swab*	□ Nasopharyngeal/wash /aspirate
□ Plasma	□ Serum
□ Whole blood	□ Bone marrow
□ Amniotic fluid	□ Peritoneal fluid
□ Ocular swab*	□ Genital swab*
□ Vesicle fluids*	□ Tissues
□ Sputum	□ Stool
□ Others:	
Date of specimen collected...../...../.....	
Time of specimen collected.....	

معلومات عن المريض	
اسم المريض:	
تاريخ الميلاد	
رقم الهوية	
المحافظة	
مصدر العينة	□ صحة ..... □ مستشفى ..... □ القسم .....
التجمع السكاني	
الجنس	□ أنثى □ ذكر

(* Swabs or vesicle fluids must be inoculated in viral transport medium)

(Tests Required)

□ Herpes Simplex Virus 1, 2 : (PCR Qualitative)	□ (Qualitative) Hepatitis B virus (HBV)): Real Time PCR
□ Cytomegalovirus (CMV) : (PCR Qualitative)	□(Quantitative) Hepatitis B virus (HBV): Abbott Real Time PCR
□ Influenza A, B: (RT-PCR)	□ (Quantitative) Hepatitis C virus (HCV): Abbott Real TimePCR
□ Avian Flu (H5N1) : (RT-PCR)	□ (Quantitative) HIV-1: Abbott Real Time RT-PCR
□ Enterovirus : (RT-PCR)	□ Mumps: (RT-PCR)
□ Measles: (RT-PCR)	□ Rubella: (RT-PCR)
□ Influenza A (H1N1) pdm: (RT-PCR)	□ MERS-CoV: (RT-PCR)
□ RSV: (RT-PCR)	□ Avian Influenza A (H7N9): (RT-PCR)
□ Adenoviruses: (PCR)	□ Parainfluenza viruses : (RT-PCR)

Suspected diagnosis:.....
Date of onset of symptoms: ...../...../.....
Treatment:.....

Brief clinical history including signs and symptoms and Lab test results:
.....

Clinician: **Signature:**

CPHL Use Only

Receiving Date:	Receiving Time:	Received By:	Sample No:	Technician Receiving Date:...../...../.....	Technician:
...../...../.....	.....	.....	.....		.....

Tel.. 00970 2 2950151
Fax: 00970 2 2950150
E- mail: cphl_palestine@yahoo.com

هاتف: 00970 2 2950151
فاكس 00970 2 2950150
البريد الإلكتروني: cphl_palestine@yahoo.com

Appendix 17 Working experience in health facility-institute (yrs.) / job title

Data entry Job Title	N	Median	Minimum	Maximum
Doctor	2	2	1	3
Nurse	54	4	1	30
Data Entry	20	1	1	8
Preventive Medicine Employee	5	5	1	10
Statistician	13	10	1	22
Laboratory Technician	15	5	1	28
Stakeholder Job Title	**N**	**Median**	**Minimum**	**Maximum**
Doctor	7	15	6	20
Developer Job Title	**N**	**Median**	**Minimum**	**Maximum**
Computer Programmer	5	7	3	12

Work experience in some health facilities/institutes were constant for some jobs and have been omitted.

Appendix 18 Distribution of data entry clerks based to job title and working place

Job Title / Working Place		N (%)
Doctor	North Hebron PHC	1 (0.88)
	Yatta PHC	1 (0.88)
Total		**2 (1.75)**
Nurse	Bethlehem PHC	11 (9.65)
	Nablus PHC	3 (2.63)
	Salfeet PHC	8 (7.02)
	Jericho PHC	1 (0.88)
	Hebron PHC	2 (1.75)
	North Hebron PHC	8 (7.02)
	South Hebron PHC	3 (2.63)
	Qalqilia PHC	2 (1.75)
	Tulkarem PHC	6 (5.26)
	Preventive Medicine Department	3 (2.63)
	Jorat Al-Shamaa - Bethlehem	1 (0.88)
	Al-Ubaidiya clinic - Bethlehem	1 (0.88)
	Iktaba Center - Tulkarem	1 (0.88)
	Halhul Hospiatal - North Hebron	3 (2.63)
	Quarntine Center - Jericho	0.88
Total		**54 (47.37)**

Data Entry	Bethlehem PHC	1 (0.88)
	Jenin PHC	3 (2.63)
	Quds PHC	2 (1.75)
	North Hebron PHC	1 (0.88)
	Qalqilia PHC	1 (0.88)
	Tubas PHC	2 (1.75)
	Tulkarem PHC	1 (0.88)
	National Center for Skin Diseases	4 (3.51)
	PNIPH	3 (2.63)
	Keshda Center - Tubas	2 (1.75)
Total		**20 (17.54)**
Preventive Medicine Employee	Hebron PHC	1 (0.88)
	Tubas PHC	1 (0.88)
	Preventive Medicine Department	2 (1.75)
	Keshda Center - Tubas	1 (0.88)
Total		**5 (4.39)**
Statistician	Nablus PHC	1 (0.88)
	North Hebron PHC	1 (0.88)
	Yatta PHC	3 (2.63)
	Qalqilia PHC	1 (0.88)
	Tulkarem PHC	1 (0.88)
	Preventive Medicine Department	1 (0.88)
	PNIPH	1 (0.88)
	PHIC	4 (3.51)
Total		**13 (11.40)**
Public Health Officer	PNIPH	1 (0.88)
Total		**1 (0.88)**
Radiology Technician	Hebron PHC	1 (0.88)
Total		**1 (0.88)**
Laboratory Technician	Bethlehem PHC	1 (0.88)
	Ramallah PHC	1 (0.88)
	Nablus PHC	1 (0.88)
	Jenin PHC	2 (1.75)
	Salfeet PHC	1 (0.88)
	Jericho PHC	1 (0.88)
	Hebron PHC	1 (0.88)
	North Hebron PHC	1 (0.88)

	South Hebron PHC	1 (0.88)
	Yatta PHC	1 (0.88)
	Tulkarem PHC	1 (0.88)
	CPHL	1 (0.88)
	Al-Dhahiriya Center for Emergency and Safe Birth - Hebron	1 (0.88)
	Keshda Center - Tubas	1 (0.88)
Total		**15 (13.16)**
Data Manager	PNIPH	1 (0.88)
Total		**1 (0.88)**
Pharmacist	Ramallah PHC	1 (0.88)
Total		**1 (0.88)**
Midwife	Nablus PHC	1 (0.88)
Total		**1 (0.88)**
General Total		**114 (100)**

