Giornale Italiano di Psicologia e Medicina del Lavoro (GIPMEL)
Italian Journal of Psychology and Occupational Health

Original Article

Implementation effectiveness of infection prevention and control measures during the first wave of COVID-19: A cross-sectional survey among healthcare workers in four regions of Tanzania

Edward Augustine MAGWE[1,2*], Modest Diamond VARISANGA[2], Secilia Kapalata NG'WESHEMI[3]

[1] *Department of Pharmaceutical Sciences, Institute of Health and Allied Sciences, Ruaha Catholic University, P.O. Box 774 Iringa, Tanzania. E-mail: edwardam87@gmail.com* ***ORCID:*** *0000-0002-0017-7469*
[2] *Department of Biological and Food Sciences, Faculty of Science, Technology and Environmental Studies, The Open University of Tanzania, P.O. Box 23409 Dar es Salaam, Tanzania. E-mail: modest.varisanga@out.ac.tz*
[3] *Department of Community Medicine, School of Medicine and Dentistry, University of Dodoma, P.O. Box 854 Dodoma, Tanzania. E-mail: mwatty92@yahoo.com*

**Corresponding Author*

Abstract

Introduction: A novel coronavirus disease was officially recognized in Wuhan, China, in December 2019. Tanzania reported its first COVID-19 case on March 16, 2020, at Mount Meru Hospital in the Arusha region, involving a returning national who re-entered the country through Kilimanjaro International Airport. This study was conducted to assess the implementation effectiveness of healthcare facilities' Infection Prevention and Control (IPC) measures during the first wave of COVID-19 among healthcare workers. This will strengthen the healthcare system's capacity whenever the disease re-emerges.

Methods: This study applied a quantitative analytical cross-sectional survey conducted from 24th of August to 3rd October 2022 in Dar es Salaam, Mwanza, Arusha, and Dodoma regions of Tanzania involving 596 healthcare workers and 40 healthcare facilities. Self-administered questionnaires were used to collect primary data. Frequencies, percentages, Chi-square and logistic regression were analyzed by using the Statistical Package for the Social Sciences (SPSS) version 26.

Results: The level of implementation effectiveness was delayed at 91% and fast responses at only 9% of IPC measures. An average of 22.2% of participants said that IPC measures were implemented before the first case was reported in Tanzania. Bivariate logistic regression found a significant relationship in the Arusha region (AOR =15.518, 95% CI, 1.947-123.672, P =0.01) and dispensary in the category of healthcare facilities (AOR =3.876, 95% CI, 1.049-14.314, P =0.042).

Discussion and Conclusions: The overall level of implementation effectiveness was maximumly delayed at 91%. It is generally a difficult task in Tanzania to control the outbreak and build hope in combating COVID-19 as a worldwide severe pandemic without strengthening healthcare facilities management and support by taking corrective measures regarding appropriate compliance to infection prevention and control.

Key words: Implementation effectiveness, Infection prevention, Healthcare workers, COVID-19, Tanzania.

Cite this paper as: Magwe EA, Varisanga MD, Ng'weshemi SK. Implementation effectiveness of infection prevention and control measures during the first wave of COVID-19: A cross-sectional survey among healthcare workers in four regions of Tanzania. G Ital Psicol Med Lav. 2023;3(1):21-33.
Received: 10 May 2023; Accepted: 30 May 2023; Published: 15 June 2023.

INTRODUCTION

A novel coronavirus disease was officially recognized in December 2019 in Wuhan, China [1]. In February 2020, the disease was later named Coronavirus Disease 2019 (COVID-19), which is an emerging infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [2]. After its first discovery, it had then swiftly spread globally. On 30 January 2020, the World Health Organization (WHO) declared the outbreak of a public health emergency of international concern, and on 11 March 2020 as a pandemic disease [3]. The severity of the disease outbreak varies significantly across different countries in the world due to several factors like country public healthcare readiness, timeliness and strength of intervention, social and economic situation of the country [4]. On 31 August 2020, the WHO reported that numbers of reported cases and deaths worldwide among 213 countries reached 25,383,993 confirmed cases and 850,588 confirmed deaths [5].

Governments used social and behavioral interventions to reduce the spread of COVID-19 in the community without vaccines and pharmacological treatment. Recent studies suggested that public health implementation measures against COVID-19 positively impacted fighting the spread of the virus. While individual measures like contact tracing and isolation of cases and contacts, wearing masks, movement restrictions, and other measures to reduce social contacts and physical proximity showed to have an impact [6] and it was suggested that only a combination of public health measures might have an effect in reducing the spread of the virus [7-10]. The European Centre for Disease Prevention and Control (ECDC), in the technical report "Strategies for Surveillance," suggests that the effectiveness of preventive measures should be evaluated regularly by monitoring the intensity and the impact on the healthcare system [11]. The report emphasizes the importance of frequent, open and transparent communication with the public for the population to accept and adhere to the selected preventive measures over a long period.

Tanzania reported its first COVID-19 case on March 16, 2020 at Mount Meru Hospital in the Arusha region, involving a returning national who re-entered the country through Kilimanjaro International Airport. In the mid of April 2020, the Ministry of Health announced the spread of COVID-19. After one month, Tanzania announced more confirmed cases and deaths related to COVID-19. On May 2, 2020, a total of 408 confirmed cases were reported [12].

In the Tanzanian government's response to the first wave of COVID-19, face masks were required in densely populated areas such as markets, public transport, and healthcare facilities, as well as banning all large public gatherings, avoiding non-essential gatherings, limiting the number of people attending funerals, the use of hand sanitizers, the installation of hand washing facilities in public places and households, the earmarking of isolation and quarantine centers, and the expansion of diagnostic centers. All these mitigations were done to prevent the spread of COVID-19 [12,13]. However, after a short time the Tanzanian government underestimated the seriousness and severity of the disease. In particular, the government never closed churches and mosques and allowed religious services to continue as normal and citizens were strongly encouraged to continue with their income-generating activities [12].

Dar es Salaam region was leading in the number of infected cases, followed by Mwanza, Arusha, and Dodoma regions [14]. Keeping in view the severity of the outbreak and the importance of healthcare professionals working with scarce resources to combat COVID-19, it was inevitable to evaluate the implementation effectiveness of Infection Prevention and Control (IPC) measures. Therefore, researching in this area in regions of Dar es Salaam, Mwanza, Arusha, and Dodoma which were among the areas of higher COVID-19 transmission in the country, will add value to the effective implementation of IPC measures, strengthen healthcare policy and good utilization of available but

limited resources whenever the disease re-emerges. This study reported a significant delay in implementation of IPC measures in combating the COVID-19 pandemic.

METHODS

Study design and population

This study applied a quantitative analytical cross-sectional survey conducted from 24th of August to 3rd October, 2022 in Dar es Salaam, Mwanza, Arusha, and Dodoma regions of Tanzania. The study involved healthcare workers, including doctors, nurses, pharmaceutical personnel, laboratory personnel, and other supportive staff in hospitals, health centers, and dispensaries.

Inclusion and exclusion criteria

Only government-owned healthcare facilities and participants who agreed to sign a consent form were included in this study. This study did not include healthcare facilities owned by private sectors, students in short-term field training attachment during data collection, and participants who could not sign a consent form.

Sample size

Sample size from a known population was calculated using Krejcie and Morgan formula (1970) in each selected region [15]. A total of 596 health workers participated in this study from four regions of Tanzania as follows; 172 from Dar es Salaam, 134 from Mwanza, 138 from Arusha, and 152 from Dodoma. The study involved 40 healthcare facilities, including 8 hospitals, 15 health centers, and 17 dispensaries.

Sampling procedures

This study applied a multi-stage sampling technique. The regions of Dar es Salaam, Mwanza, Arusha, and Dodoma were selected purposefully due to their potential alarm and prevalence of having more COVID-19 infections [14]. Then, healthcare facilities that were allocated to serve COVID-19 patients were selected purposefully, and the remaining facilities were selected randomly. In healthcare facilities, healthcare workers allocated to serve COVID-19 patients were also selected purposefully, and the rest were chosen randomly.

Pilot test

A pre-test of data was conducted among 25 healthcare workers, including all groups of participants in two healthcare facilities in the Dodoma region, one of the four regions where the study was conducted. Cronbach's alpha coefficient was used to measure reliability, item testing >0.7 was regarded as reliable, and those <0.7 were either modified or removed from the questionnaire.

Data collection and analysis

Self-administered questionnaires were used to collect primary data from healthcare workers. Collected data from participants were analyzed by using the Statistical Package for the Social Sciences (SPSS) version 26. Frequencies and percentages were computed for categorical variables. Relationships between categorical variables were analyzed using Chi-square, and significant relationships between variables were observed at P value <0.05. Factors influencing the level of IPC measures implementation effectiveness among health workers were analyzed by binary logistic regression and computing adjusted odds ratio (AOR), 95% Confidence Interval (CI), and P values, also, significant relationships were observed at P <0.05.

Scoring and definitions of IPC measures implementation effectiveness

Implementation in this study involved putting Infection Prevention and Control (IPC) measures into action as a response towards the first wave of COVID-19. The overall level of implementation effectiveness of IPC measures was categorized as a fast response if the score was between 100% and 60% and a delayed response if the score was below 60%. Infection prevention and control measures implemented before the first case reported in Tanzania were used to grade the level of implementation effectiveness.

Ethical approval

This study was accompanied by a research clearance letter with reference number PG202001923 issued by the Open University of Tanzania. Then, regional and district medical officers issued a letter of permission to conduct research in their respective areas. In the facility, participants were asked to

sign a consent form to ensure their confidentiality and willingness to participate in the study.

RESULTS

Socio-demographic characteristics of participants

This study involved 596 healthcare workers, whose demographic characteristics include: sex, age in years, field profession, the highest level of education, if the participant was dedicated to the COVID-19 team to care for infected patients in healthcare facilities, and service experience in years of each participant.

Table 1. Socio-demographic characteristics of participants (*n*=596).

Predictor variables	Valid response	Frequency (%)
Sex	Male	267 (44.8)
	Female	329 (55.2)
Age in years	18 – 29	209 (35.1)
	30 – 39	212 (35.6)
	40 – 49	111 (18.6)
	50 and above	64 (10.7)
Field profession	Clinician (doctor)	157 (26.3)
	Nurse	184 (30.9)
	Pharmaceutical personnel	90 (15.1)
	Laboratory personnel	87 (14.6)
	Supportive staff	78 (13.1)
Highest level of education	Primary school	21 (3.5)
	Secondary school	42 (7.0)
	Certificate	109 (18.3)
	Diploma	256 (43.0)
	Bachelor degree	155 (26.0)
	Master degree	13 (2.2)
Dedicated in COVID-19 team to care COVID-19 patients	Yes	222 (37.2)
	No	357 (59.9)
	No dedicated team	17 (2.9)
Service experience in years	Less than 1	86 (14.4)
	1 – 5	203 (34.1)
	6 – 10	120 (20.1)
	11 – 15	73 (12.2)
	16 – 20	44 (7.4)
	Above 20	70 (11.7)
Region	Dar es Salaam	172 (28.9)
	Mwanza	134 (22.5)
	Arusha	138 (23.2)
	Dodoma	152 (25.5)
Category of healthcare facility	Hospital	307 (51.5)
	Health center	185 (31.0)
	Dispensary	104 (17.4)
Type of patients served at healthcare facility	Outpatients only	163 (27.3)
	Outpatients and inpatients	433 (72.7)
The situation of caring COVID-19 patients in healthcare facility	Cared COVID-19 patients only	93 (15.6)
	It served all patients	341 (57.2)
	It referred patients with COVID-19 symptoms	162 (27.2)