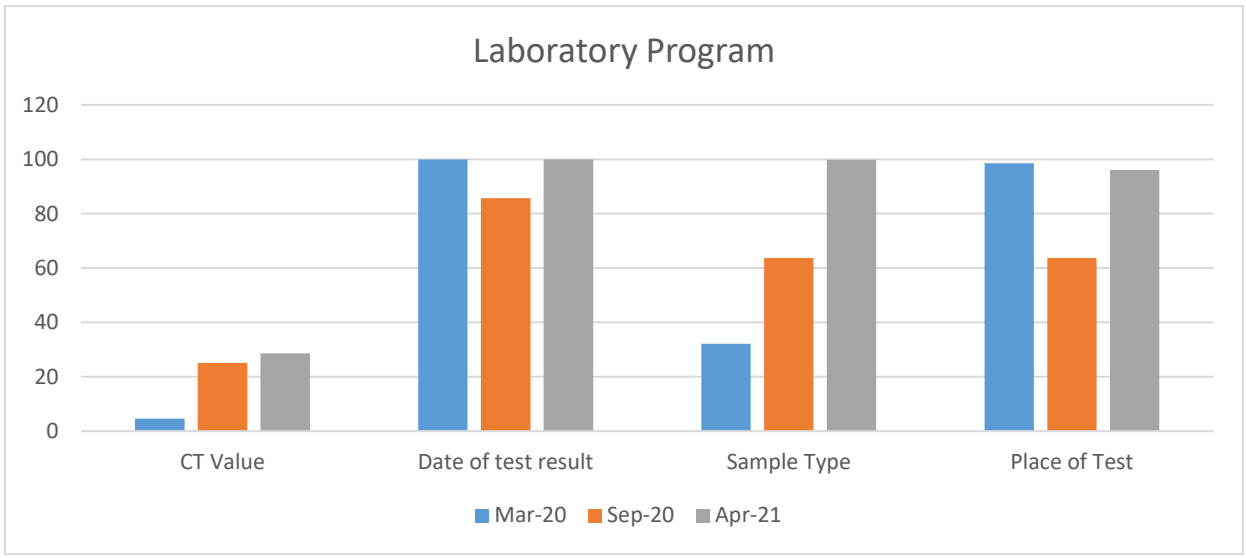
Appendix 19 Distribution of stakeholders based to job title and working place

Job Title / Working Place		N (%)
Doctor	Salfeet PHC	1 (10)
	Jericho PHC	2 (20)
	Preventive Medicine Department	1 (10)
	PMoH	3 (30)
Total		**7 (70)**
Nurse	PMoH	2 (20)
Total		**2 (20)**
Statistician	PMoH	1 (10)
Total		**1 (10)**
General Total		**10 (100)**

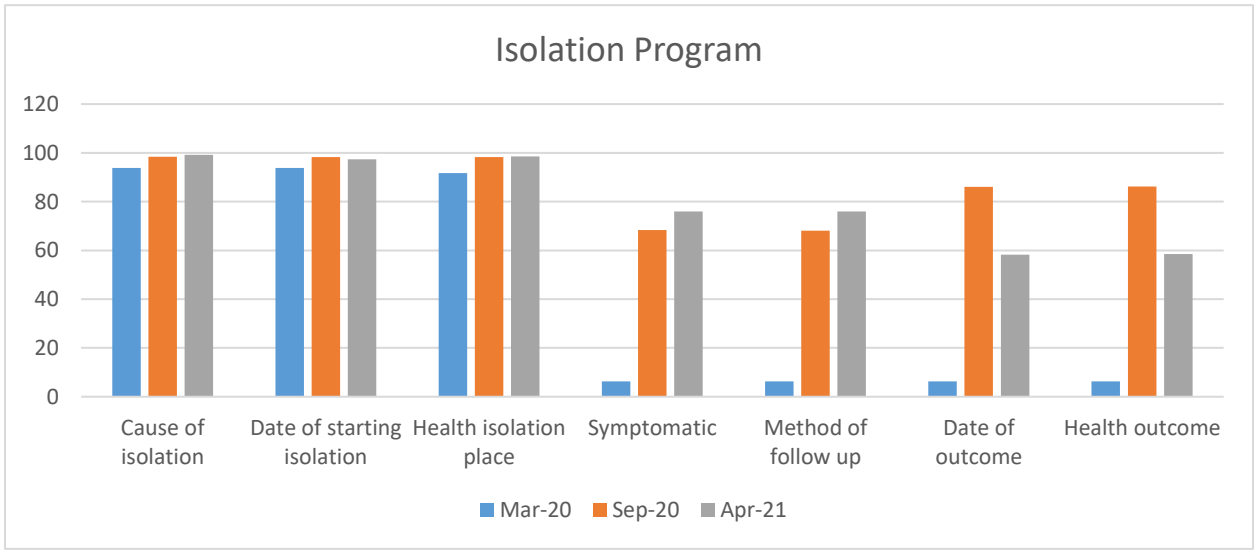
Appendix 20 Distribution of developer based to job title and working place

Job Title / Working Place		N (%)
Computer Programmer	PMOH	4 (50)
	PNIPH	1 (12.50)
Total		**5 (62.50)**
Data Base Administrator	PNIPH	1 (12.50)
Total		**1 (12.50)**
Project Coordinator	PNIPH	1 (12.50)
Total		**1 (12.50)**
Computer Engineer	PNIPH	1 (12.50)
Total		**1 (12.50)**
General Total		**8 (100)**

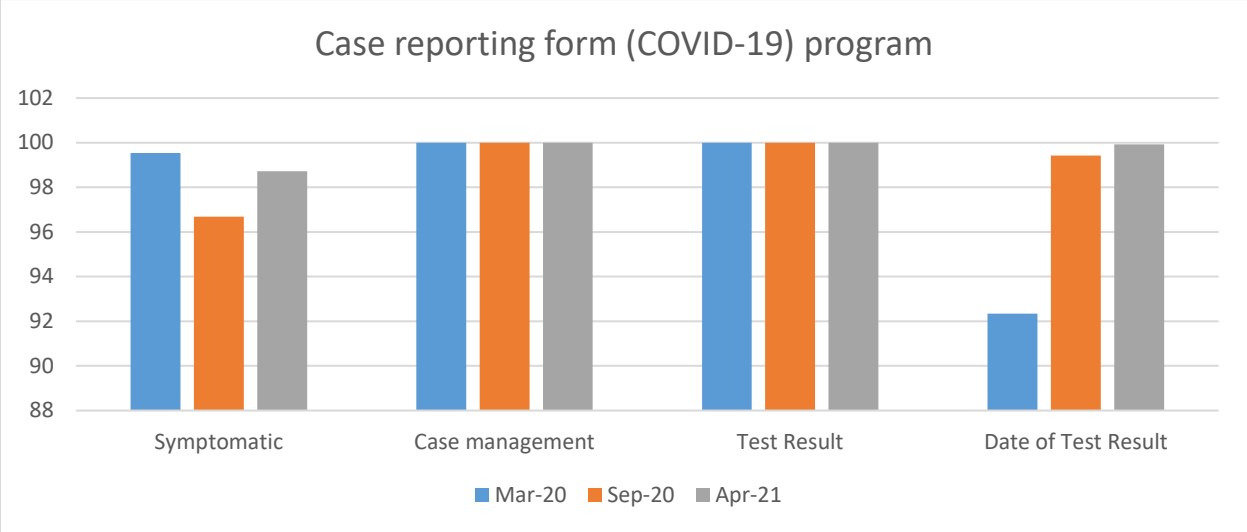
Appendix 21 Completeness of main variables for main programs in COVID-19 surveillance system (1)