As shown in Table 1, sex distribution involved 329 (55.2%) females and 267 (44.8%) males; participants aged between 30-39 years were higher than others 212 (35.6%). Nurses' category in terms of distribution of field profession were higher 184 (30.9%) than in the other categories. Regarding the distribution of the highest level of education, the level of diploma had the most significant number of participants, with 256 (43.0%). Demographic characteristics of participants based on healthcare facilities, hospital category was higher 307 (51.5%) than health center 185 (31.0%) and dispensary 104 (17.4). Healthcare facilities that provide services to outpatients and inpatients involved many participants, 433 (72.7%) and 163 (27.3%) from healthcare facilities served outpatients only. Based on caring for patients at healthcare facilities during the first wave of COVID-19, 341 (57.2%) participants were involved from health facilities that served all patients.

Descriptive analysis of IPC measures implementation effectiveness in healthcare facilities

In this study, participants responded if Infection Prevention and Control (IPC) measures were implemented before the first case reported in Tanzania, implemented after the first case reported in Tanzania, currently not implemented, or not sure. An average of 22.2% of participants said that IPC measures were implemented before the first case reported in Tanzania; 68.8% reported that IPC measures were implemented after the first case reported in Tanzania; 2.4% replied that currently not implemented, and 6.6% of participants were not sure with the implementation status as shown in Figure 1.

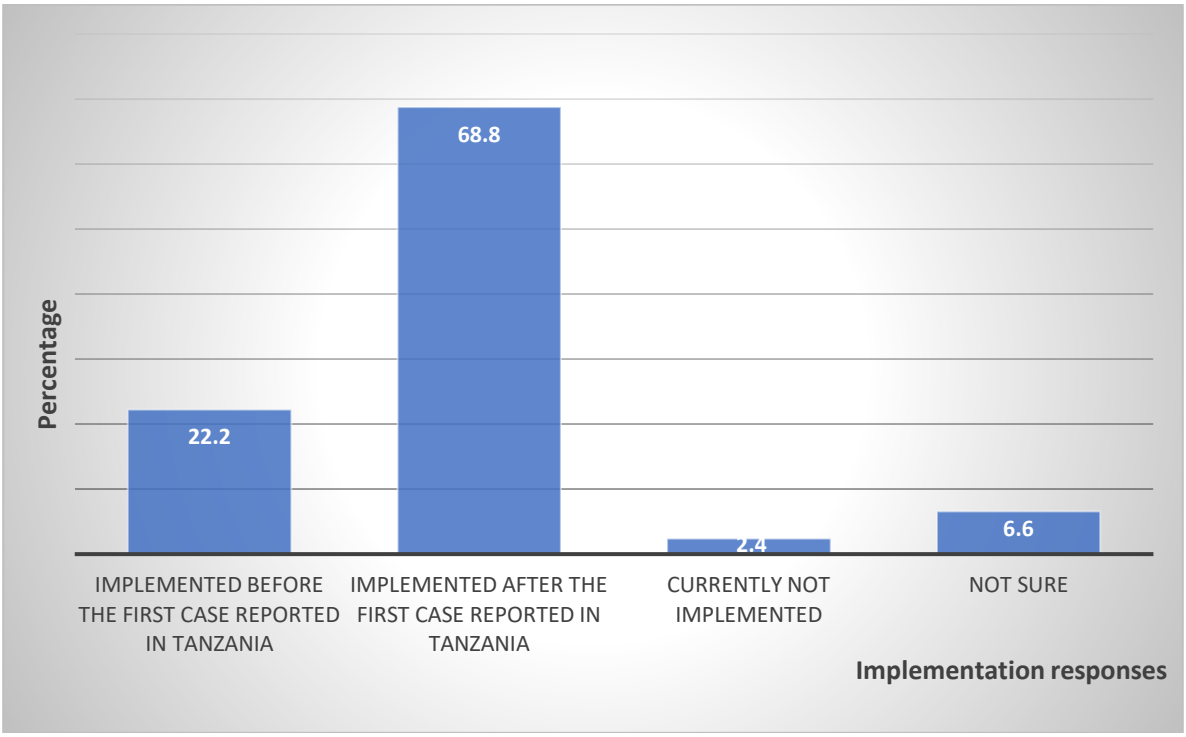

Figure 1. Overall description of implementation effectiveness in healthcare facilities.

The percentage score of only IPC measures implemented before the first case reported in Tanzania was used to categorize the overall implementation effectiveness. As shown in (Figure 2), implementation effectiveness was delayed at 91% and fast responses at only 9% of IPC measures.

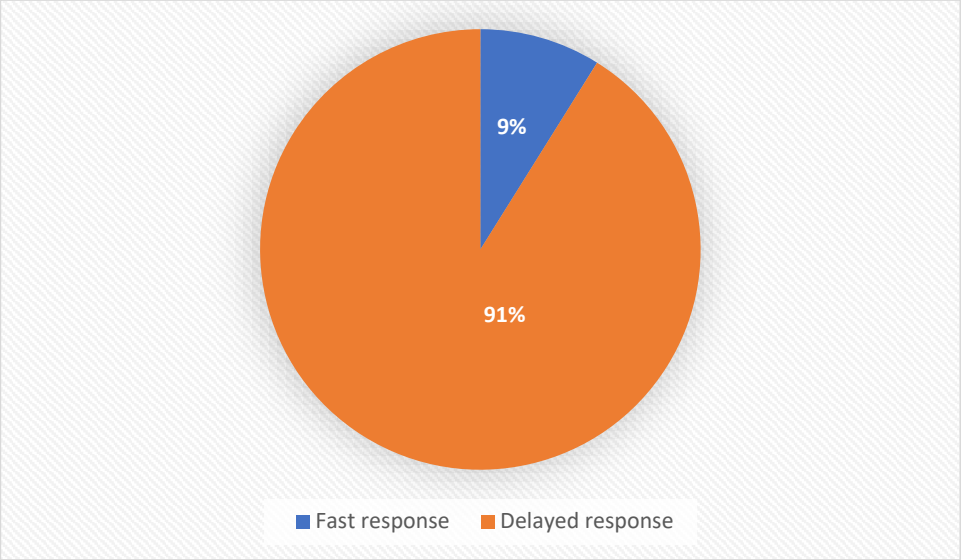

Figure 2. Average level of implementation effectiveness of IPC measures in healthcare facilities.

All IPC measures in this study were not well implemented before the first case of COVID-19 reported in Tanzania. Availability of soap and water for hand hygiene to healthcare workers was at least the most IPC measure implemented before the first case reported in Tanzania at 263 (44.1%), followed by the availability of soap and water for hand hygiene to patients and visitors 204 (34.2%) and implementation of the surveillance system for health-care-associated infections 203 (34.1%). Allocation of special budget related to COVID-19 issues was less implemented before the first case reported in Tanzania at 93 (15.6%), followed by dedicated beds for COVID-19 patients at 98 (16.4%), similar to the adoption of a universal masking policy for all health workers, patients and visitors at 98 (16.4%). Detailed implementation effectiveness of all IPC measures is well elaborated in Table 2.

Table 2. Description of implementation effectiveness of IPC measures in healthcare facilities.

Area of implementation	**Valid responses** ***n*** **(%)**			
	Implemented before the first case reported in Tanzania	Implemented after the first case reported in Tanzania	Currently not implemented	Not sure
Allocate area for triage and care for COVID-19 patients	124 (20.8)	396 (66.4)	33 (5.5)	43 (7.2)
Dedicate beds for COVID-19 patients	98 (16.4)	405 (68.0)	43 (7.2)	50 (8.4)
Allocation of special budget related to COVID-19 issues	93 (15.6)	346 (58.1)	34 (5.7)	123 (20.6)
Response of the government to COVID-19 in healthcare facility	146 (24.5)	401 (67.3)	11 (1.8)	38 (6.4)
Response of leaders in healthcare facility to fight COVID-19	120 (20.1)	450 (75.5)	5 (0.8)	21 (3.5)
Response of healthcare workers in healthcare facility to fight COVID-19	112 (18.8)	455 (76.3)	4 (0.7)	25 (4.2)
Communication and demand of teamwork with other healthcare facilities	108 (18.1)	426 (71.5)	5 (0.8)	57 (9.6)

Dedicate staff to care COVID-19 patients	77 (12.9)	432 (72.5)	32 (5.4)	55 (9.2)
Implementation of screening strategy for healthcare workers	115 (19.3)	425 (71.3)	22 (3.7)	34 (5.7)
Implementation of the strategy to protect patients and visitors from infection with Corona virus	107 (18.0)	448 (75.2)	9 (1.5)	32 (5.4)
Adoption of a universal masking policy for all health workers, patients and visitors	98 (16.4)	466 (78.2)	5 (0.8)	27 (4.5)
Availability of IPC guidelines to protect visitors, patients and healthcare workers	120 (20.1)	420 (70.5)	12 (2.0)	44 (7.4)
IPC training for healthcare workers	125 (21.0)	431 (72.3)	15 (2.5)	25 (4.2)
Availability of sanitizers	166 (27.9)	414 (69.5)	4 (0.7)	12 (2.0)
Availability of soap and water for hand hygiene to healthcare workers	263 (44.1)	321 (53.9)	2 (0.3)	10 (1.7)
Availability of soap and water for hand hygiene to patients and visitors	204 (34.2)	377 (63.3)	2 (0.3)	13 (2.2)
Availability of additional equipment to protect against the Corona virus infection	109 (18.3)	439 (73.7)	14 (2.3)	34 (5.7)
Implementation of surveillance system for health-care-associated infections	203 (34.1)	325 (54.5)	10 (1.7)	58 (9.7)
Awareness of reporting patients with symptoms COVID-19	132 (22.1)	410 (68.8)	8 (1.3)	46 (7.7)

Association of predictor variables and level of implementation effectiveness of IPC measures

In this study, bivariate analysis computed a significant relationship between predictor variables and level of implementation effectiveness in IPC measures implemented before the first case of COVID-19 reported in Tanzania. Two personnel-related independent variables (age and field profession) have a significant relationship with the level of implementation effectiveness, all having P-value < 0.05, as shown in Table 3**.** One facility-related independent variable (region of healthcare facility) has a significant relationship with the level of implementation effectiveness with a P-value < 0.05. The rest variables have no significant association with implementation effectiveness, all having P-value > 0.05, as shown in Table 3.