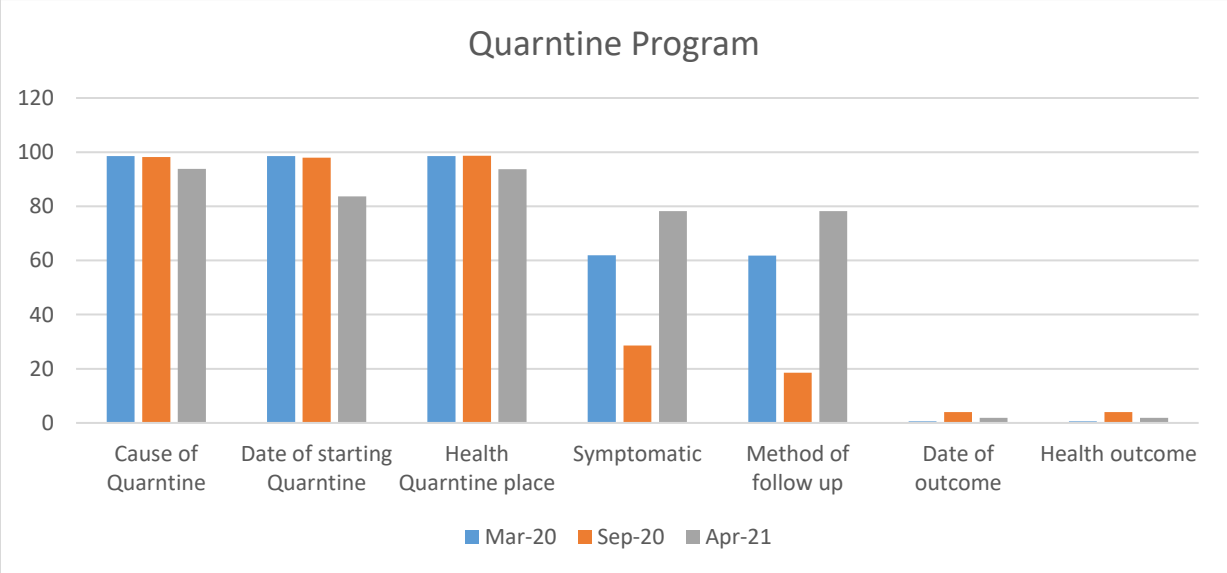
Appendix 22 Completeness of main variables for main programs in COVID-19 surveillance system (2)



Appendix 24 Completeness of main variables for main programs in COVID-19 surveillance system (3)



Appendix 23 Completeness of main variables for main programs in COVID-19 surveillance system (4)



Appendix 25 Data elements/variables for main programs in COVID-19 surveillance system (1)

Laboratory Program
Laboratory Test Stage
Laboratory Request Section
Date of registration
Sample kind
Sample type
Specimen ID
Date of specimen collected
Type of specimen
Place of test
Laboratory Test Result Section
Date of test result
Test result
Ct-value
RNaseP- value
Strains

Appendix 26 Data elements / variables of the main programs in COVID-19 surveillance system (2)

Health Facility Isolation Program
Health Facility Isolation Information Stage
Health Facility Isolation Section
Date of entry
Last date of exposure
Date of starting health facility isolation
Cause of isolation
Health isolation place (Home or Institution or other)
If isolation place is in institution select isolation district
Place of isolation (name of hospital, medical center or hotel)
Isolation follow up Stage
Health Facility Isolation follow up Section
Follow up date
Symptomatic (yes / no)
Fever
Shortness of breath
Sore throat
Cough
Headache
Muscle / Joint pain
Diarrhea
Vomiting / nausea
Running nose
Other symptoms
Specify other symptoms
Care provider name

Care provider title
Method of follow up
Daily Health Status Section
Daily health status
Health Outcome Stage
Health Outcome Section
Health outcome
Date

Appendix 27 Data elements / variables of the main programs in COVID-19 surveillance system (3)

Health Quarantine Program
Health Quarantine Information Stage
Health Quarantine Section
Date of entry
Last date of exposure
Date of starting health quarantine
Last date of quarantine
Remaining days of quarantine
Cause of quarantine
Site of quarantine (Home or Institution or other)
If quarantine place is in institution select quarantine district
Place of quarantine (name of hospital, medical center or hotel)
Quarantine follow up Stage
Health Quarantine follow up Section
Follow up date
Symptomatic (yes / no)
Fever
Shortness of breath
Sore throat
Cough
Headache
Muscle / Joint pain
Diarrhea
Vomiting / nausea
Running nose
Other symptoms
Specify other symptoms
Care provider name
Care provider title
Method of follow up
Daily Health Status Section
Daily health status
Health Outcome Stage
Health Outcome Section
Health outcome
Date

Appendix 28 Questionnaires' Reviewers

Reviewer Name	University Name
Dr. Salwa Massad	Birzeit University
Dr. Mohammed Moreb	Arab American University

Appendix 29 Some indicators from COVID-19 surveillance system

Indicator
Total number of examined
Percentage of suspected cases (%)
The number of cases reported at the crossing points
Percentage of cases reported at crossing points (%)
Distribution of registered cases reported at crossing points by country of origin
Distribution of registered cases reported at crossing points by entry day
Distribution of registered cases reported at crossing points weekly
Distribution of registered cases by age groups
Distribution of registered cases by sex
Distribution of registered cases by age and Sex
Distribution of registered cases by day of registration
Distribution of cumulative registered cases by week
Distribution of registered cases reported at crossing points by age and sex
Distribution of registered cases by residence governorate
Distribution of registered cases reported at crossing points by residence governorate
Distribution of registered cases by social status
Distribution of registered cases by smoking status
Percentage of the currently smoker among the registered cases (%)
Percentage of non-smoking cases (%)
Number of Symptomatic registered cases
Percentage of Symptomatic registered cases (%)
Distribution of Symptomatic cases, by symptom
Percentage of registered cases with a temperature of 38 or more (%)
Distribution of registered cases, by sign
Distribution of registered cases by underlying conditions and comorbidity
Percentage of pregnant women among the registered cases of (%)
Distribution of registered pregnant women by pregnancy trimester
Distribution of registered cases, by Occupation (Job)
Percentage of registered cases that travelled in the 14 days prior to symptom onset (%)