Table 3. Association of predictor variables and level of implementation effectiveness of IPC measures.

Predictor variables	**Valid response**	**Effectiveness of implementation**		**Total**	**Chi-square**	**P-value**
		Fast response	**Delayed response**			
		N (%)	N (%)	N (%)		
Sex	Male	19 (3.2)	248 (41.6)	267 (44.8)	1.884	0.170
	Female	34 (5.7)	295 (49.5)	329 (55.2)		
Age in years	18 – 29	30 (5.0)	179 (30.0)	209 (35.1)		
	30 – 39	12 (2.0)	200 (33.6)	212 (35.6)	12.988	**0.011***
	40 – 49	8 (1.3)	103 (17.3)	111 (18.6)		

	50 and above	3 (0.5)	61 (10.2)	64 (10.7)		
Field profession	Clinician (doctor)	5 (0.8)	152 (25.5)	157 (26.3)		
	Nurse	18 (3.0)	166 (27.9)	184 (30.9)		
	Pharmaceutical personnel	12 (2.0)	78 (13.1)	90 (15.1)	9.590	**0.048***
	Laboratory personnel	10 (1.7)	77 (12.9)	87 (14.6)		
	Other health support staff	8 (1.3)	70 (11.7)	78 (13.1)		
Highest level of education	Primary school	1 (0.2)	20 (3.4)	21 (3.5)		
	Secondary school	1 (0.2)	41 (6.9)	42 (7.0)		
	Certificate	12 (2.0)	97 (16.3)	109 (18.3)	5.727	0.334
	Diploma	28 (4.7)	228 (38.3)	256 (43.0)		
	Bachelor degree	10 (1.7)	145 (24.3)	155 (26.0)		
	Master degree	1 (0.2)	12 (2.0)	13 (2.2)		
Dedicated in COVID-19 team	Yes	15 (2.5)	207 (34.7)	222 (37.2)		
	No	38 (6.4)	319 (53.5)	357 (59.9)	4.261	0.119
	Dedication was not done	0 (0.0)	17 (2.9)	17 (2.9)		
Service experience in years	Less than 1	12 (2.0)	74 (12.4)	86 (14.4)		
	1 – 5	24 (4.0)	179 (30.0)	203 (34.1)		
	6 – 10	6 (1.0)	114 (19.1)	120 (20.1)	9.389	0.095
	11 – 15	5 (0.8)	68 (11.4)	73 (12.2)		
	16 – 20	2 (0.3)	42 (7.0)	44 (7.4)		
	Above 20	4 (0.7)	66 (11.1)	70 (11.7)		
Region	Dar es Salaam	28 (4.7)	144 (24.2)	172 (28.9)		
	Mwanza	1 (0.2)	133 (22.3)	134 (22.5)	26.030	**<0.001***
	Arusha	7 (1.2)	131 (22.0)	138 (23.2)		
	Dodoma	17 (2.9)	135 (22.7)	152 (25.5)		
Category of health care facility (HCF)	Hospital	31 (5.2)	276 (46.3)	307 (51.5)		
	Health center	9 (1.5)	176 (29.5)	185 (31.0)	5.925	0.052
	Dispensary	13 (2.2)	91 (15.3)	104 (17.4)		
Type of patients served in HCF	Outpatients only	18 (3.0)	145 (24.3)	163 (27.3)	1.280	0.258
	Outpatients and inpatients	35 (5.9)	398 (66.8)	433 (72.7)		
Situation of caring Covid-19 patients at HCF during the first wave	It served only Covid-19 patients	12 (2.0)	81 (13.6)	93 (15.6)	3.066	0.216
	It served all patients	25 (4.2)	316 (53.0)	341 (57.2)		
	It referred patients with Covid-19 symptoms	16 (2.7)	146 (24.5)	162 (27.2)		

* $P<0.05$ is statistically significant

Factors influencing the level of IPC measures implementation effectiveness

Binary logistic regression was conducted to examine the combined influence of the level of IPC measures implementation effectiveness in which socio-demographic characteristics were used as Predictor variables against the level of implementation effectiveness. The delayed implementation response category was contrasted against the fast implementation response as a reference category. Logistic regression results shown in (Table 4) indicate that when the delayed category was contrasted against the fast category response, regions and category of healthcare facilities significantly predicted a relationship with a P-value < 0.05. Arusha region significantly increased odds by a factor of 15.5 (AOR =15.518, 95% CI: 1.947-123.672, P =0.01), and dispensary in the category of healthcare facilities increased odds by a factor of 3.9 (AOR =3.876, 95% CI: 1.049-14.314, P =0.042).

Table 4. Binary logistic analysis of predictor variables and level implementation effectiveness of IPC measures.

Predictor variables	Fast response (Reference) vs. Delayed response							
	B	SE	Wald's $\chi 2$	df	P-value	AOR	95% C.I.for EXP(B)	
							Lower	Upper
Sex								
Male	Reference							
Female	0.437	0.36	1.473	1	0.225	1.548	0.764	3.137
Age in years								
18 – 29	Reference							
30 – 39	-0.803	1.157	0.482	1	0.488	0.448	0.046	4.325
40 – 49	0.094	1.122	0.007	1	0.933	1.099	0.122	9.909
50 and above	-0.477	0.922	0.268	1	0.605	0.621	0.102	3.783
Field profession								
Clinician (doctor)	Reference							
Nurse	1.208	0.682	3.135	1	0.077	3.346	0.879	12.738
Pharmaceutical personnel	-0.253	0.531	0.228	1	0.633	0.776	0.274	2.197
Laboratory personnel	-0.494	0.588	0.705	1	0.401	0.61	0.193	1.932
Other health support staff	-0.515	0.623	0.684	1	0.408	0.598	0.176	2.024
Level of education								
Primary school	Reference							
Secondary school	0.702	1.616	0.188	1	0.664	2.017	0.085	47.938
Certificate	1.439	1.564	0.847	1	0.357	4.216	0.197	90.331
Diploma	-0.015	1.192	0	1	0.99	0.985	0.095	10.175
Bachelor degree	0.086	1.177	0.005	1	0.942	1.089	0.109	10.934
Master degree	0.575	1.196	0.231	1	0.631	1.776	0.17	18.511
Dedicated in COVID-19 team								
Yes	Reference							
No	-18.683	8588.459	0	1	0.998	0	0	[b]
Dedication was not done	-18.894	8588.459	0	1	0.998	0	0	[b]
Service experience in years								
Less than 1	Reference							
1 – 5	-0.372	1.128	0.109	1	0.742	0.689	0.076	6.292
6 – 10	-0.228	1.049	0.047	1	0.828	0.796	0.102	6.22
11 – 15	0.165	1.06	0.024	1	0.876	1.179	0.148	9.415
16 – 20	-0.147	0.929	0.025	1	0.874	0.863	0.14	5.335
Above 20	0.857	1.071	0.641	1	0.423	2.357	0.289	19.219
Region								
Dar es Salaam	Reference							
Mwanza	-0.514	0.394	1.701	1	0.192	0.598	0.276	1.295
Arusha	2.742	1.059	6.704	1	**0.01***	15.518	1.947	123.672
Dodoma	0.795	0.502	2.511	1	0.113	2.215	0.828	5.924

Category of healthcare facility								
Hospital	Reference							
Health center	0.464	0.622	0.556	1	0.456	1.59	0.47	5.383
Dispensary	1.355	0.667	4.13	1	**0.042***	3.876	1.049	14.314
Type of patients receiving healthcare at healthcare facility								
Outpatients only	Reference							
Outpatients and inpatients	0.008	0.559	0	1	0.989	1.008	0.337	3.011
Situation of caring Covid-19 patients at healthcare facility during the first wave of Covid-19								
It served only Covid-19 patients	Reference							
It served all patients	-0.309	0.501	0.381	1	0.537	0.734	0.275	1.959
It referred patients with Covid-19 symptoms	0.279	0.427	0.426	1	0.514	1.322	0.572	3.052

* $P<0.05$ is statistically significant, df = degree of freedom, CI=Confidence Interval, B= Logistic regression coefficient, SE= Standard Error, χ^2 = Chi-Square test, AOR=Adjusted Odds Ratio, [b]N/A results were not considered due to maximum variation caused by zero odds in reference categorical variable.

DISCUSSION

An average of 22.2% of participants said that Infection Prevention and Control (IPC) measures were implemented before the first case reported in Tanzania; 68.8% reported that IPC measures were implemented after the first case reported in Tanzania; 2.4% reported that currently not implemented, and 6.6% of participants were not sure with the implementation status. The percentage score of only IPC measures implemented before the first case reported in Tanzania was used to categorize the overall level of implementation effectiveness. As shown in Figure 2, implementation effectiveness delayed at 91% and fast responses at only 9% of IPC measures. This low level of implementation brings great alarm and concern to Tanzania as a country if it can fight well against the outbreak of COVID-19 in case of a serious outbreak. More importantly, this level of implementation may be interpreted that Tanzania is prepared to deal with the consequences of COVID-19 rather than preparing the environment to prevent the outbreak of the disease, which is not the right way for public health concerns.

The way Tanzania prepared to fight against COVID-19 is contrary to many other countries. The Central Epidemic Command Center (CECC) assessed public and private health sector readiness in Taiwan. Then, it established clinical manifestations and criteria for dealing with COVID-19, all hospital entrance points were screened and reorganized, the flow of patients was controlled, and reviewed medical materials for disease control measures [16]. The ongoing experience in reducing the spread of COVID-19 in Vietnam reported that the Vietnamese response was characterized by established rapid response, transparent and clear leadership, and a multi-sectoral approach that helped to integrate high-impact decisions supported by clinical care and public health response. The wider application of these experiences depends on the social and political environment differences, which determines the public's compliance with the government's agenda [17]. Another study in Vietnam provided evidence that infection control that involved mass masking and universal hygiene in the initial steps to fight against COVID-19 led to a decrease in infectious respiratory diseases by 50%, according to historical data during the influenza season in Taiwan. These results support the effectiveness of implementing public health IPC measures in controlling the COVID-19 pandemic without even having a general lockdown policy [18].