Percentage of registered cases that visited any health care facility (ies) in the 14 days prior to symptom onset (%)
Percentage of registered cases that have any direct or indirect contact with animal (%)
Distribution of registered cases by animal species that have any direct or indirect contact with
Distribution of registered cases by animal contact setting
Percentage of registered cases that had contact with a probable or confirmed case in the 14 days prior to symptom onset (%)
Total number of specimens requested to be examined
Distribution of specimens requested to be examined by sex & age
Distribution of specimens requested to be examined by governorate
Distribution of specimens requested to be examined by the confirming laboratory
Mean time interval between specimen collected & time of specimen sent to laboratory
Mean time interval between laboratory received Specimen & Specimen result
Distribution of the examined specimens by the confirming laboratory
Percentage of lab tests by the confirming laboratory (%)
Distribution of the examined specimens by result
Distribution of the examined specimens by day of test
Distribution of the examined specimens by the week
Percentage of the confirmed result specimens (%)
Percentage of the Negative result specimens (%)
Percentage of inconclusive result specimens (%)
Percentage of invalid (Rejected) specimens (%)
Distribution of registered cases by Case management
Percentage of registered cases need Hospital admission as Case management (%)
Percentage of registered cases need Health Quarantine as Case management (%)
Distribution of Health Quarantine cases by type of quarantine (Home, facility)
Percentage of registered cases need health facility isolation as Case management (%)
Distribution of hospital admission cases by type of service
Percentage of cases need care in intensive care unit (ICU) (%)
Percentage of cases need Ventilation (%)
Percentage of cases need Isolation with infection control practice in place (%)

Distribution of Health Quarantine cases by quarantine place
Distribution of Health Quarantine cases by governorate
Distribution of Health facility isolation cases by isolation place
Distribution of Health facility isolation cases by governorate
Distribution of COVID -19 death cases by governorate
Distribution of COVID -19 death cases by sex
Distribution of COVID -19 death cases by age
COVID -19 Mortality rate
COVID -19 Mortality rate by age
COVID -19 Mortality rate by Sex
Distribution of confirmed cases by age group
Distribution of confirmed cases by Sex
Distribution of confirmed cases by governorate
Percentage of confirmed cases (%)
COVID -19 virus infection rate

Appendix 30 Consent form

Arab American University
College of Graduate Studies
Health Informatics program
Informed Consent

Title of thesis : Assessment of reporting and documentation of Corona virus (COVID-19) outbreak in Palestine – Situation analysis

موضوع الرسالة : تقييم توثيق حالات الاصابة بفايروس كورونا في فلسطين و توثيق التدخلات والمتابعة- تحليل الوضع الراهن

Student's Name:Alaa Amin Abed Mohammed Abed Al-khaleel

Supervisor:Dr. Salwa George Massad

E-mail address:ala.abuaisheh@gmail.com

Date:

Thank you for accepting participate in this study.
Our study aims to assessment of reporting and documentation of Corona virus (COVID-19) outbreak in Palestine and analysis the current situation as well as to design an electronic form to collect data. You were selected to participate in this study as you are involved in surveillance of COVID-19. The questionnaire is related to your work in tracking, documenting and reporting the data of COVID-19. This questionnaire will take approximately about 15 minutes.

Your participation is voluntary. There are no expected risks to your participation and we will not mentioned names and any identified data about you.
Please sign this form if you agree to participate
Signature ---------- date ----------

Socio-demographic data (for all questionnaires)

1. Sex: a. Male b. Female
2. Age (yrs.):
3. Job Title: a. Doctor. b. Nurse. c. Data Entry d. Preventive Medicine employee

   e. Statistician f. Other, Specify……...
4. District: Bethlehem, Ramallah, Nablus, Jenin, Salfeet, Jericho, Quds, Hebron, North Hebron, South Hebron, Yatta, Qalqilia, Tubas, Tulkarem
5. Health Facility/Institute:
6. Working experience in health facility/Institute (yrs.):

Appendix 31 Data entry clerks questionnaire in English

I will be grateful if you answer the following questions, you can give us your opinion about the following performance of the system.

(1=agree, 2= disagree, 3= don't know / no answer)

Usefulness				
No	**Items**	**1**	**2**	**3**
1	The surveillance system determines the distribution and spread of disease			
2	The surveillance system identifies risk groups			
3	The surveillance system determines the incidence trends over time			
4	The data was used for epidemiological daily reports			
5	The data was used to detect spikes in the outbreak in a timely way to permit rapid prevention and control (action taken)			

Flexibility				
No	**Items**	**1**	**2**	**3**
1	The system can adapt to accommodate additional information to the case definition			
2	Staff are well trained.			

Representativeness				
No	**Items**	**1**	**2**	**3**
1	The surveillance system covered all governorates			
2	The surveillance system covered all ages			
3	The surveillance system covered gender			
4	The surveillance system can estimate the incidence of COVID19			
5	The surveillance system can estimate the incidence for specific geographic area			

Stability				
No	**Items**	**1**	**2**	**3**
1	The COVID-19 surveillance system has sustainable trained staff and they are rarely exchanged			
2	Technical issues (e.g. data entry and reporting) rarely occurred during the last two months			
3	Electrical power outages rarely occur			
4	All facilities have generators			
5	The system is able to operate at all times			
6	Data transfer, entry, and storage are accomplishable daily			

Completeness				
No	**Items**	**1**	**2**	**3**
1	Reporting COVID-19 surveillance forms are complete			
2	Case reporting is complete			
3	Surveillance data is complete			

Timeliness				
No	**Items**	**1**	**2**	**3**
1	Reporting is timely			
2	Entering data in real time			
3	Immediate notification for positive cases is made			
4	The test result are entered in real time			
5	Daily reports are sent in a timely manner			

Simplicity				
No	**Items**	**1**	**2**	**3**
1	The reporting form is clear			
2	A phone is always available in your facility			
3	Data follow up is necessary to update data on the cases			
4	Took a training in data entry for COVID-19 surveillance			
5	The program provided you with a smart phone / tablet or computer to facilitate entering and sending data			
6	You receive a feedback report on your work from a governorate level			
7	Data entry in the electronic system is clear			
8	Data entry in the electronic system is easy			
9	Internet access is always available at your site			
10	Analysis of data describes time, place and person.			
11	Dissemination of data / reports to stakeholders and key actors occurs on daily basis			
12	You receive feedback from a central level (PHC)			
13	Easy to use			
14	In your experience/judgment do you believe any part of the surveillance system is unnecessarily complicated			
15	The surveillance system has multiple steps			
16	The surveillance system has a complicated work flow			

Acceptability				
No	**Items**	**1**	**2**	**3**
1	The surveillance system is appropriate to the MoH's needs			
2	There is ongoing data analysis from the surveillance system			
3	Users are satisfied with the surveillance data			

Appendix 32 Developers questionnaire in English

I will be grateful if you answer the following questions, you can give us your opinion about the following performance of the system.