Not limited to this current study, another previous study among healthcare workers in Tanzania which measured compliance by observation, reveals that IPC compliance was inadequate in outpatient facilities [19]. Political inconvenience and lack of management support stated by [12, 13] may contribute to poor adherence to IPC measures in this study. Another recent study in Tanzania also reported an insufficient level of preparedness by 52%. Only 25% of preventive measures were well prepared, and about 23% reported average preparedness. Then added that it is not easy for

Tanzania to have great success in fighting against COVID-19 due to low responses to the implementation of preventive measures to protect against the disease while the disease is still re-emerging [20]. A similar study conducted in Ghana among healthcare workers during the Ebola Virus Disease (EVD) outbreak showed ill-preparedness in healthcare facilities in dealing with cases [21]. Also, a study that was conducted in Nigeria reported inadequate IPC compliance in the fight against COVID-19 and inadequate supply of Personal Protective Equipment (PPE), which could lead to an increase in the infection of COVID-19 among healthcare workers [22]. Despite this finding, the Nigerian Centre for Disease Control (NCDC) developed the Surveillance and Outbreak Response Management System (SORMAS) for case-based reporting early in the pandemic [22]. Similarly, the National Incident Coordination Centre (NICC) was established to gather daily intelligence reports and ensure early coordinated response to the COVID-19 outbreak [23].

Although, a study conducted in China reported IPC behavior improvement among healthcare workers during the COVID-19 outbreak [24]. This may be productive information in IPC protocol compliance in this current study. Infection prevention and control compliance contribute a critical role in reducing COVID-19 virus exposure to healthcare workers. In contrast, non-compliance with IPC protocols against COVID-19 infection is essential for healthcare workers in ensuring their safety [25]. In their interim guidelines, the WHO recommends strict adherence to IPC protocols in response to the COVID-19 outbreak [26]. Many factors are related to healthcare workers' compliance with IPC protocols, including taking care of their health and the general public. Clear IPC guidelines, effective communication, manager support, training, access, and trust in PPEs are essential in promoting healthcare compliance with IPC protocols [27]. Other studies [19, 28] consistently reported nearly universal compliance with medical mask use during healthcare interaction with COVID-19 patients. Indeed, personal protective equipment used effectively prevents nosocomial transmission of SARS-CoV-2 [29, 30].

Generally, IPC strategies in response to highly infectious diseases, such as COVID-19, should include early recognition, contact tracing, travel bans, physical distancing, taking precautions and appropriate use of PPEs, environmental cleaning, and disinfection as well as support for healthcare workers [26, 31, 32]. Minimizing exposure of healthcare workers to the SARS-CoV-2 is the best option for protecting frontline healthcare workers from COVID-19 infection, and this is best done through healthcare worker adherence to IPC protocols as well as inoculating against the SARS-COV-2 [33]. We believe these results are generalizable and can be applied to other countries while pharmaceutical products remain under development.

CONCLUSION

Due to the maximum delayed level of implementation effectiveness at 91% and fast at only 9% of IPC measures, it is generally still a difficult task in Tanzania to control the outbreak of the COVID-19 pandemic without strengthening healthcare facilities management and support by taking corrective measures regarding appropriate compliance to infection prevention and control. All IPC measures considered in this survey were delayed from being implemented even for 50%. The effectively implemented IPC measure was the availability of soap and water for hand hygiene to healthcare workers by 44%, which is very low for building hope in combating COVID-19 as a worldwide severe pandemic.

Implications for policymakers and recommendations

The government of Tanzania should strengthen its commitment, management, and political willingness to fight against COVID-19 and other diseases of the same kind whenever they emerge. In addition, it is important to strengthen healthcare facilities management and support by taking corrective measures regarding appropriate compliance to infection prevention and control.

Acknowledgements

Authors hereby extend their gratitude to the Open University of Tanzania for approving an ethical clearance letter to conduct this study, regional and district medical officers, medical officer in charge, heads of units and healthcare workers who made this study possible.

Author Contributions: Conceptualization, study design, methodology, resources, data collection, data analysis and writing original draft: EAM. Study design, methodology, supervision, review and editing: MDV, SKN
Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Conflicts of interest: The authors declare that there is no financial, general, or institutional conflict of interest regarding the publication of this article.
Data Availability Statement: Some or all data and models that support the findings of this study are available from the corresponding author upon reasonable request.
Publisher's Note: The Publisher stays neutral with regard to jurisdictional claims in published maps and institutional affiliation.