(1=agree, 2= disagree, 3= don't know / no answer)

Usefulness				
No	**Items**	**1**	**2**	**3**
1	The surveillance system informs appropriate and effective public health responses			
2	The surveillance system identifies risk groups			
3	The surveillance system determines the incidence trends over time			
4	The data is used for epidemiological daily reports			
5	The data is used to detect spikes in the outbreak in a timely way to permit rapid prevention and control (action taken).			
6	The surveillance system determines the groups most at risk of death by COVID-19			

Flexibility				
No	**Items**	**1**	**2**	**3**
1	The system adapts to accommodate additional information to case definition			
2	The system adapts to integrate with other surveillance			
3	The system adapted to accommodate to new additional information (e.g. change in case definition, the introduction of data from other system)			
4	The system is affected by fund variation			
5	The current reporting formats can be used for other newly occurring health event (disease) without much difficulty			
6	Staff are well trained			

Representativeness				
No	**Items**	**1**	**2**	**3**
1	The surveillance system covered all governorates			
2	The surveillance system covered all ages			
3	The surveillance system covered genders			
4	The surveillance system can estimate the incidence of COVID-19			
5	The surveillance system can estimate the incidence for specific geographic area			
6	All public and private health facilities are covered			
7	The surveillance system is able to follow COVID-19 cases in the whole community			

Stability				
No	**Items**	**1**	**2**	**3**
1	The COVID-19 surveillance system has a sustainable trained staff and they rarely exchanged			
2	The system is sustainable even without sponsors support			
3	Electrical power outages rarely occur			
4	All facilities have generators			
5	Technical issues (e.g. data entry and reporting) rarely occurred during the last two months			
6	The system is fully functional with financial support			
7	The database is stable despite regular electricity and power interruption			
8	The surveillance system is able to collect, manage and provide data in a timely manner			
9	The system is able to operate at all times			
10	Data transfer, entry, and storage is accomplishable daily			
11	The servers of the surveillance system are stable			
12	The surveillance system is continuously backed up			
13	Internet is always available without interruption in the main data center			

Completeness				
No	**Items**	**1**	**2**	**3**
1	Reporting COVID-19 surveillance forms are complete			
2	Case reporting is complete			
3	Surveillance data is complete			

Timeliness				
No	**Items**	**1**	**2**	**3**
1	Immediate notification for positive cases is made			
2	Daily reports are sent in a timely manner			
3	The surveillance system was created at the right time			
4	The creation and development of the surveillance system took a long time			

Simplicity				
No	**Items**	**1**	**2**	**3**
1	Standard case definitions for COVID-19 are available			
2	Transferring data to high level is very easy			
3	Analysis of data describe time, place and person			
4	Dissemination of data / reports to stakeholders and key actors occurs on daily basis			
5	The system is easy to implementation			
6	There is simplicity of information flow from the point of generation to the end users			
7	All the different DBs are complementary to one another			
8	The surveillance system has multiple steps			
9	The surveillance system is extremely hard to use			
10	The surveillance system has a complicated work flow			
11	Internet access is always available at your site			
12	All capabilities necessary to establish surveillance system are available			

Acceptability				
No	**Items**	**1**	**2**	**3**
1	Users are satisfied with the surveillance data			

Appendix 33 Stakeholders questionnaire in English

I will be grateful if you answer the following questions, you can give us your opinion about the following performance of the system.

(1=agree, 2= disagree, 3= don't know / no answer)

Usefulness				
No	**Items**	**1**	**2**	**3**
1	The surveillance system informs appropriate and effective public health responses			
2	The surveillance system determines the distribution and spread of disease			
3	The surveillance system provides data to evaluate control measures			
4	The surveillance system estimates the disease burden			
5	The surveillance system identifies risk groups			
6	The surveillance system determines the incidence trends over time			
7	The surveillance system measures outcomes and impacts of preventive and public health interventions			
8	The surveillance system evaluates the overall control interventions			
9	The surveillance system illustrates and tracks the disease			
10	The data used for epidemiological daily reports			
11	The data used to detect spikes in the outbreak in a timely way to permit rapid prevention and control (action taken)			
12	Dissemination of data to key actors and decision makers occurs on daily basis			
13	The surveillance system determines the groups most at risk of death by COVID-19			

Flexibility				
No	**Items**	**1**	**2**	**3**
1	The current reporting formats can be used for other newly occurring health event (disease) without much difficulty			

Representativeness				
No	**Items**	**1**	**2**	**3**
1	The surveillance system covered all governorates			
2	The surveillance system covered all ages			
3	The surveillance system covered genders			
4	The surveillance system can estimates the incidence of COVID-19			
5	The surveillance system can estimates the incidence for specific geographic area			
6	All public and private health facilities are covered			
7	The surveillance system is able to follow COVID-19 cases in the whole community			
8	The surveillance system can be used for monitoring the COVID-19 pandemic			

Timeliness				
No	**Items**	**1**	**2**	**3**
1	Reporting is timely			
2	Immediate notification for positive cases is made			
3	Daily reports sent in a timely manner			

Stability				
No	**Items**	**1**	**2**	**3**
1	The system is sustainable even without sponsors support			
2	The COVID-19 surveillance system has a sustainable trained staff and they are rarely exchanged			
3	The system is fully functional with financial support			
4	The surveillance system able to collect, manage and provide data in a timely manner			
5	The system is able to operate at all times			
6	There are planned resources for maintenance of the system			
7	Data transfer, entry, and storage are accomplishable daily			

Simplicity				
No	**Items**	**1**	**2**	**3**
1	Standard case definitions for COVID-19 are available			
2	Laboratory tests findings for COVID-19 are always reported in the surveillance system on daily basis			
3	The reporting form is clear			
4	Took a training in how to extract reports from the COVID-19 surveillance			
5	There is a need for timely notification of positive cases using phone			
6	Analysis of data describe time, place and person			
7	The surveillance system is extremely hard to use			

Acceptability				
No	**Items**	**1**	**2**	**3**
1	The surveillance system is appropriate to the MoH’s needs			
2	There is ongoing data analysis from the surveillance system			
3	Users are satisfied with the surveillance data			

Appendix 34 Data entry clerks questionnaire in Arabic

(1 = أوافق ، 2 = لا أوافق ، 3 = لا أعلم)

Usefulness				
No	**Items**	**1**	**2**	**3**
1	هل ساعد المرصد الالكرتوني في تحديد توزيع المرض و انتشاره			
2	هل ساعد المرصد الالكرتوني في تحديد المجموعات الأكثر عرضة لخطر الإصابة بالمرض			
3	هل ساعد المرصد الالكرتوني في تحديد اتجاهات الإصابة مع مرور الزمن			
4	تستخدم البيانات في التقارير الوبائية اليومية			
5	تستخدم البيانات في اكتشاف الطفرات في الوقت المناسب للسماح بالوقاية و السيطرة السريعة على المرض			