References

1. Pan A, Liu L, Wang C, et al. Association of public health interventions with the epidemiology of the COVID-19 outbreak in Wuhan, China. JAMA—J Am Med Assoc. 2020;323(19):1915–23. PMID:32275295.
2. McAleer M. Prevention is better than the cure: Risk management of COVID-19. J Risk Financ Manag. 2020;13(3):46.
3. World Health Organization. Coronavius disease 2019 (COVID-19) situation report-51. WHO 2020.https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf? Accessed 12 March 2023.
4. World Health Organization. Coronavirus disease (COVID-19) situation reports. WHO 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/ Accessed 12 March 2023.
5. World Health Organization. Coronavirus Disease (COVID-19). Situation Report—209; WHO 2020. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200816-covid-19-sitrep-209.pdf. Accessed 12 March 2023.
6. Koo JR, Cook AR, Park M, et al. Interventions to mitigate early spread of SARS-CoV-2 in Singapore: a modelling study. Lancet Infect Dis. 2020;20(6):678-88. doi: 10.1016/S14733099(20)30261-9.
7. Lai S, Ruktanonchai NW, Zhou L, et al. Effect of non-pharmaceutical interventions for containing the COVID-19 outbreak: an observational and modelling study. medRxiv. 2020:2020.03.03.20029843.
8. Kraemer MU, Yang CH, Gutierrez B, et al. The effect of human mobility and control measures on the COVID-19 epidemic in China. Science. 2020; 368:493-7.
9. Hellewell J, Abbott S, Gimma A, et al. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. Lancet Glob Heal. 2020;8:E488-96.
10. Anderson RM, Heesterbeek H, Klinkenberg D, et al. How will country-based mitigation measures influence the course of the COVID-19 epidemic? Lancet. 2020;395: P931-4.
11. European Centre for Disease Prevention and Control. Strategies for the surveillance of COVID-19. Stockholm: ECDC; 2020. https://www.ecdc.europa.eu/en/publications-data/strategies-surveillance-covid-19. Accessed 10 March 2023.
12. Hamisi NM, Dai B, Ibrahim M. Global Health Security amid COVID-19: Tanzanian government's response to the COVID-19 Pandemic. BMC Public Health. 2023; 23(1):1-0.
13. Makoni, M. (2021, February 13). Tanzania refuses COVID-19 vaccines. The Lancet. https://www.thelancet.com/journals/lancet/article/PIIS0140 6736(21)00362-7/full text. Accessed 26 February 2023.
14. Rugarabamu S, Ibrahim M, Byanaku A. Knowledge, attitudes, and practices (KAP) towards COVID-19: A quick online cross-sectional survey among Tanzanian residents. medRxiv. 2020; doi: https://doi.org/10.1101/2020.04.26.20080820.
15. Krejcie RV, Morgan DW. Determining sample size for research activities. Educ Psychol Meas. 1970;30(3):607-10.
16. Tan TW, Tan HL, Chang MN, et al. Effectiveness of epidemic preventive policies and hospital strategies in combating COVID-19 outbreak in Taiwan. Int J Environ Health Res. 2021;18(7):3456.
17. Ha BT, Ngoc Quang L, Mirzoev T, et al. Combating the COVID-19 epidemic: experiences from Vietnam. Int J Environ Health Res. 2020;17(9):3125.
18. Hsieh CC, Lin CH, Wang WY, et al. The outcome and implications of public precautionary measures in Taiwan–Declining respiratory disease cases in the COVID-19 pandemic. Int J Environ Health Res. 2020;17(13):4877.

19. Powell-Jackson T, King JJ, Makungu C, et al. Infection prevention and control compliance in Tanzanian outpatient facilities: a cross-sectional study with implications for the control of COVID-19. Lancet Global Health. 2020; 8(6): e780-9.
20. Magwe E, Varisanga MD, Ng'weshemi SK. Healthcare facilities' level of preparedness response on COVID-19 preventive measures in selected regions of Tanzania: A perspective of healthcare workers. Microbes Infect Dis 2023; 4(2): 343-456. Doi: 10.21608/mid.2023.193210.1466.
21. Annan AA, Yar DD, Owusu M, et al. Health care workers indicate ill preparedness for Ebola Virus Disease outbreak in Ashanti Region of Ghana. BMC Public Health. 2017; 17(1):1-7.
22. Ilesanmi OS, Afolabi AA, Akande A, et al. Infection prevention and control during COVID-19 pandemic: realities from health care workers in a north central state in Nigeria. Epidemiol Infect. 2021;149.
23. Mustapha JO, Adedokun KA, Nasir IA. Public health preparedness towards COVID-19 outbreak in Nigeria. Asian Pac J Trop Med. 2020;13(5):197.
24. Lai X, Wang X, Yang Q, et al... Will healthcare workers improve infection prevention and control behaviors as COVID-19 risk emerges and increases, in China? Antimicrob Resist Infect Control. 2020; 9(1):1-9.
25. Xiong Y, Zhang Q, Sun D, et al. Clinical and CT characteristics of healthcare workers with COVID-19: A single-centered, retrospective study. Med. 2020; 99(30). https://doi.org/10.1097/MD.0000000000021396.
26. World Health Organization. Infection Prevention and Control guidance for Long-Term Care Facilities in the context of COVID-19. WHO Interim Guidance 2020:1–5. https://apps.who.int/iris/bitstream/handle/10665/331508/WHO-2019-nCoV-IPC_long_term_care-2020.1-eng.pdf?sequence=1&isAllowed=y. Accessed 10 March 2023.
27. Houghton C, Meskell P, Delaney H, et al. Barriers and facilitators to healthcare workers' adherence with infection prevention and control (IPC) guidelines for respiratory infectious diseases: a rapid qualitative evidence synthesis. Cochrane Database Syst Rev. 2020(8). Doi: 10.1002/14651858.CD013582.
28. Sarfraz S, Raza R, Aziz K, et al. Compliance on the Use of Different Types of Face Mask by Healthcare Workers and General Public in Tertiary Care Hospital of RMU during COVID-19 Pandemic. J Rawalpindi Med Coll. 2020; 24:71–6. https://doi.org/10.37939/jrmc.v24isupp-1.1440.
29. Verbeek JH, Rajamaki B, Ijaz S, et al. Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff. Cochrane Database Syst Rev. 2020(4). https://doi.org/10.1002/14651858.
30. Zhao Y, Liang W, Luo Y, et al Personal protective equipment protecting healthcare workers in the Chinese epicentre of COVID-19. Clin Microbiol Infect. 2020; 26:1716–8. https://doi.org/10.1016/j.cmi.2020.07.029.
31. Mahikul W, Chotsiri P, Ploddi K, et al. Evaluating the impact of intervention strategies on the first wave and predicting the second wave of COVID-19 in Thailand: a mathematical modelling study. Biology. 2021;10(2):80.
32. World Health Organization. Infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in health care. WHO Guide 2014. https://apps.who.int/iris/bitstream/handle/10665/112656/97892?sequence=1. Accessed 12 March 2023.
33. Matrajt L, Eaton J, Leung T, et al. Vaccine optimization for COVID-19: Who to vaccinate first? Sci Adv. 2021;7(6): eabf1374.