Flexibility				
No	**Items**	**1**	**2**	**3**
1	يُمكن للمرصد الالكتروني استيعاب معلومات إضافية للأفراد الذين قامو بإجراء فحوصات COVID-19			
2	تم تدريب مستخدمي المرصد الالكتروني تدريباً جيداً			

Representativeness				
No	**Items**	**1**	**2**	**3**
1	يشمل المرصد الالكتروني جميع المحافظات			
2	يشمل المرصد الالكتروني جميع الأعمار			
3	يغطي المرصد الالكرتوني النوع الاجتماعي (ذكور و اناث)			
4	يُمكن للمرصد الالكتروني تقدير نسبة انتشار وباء COVID-19 بشكل عام			
5	يُمكن للمرصد الالكتروني تقدير تقدير نسبة انتشار وباء COVID-19 في منطقة جغرافية معينة			

Stability				
No	**Items**	**1**	**2**	**3**
1	يستخدم المرصد الالكتروني موظفين مدربين و نادراً ما يتم تدويرهم / تبديلهم			
2	نادراً ما حدثت مشاكل فنية في ادخال البيانات و استخراج التقارير خلال الشهرين الماضيين			
3	نادراً ما يحدث انقطاع للتيار الكهربائي في المراكز التي تعمل على المرصد الالكتروني			
4	جميع المراكز التي تعمل على المرصد الالكرتوني تمتلك مولدات كهربائية			
5	المرصد الالكتروني قابل للعمل في جميع الأوقات			
6	يتم ادخال و نقل و تخزين البيانات بشكل يومي			

Completeness				
No	**Items**	**1**	**2**	**3**
1	لايوجد نقص في التقارير الصادرة من المرصد الالكرتوني			
2	لايوجد نقص في البيانات الخاصة بالحالات المُبلّغ عنها			
3	لا يوجد نقص في جميع البيانات المطلوب تعبئتها في المرصد الالكتروني			

Timeliness				
No	**Items**	**1**	**2**	**3**
1	يتم اصدار التقارير في الوقت المناسب			
2	يتم ادخال البيانات فور الحصول عليها			
3	يتم التبليغ الفوري للحالات المصابة			
4	يتم ادخال نتائج الفحوصات المخبرية فور ظهورها			
5	يتم ارسال التقارير اليومية في الوقت المناسب			

Simplicity				
No	**Items**	**1**	**2**	**3**
1	النموذج المحوسب ضمن المرصد الالكرتوني و المخصص لادخال الحالات واضح			
2	الهاتف متوفر بشكل دائم في المركز الصحي الذي تعمل به			
3	متابعة البيانات ضرورية لتحديث البيانات الخاصة بالحالات			
4	حصلت على التدريب اللازم لادخال البيانات للمرصد الالكتروني			
5	هل تم تزويدك بهاتف ذكي او حاسوب لتسهيل ادخال البيانات			
6	يتم تزويدك بالتغذية الراجعة من دائرتك المباشرة / على مستوى المحافظة			
7	آلية ادخال البيانات الى المرصد الالكرتوني واضحة			
8	آلية ادخال البيانات الى المرصد الالكرتوني سهلة			
9	يتوفر الانترنت بشكل دائم في مكان عملك			
10	يصف تحليل البيانات الزمان و المكان و الجنس و العمر			
11	يتم تزويد نقاط الاتصال و صانعي القرار بالتقارير بشكل يومي			
12	يتم تزويدك بتغذية راجعة من الدائرة المركزية (الرعاية الصحية الأولية)			
13	المرصد الالكرتوني سهل الاستخدام			
14	من واقع خبرتك / حكمك ، هل تعتقد أن أي جزء من المرصد الالكتروني معقد بشكل غير ضروري			
15	هناك العديد من الخطوات اللازمة لتعبئة البرامج المختلفة ضمن المرصد الالكتروني			
16	هناك تعقيد في الخطوات المتبعة لإدخال البيانات			

Acceptability				
No	**Items**	**1**	**2**	**3**
1	المرصد الالكرتوني مناسب حسب احتياجات وزارة الصحة			
2	هناك تحليل مستمر للبيانات من المرصد الالكتروني			
3	هل هناك رضى من قبل مستخدمو البيانات عن أداء المرصد الالكرتوني			

Appendix 35 Developers questionnaire in Arabic

(1 = أوافق ، 2 = لا أوافق ، 3 = لا أعلم)

Usefulness				
No	**Items**	**1**	**2**	**3**
1	هل ساعد المرصد الالكتروني في وضع التدخلات و السياسات للسيطرة على الوباء			
2	هل ساعد المرصد الالكتروني في تحديد المجموعات الأكثر عرضة لخطر الإصابة بالمرض			
3	هل ساعد المرصد الالكتروني في تحديد اتجاهات الإصابة مع مرور الزمن			
4	تستخدم البيانات في التقارير الوبائية اليومية			
5	تستخدم البيانات في اكتشاف الطفرات في الوقت المناسب للسماح بالوقاية و السيطرة السريعة على المرض			
6	هل ساعد المرصد الالكتروني في تحديد المجموعات الأكثر عرضة للوفاة			

Flexibility				
No	**Items**	**1**	**2**	**3**
1	يُمكن للمرصد الالكتروني استيعاب معلومات إضافية للأفراد الذين قامو بإجراء فحوصات COVID-19			
2	يُمكن ربط المرصد الالكتروني مع أنظمة الكترونية أخرى			
3	تم تكييف النظام لاستيعاب المعلومات الإضافية الجديدة (مثل التغيير في تعريف الحالة ، وإدخال البيانات من نظام آخر)			
4	يتأثر عمل المرصد الالكتروني بموارد التمويل المختلفة			
5	يمكن استخدام برامج توثيق الحالات الحالية و الموجودة ضمن المرصد الالكتروني لأمراض معدية أخرى في المستقبل دون صعوبة كبيرة			
6	تم تدريب مستخدمي المرصد الالكتروني تدريباً جيداً			

Representativeness				
No	**Items**	**1**	**2**	**3**
1	يشمل المرصد الالكتروني جميع المحافظات			
2	يشمل المرصد الالكتروني جميع الأعمار			
3	يغطي المرصد الالكرتوني النوع الاجتماعي (ذكور و اناث)			
4	يُمكن للمرصد الالكتروني تقدير نسبة انتشار وباء COVID-19 بشكل عام			
5	يُمكن للمرصد الالكتروني تقدير تقدير نسبة انتشار وباء COVID-19 في منطقة جغرافية معينة			
6	يشمل المرصد الالكتروني جميع المراكز الصحية الحكومية و غير الحكومية			
7	المرصد الالكتروني قادر على تتبع حالات COVID-19 في المجتمع بأسره			

Stability				
No	**Items**	**1**	**2**	**3**
1	استمرار عمل المرصد الالكتروني يعتمد على وجود دعم خارجي			
2	يستخدم المرصد الالكتروني موظفين مدربين و نادراً ما يتم تدويرهم / تبديلهم			
3	نادراً ما حدثت مشاكل فنية في ادخال البيانات و استخراج التقارير خلال الشهرين الماضيين			
4	نادراً ما يحدث انقطاع للتيار الكهربائي في المراكز التي تعمل على المرصد الالكتروني			
5	جميع المراكز التي تعمل على المرصد الالكرتوني تمتلك مولدات كهربائية			
6	المرصد الالكتروني يعمل بكامل طاقته مع وجود الدعم المالي			
7	قاعدة البيانات مستقرة على الرغم من انقطاع الكهرباء والطاقة بشكل مستمر			
8	المرصد الالكتروني قادر على جمع البيانات وإدارتها وتوفيرها في الوقت المناسب			
9	المرصد الالكتروني قابل للعمل في جميع الأوقات			
10	يتم ادخال و نقل و تخزين البيانات البيانات بشكل يومي			
11	الخوادم الخاصة بالمرصد الالكتروني مستقرة			
12	باستمرار backup يتم اخذ نسخة احتياطية			
13	يتوفر الانترنت بشكل دائم دون انقطاع في مركز البيانات الرئيسي			

Completeness				
No	**Items**	**1**	**2**	**3**
1	لايوجد نقص في التقارير الصادرة من المرصد الالكرتوني			
2	لايوجد نقص في البيانات الخاصة بالحالات المُبلّغ عنها			
3	لا يوجد نقص في جميع البيانات المطلوب تعبئتها في المرصد الالكتروني			

Timeliness				
No	**Items**	**1**	**2**	**3**
1	يتم التبليغ الفوري للحالات المصابة			
2	يتم ارسال التقارير اليومية في الوقت المناسب			
3	تم انشاء المرصد الالكتروني في الوقت المناسب			
4	استغرق انشاء و تطوير المرصد الالكتروني وقتا طويلاً			

Simplicity				
No	**Items**	**1**	**2**	**3**
1	يوجد تعريف للمصاب بوباء COVID-19 في المرصد الالكتروني			
2	من السهل جدًا نقل البيانات إلى المستويات الادارية العليا			
3	يصف تحليل البيانات الزمان و المكان و الجنس و العمر			
4	يتم تزويد نقاط الاتصال و أصحاب القرار بالتقارير بشكل يومي			
5	المرصد الالكتروني سهل التنفيذ			
6	بساطة انتقال المعلومات من لحظة ادخالها إلى المستخدمين النهائيين			
7	جميع قواعد البيانات المختلفة مكملة لبعضها البعض			
8	هناك العديد من الخطوات اللازمة لتعبئة البرامج المختلفة ضمن المرصد الالكتروني			
9	هناك صعوبة عالية في استخدام المرصد الالكتروني			
10	هناك تعقيد في الخطوات المتبعة لإدخال البيانات من خلال المرصد الالكتروني			
11	توفر الانترنت بشكل دائم في مكان عملك			
12	تتوفر جميع الامكانيات اللازمة لإنشاء المرصد الالكتروني			

Acceptability				
No	**Items**	**1**	**2**	**3**
1	هل هناك رضى من قبل مستخدمو البيانات عن أداء المرصد الالكرتوني			

Appendix 36 Stakeholders questionnaire in Arabic

(1 = أوافق ، 2 = لا أوافق ، 3 = لا أعلم)

Usefulness				
No	**Items**	**1**	**2**	**3**
1	هل ساعد المرصد الالكرتوني في وضع التدخلات و السياسات للسيطرة على الوباء			
2	هل ساعد المرصد الالكرتوني في تحديد توزيع المرض و انتشاره			
3	هل ساعد المرصد الالكرتوني في تزويدنا بالبيانات لتقييم اجراءات الرقابة على الوباء			
4	هل ساعد المرصد الالكرتوني في تقدير أعباء الوباء			
5	هل ساعد المرصد الالكرتوني في تحديد المجموعات الأكثر عرضة لخطر الإصابة بالمرض			
6	هل ساعد المرصد الالكرتوني في تحديد اتجاهات الإصابة مع مرور الزمن			
7	هل ساعد المرصد الالكرتوني في قياس نتائج وآثار التدخلات الوقائية والصحة العامة			
8	هل ساعد المرصد الالكرتوني في تقييم جميع التدخلات المتعلقة بالتحكم بالوباء			
9	هل ساعد المرصد الالكرتوني في تتبع الوباء			
10	تستخدم البيانات في التقارير الوبائية اليومية			
11	تستخدم البيانات في اكتشاف الطفرات في الوقت المناسب للسماح بالوقاية و السيطرة السريعة على المرض			
12	هل يساعد المرصد الالكتروني في تزويد نقاط الاتصال و صانعي القرار بالتقارير بشكل يومي			
13	هل ساعد المرصد الالكرتوني في تحديد المجموعات الأكثر عرضة للوفاة			

Flexibility				
No	**Items**	**1**	**2**	**3**
1	يمكن استخدام برامج توثيق الحالات الحالية و الموجودة ضمن المرصد الالكتروني لأمراض معدية أخرى في المستقبل دون صعوبة كبيرة			

Representativeness				
No	**Items**	**1**	**2**	**3**
1	يشمل المرصد الالكتروني جميع المحافظات			
2	يشمل المرصد الالكتروني جميع الأعمار			
3	يغطي المرصد الالكرتوني النوع الاجتماعي (ذكور و اناث)			
4	يُمكن للمرصد الالكتروني تقدير نسبة انتشار وباء COVID-19 بشكل عام			
5	يُمكن للمرصد الالكتروني تقدير نسبة انتشار وباء COVID-19 في منطقة جغرافية معينة			
6	يشمل المرصد الالكتروني جميع المراكز الصحية الحكومية و غير الحكومية			
7	المرصد الالكتروني قادر على تتبع حالات COVID-19 في المجتمع بأسره			
8	يُمكن استخدام المرصد الالكرتوني لمراقبة وباء COVID-19			

Timeliness				
No	**Items**	**1**	**2**	**3**
1	يتم اصدار التقارير في الوقت المناسب			
2	يتم التبليغ الفوري للحالات المصابة			
3	يتم ارسال التقارير اليومية في الوقت المناسب			

Stability				
No	**Items**	**1**	**2**	**3**
1	استمرار عمل المرصد الالكرتوني يعتمد على وجود دعم خارجي			
2	يستخدم المرصد الالكتروني موظفين مدربين و نادراً ما يتم تدويرهم / تبديلهم			
3	المرصد الالكتروني يعمل بكامل طاقته مع وجود الدعم المالي			
4	المرصد الالكتروني قادر على جمع البيانات وإدارتها وتوفيرها في الوقت المناسب			
5	المرصد الالكتروني قابل للعمل في جميع الأوقات			
6	هناك موارد مخطط لها مسبقاً لصيانة المرصد الالكرتوني			
7	يتم ادخال و نقل و تخزين البيانات بشكل يومي			

Simplicity				
No	**Items**	**1**	**2**	**3**
1	يوجد تعريف للمصاب بوباء COVID-19 في المرصد الالكتروني			
2	يتم تسجيل نتائج الفحوصات المخبرية يومياً في المرصد الالكتروني			
3	النموذج المحوسب ضمن المرصد الالكتروني و المخصص لادخال الحالات واضح			
4	حصلت على التدريب اللازم حول كيفية استخراج التقارير من المرصد الالكرتوني الخاص ب COVID-19			
5	هناك حاجة لإخطار المصابين في الوقت الفعلي لظهور النتيجة باستخدام الهاتف			
6	يصف تحليل البيانات الزمان و المكان و الجنس و العمر			
7	هناك صعوبة عالية في استخدام المرصد الالكتروني			

Acceptability				
No	**Items**	**1**	**2**	**3**
1	المرصد الالكتروني مناسب حسب احتياجات وزارة الصحة			
2	هناك تحليل مستمر للبيانات من المرصد الالكتروني			
3	هل هناك رضى من قبل مستخدمو البيانات عن أداء المرصد الالكرتوني			

الملخص

بدأ وباء COVID-19 بالانتشار في جميع دول العالم بدءاً في الصين في ديسمبر 2019 و من ثم جميع أنحاء العالم مما تسبب في ملايين الإصابات والوفيات. ظهرت أول حالة في فلسطين في شهر مارس 2020 الأمر الذي استدعي وجود آلية لتوثيق الاصابات لتسهيل اخذ القرارات المناسبة من قبل اصحاب القرار في وزارة الصحة الفسطينية للحد من انتشاره و تقليل الوفيات.

لذلك قامت وزارة الصحة و بالتعاون مع المعهد الوطني للصحة العامة بتطوير نظام الكتروني لرصد و توثيق الحالات المصابة و الحالات التي يتم عزلها و حجرها و تتبعها باستخدام منصة DHIS2 و لكن لم يتم إجراء أي تقييم لجميع البرامج الموجودة ضمن النظام حسب علمنا سعياً لتطويره و تحسين أدائه.

كان الهدف الرئيسي من هذه الدراسة هو استخدام معايير مراكز السيطرة على الأمراض والوقاية منها لتقييم المرصد الالكرتوني من خلال قياس فائدة ومرونة ومقبولية وتمثيل وبساطة وحسن توقيت واستقرار واكتمال المرصد و ذلك من منظور مستخدمي النظام و مطوري النظام و أصحاب المصلحة في وزارة الصحة. بالإضافة إلى تقييم آلية العمل و تحديد نقاط القوة والضعف والفرص لتعزيز النظام وتحسينه و تحديد التحديات والعقبات والفرص لتعزيز التوثيق والإبلاغ عن حالات COVID-19 .

أجريت هذه الدراسة في الضفة الغربية 2021 باستخدام استبيان الكتروني لجمع البيانات في الفترة ما بين 10 مايو و 1 أغسطس استهدف جميع الفئات المذكورة سابقاً بالإضافة إلى مقابلات مع مجموعة من أصحاب المصلحة الرئيسين في الوزارة حيث تم ارسال الاستبيان إلى 150 مستخدم حيث تم تعبأة 132 استبيان (114 كاتب ادخال بيانات ، 8 مطوريين ، 10 أصحاب المصلحة).

كما و تم استخراج البيانات للمتغيرات الرئيسية في النظام و التي تشمل أشهر مارس 2020 وسبتمبر 2020 وأبريل 2021 لتغطية الأشهر المختلفة أثناء الوباء و ذلك لتقييم مدى اكتمال البيانات في النظام علماً أنه قد تم استثناء الحقول الإجبارية.

تم إجراء التحليل باستخدام تطبيق IBM SPSS Statistics 20 و ذلك للبيانات التي تم جمعها بواسطة الاستبيان ، أما فيما يتعلق بنتيجة المقابلات فقط تم تحليليها يدوياً باستخدام themes and subthemes.

أظهرت أن النتائج أن الأداء العام للمرصد الإلكتروني يعادل 72.36% من وجهة نظر كتبة إدخال البيانات ، و 83.89% من وجهة نظر مطوري النظام و 62.2% من وجهة نظر أصحاب المصلحة الرئيسين .

أظهرت النتائج بأن النظام مفيد في وضع السياسات والاستراتيجيات للسيطرة على انتشار الوباء حيث أنه يساعد في تحديد أماكن انتشار الوباء و المجموعات الأكثر عرضة للإصابة و الوفاة. و يتمتع النظام بالمرونة حيث يمكن إضافة تعديلات عليه بكل سهولة دون الحاجة لوقت و تكاليف مالية إضافية كما أنه قادر على العمل في جميع الأوقات ويقوم يوميًا بنقل البيانات وإدخالها وتخزينها تلقائاً.

بالإضافة إلى ذلك فإن النظام يمتاز بالاستقرار نظرا لقلة المشاكل الفنية التي تحصل و وجود خوادم و قواعد بيانات مستقرة تتيح النسخ الاحتياطي بشكل مستمر، كما تمتاز البيانات الموجودة في النظام بأنها تمثيلية تعكس الفئات العمرية و الجنس و تقيس مدى انتشار الوباء و يمكنه تقدير حدوث COVID-19 على الصعيد الوطني وفي مناطق أو مقاطعات محددة الأمر الذي ساعد أصحاب القرار على تقسيم المناطق إلى ألوان الأحمر والأصفر والأخضر بناءً على عدد الإصابات وتحديد الإجراءات المناسبة لكل منطقة.

أما فيما يتعلق باكتمال البيانات فقد كانت النتيجة بأنها غير مكتملة بالرغم من أن نتيجة التحليل أظهرت تحسناً مع مرور الوقت و ذلك لعدة أسباب منها عدم وجود مراقبة يومية و تغذية راجعة من قبل أصحاب القرار. إلا أن النظام يوفر جميع التقارير و المؤشرات اللازمة وبالتالي فهو قادر على توجيه السياسات و الإجراءات الخاصة بوضع الجائحة في فلسطين.

كما أظهرت نتيجة التحليل أنه يتم إدخال البيانات في الوقت الفعلي إلى النظام و أن التنقل فيما بين المتغيرات المختلفة في النظام يتم بسرعة كبيرة. علاوة على ذلك فإنه يتم نقل البيانات مباشرة من برنامج إلى آخر و من جميع البرامج إلى صناع القرار مما يجعل من السهل نشر البيانات والتقارير لأصحاب القرار يومياً ، بالإضافة إلى أنه يمتاز ببساطته حيث يتميز بسيرعمل بسيط بدون أي أجزاء معقدة و يسمح بتتبع المريض دون بذل جهد و وقت و بناء على كل الميزات المذكورة فقد كان النظام مقبولا من قبل المستخدمين.