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The Epidemiological Landscape of the National Influenza Sentinel Surveillance System from 2016 to 2019, Tanzania

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Abstract:-
Background: To describe epidemiology, seasonality, burden and identify new viral strains of influenza in Tanzania, in 2008 the country initiated the National Influenza Surveillance System.This study aimed at assessingthe distribution, trend and associated demographic factors for influenza cases in Tanzania from 2016 to 2019.

Methodology: Was a cross-sectional study using secondary data obtained from national laboratory information systemat National Influenza Center (NIC) dataset from 2016 to 2019.

Results: A total of 7260 swab samples were collected between 2016 to 2019 from clients with a median age of 4 years [Interquartile range (IQR) =25; (26,1)], most samples (53.4%) were from patients aged under five years. From the samples collected,58% (4137/7171) were from Influenza-Like Illness (ILI) clients while 42% (3034/7171) were from those who hadSevere Acute Respiratory Illness (SARI).Laboratory confirmation was done by PCR technique whereby cases were 17% with a higher prevalence of influenza A [12% (881/7260)] as compared to influenza B [5% (373/7260)].Sixty seven percent(844/1254) of positive samples were from patients enrolled with ILI. We observed the seasonality of influenza withincreased cases in rainy and cold seasons.Individuals with SARI had 25% less likelihood of testing positive for Influenza as compared to those presenting with ILI"(aOR 0.75, 95% CI [0.64-0.89], p=0.001).

Conclusion: Children aged under five years, being the most affected group, requires nonstop support and care.ILI cases need attention in care and management,having known the seasonality of the disease apprises for the proper allocation of resources for the surveillance activities.

Keywords :- *Influenza, Sentinel surveillance, Severe acute respiratory infections, Influenza like illness, National public health laboratory, National influenza center.*

I. INTRODUCTION

Globally, about 3 to 5 million cases of severe influenza disease occur each year [1].This goes abreast with estimated annual influenza-associated mortality between 500,000 and 1,000,000 cases with a median case-fatality of 190 deaths per 100,000 people infected with influenza[2]. Complicating the global influenza burden is the recognition of a novel swine-origin influenza A virus which is the agent associated with the WHO declared influenza pandemic in 2009 [3].

Influenza refers to an acute viral respiratory tract disease characterized by fever, headache, myalgia, prostration, coryza, sore throat and cough. Cough is often severe and prolonged with recoveryin 2-7 days[4]**.** The history of influenza dates back to 1918 whereby the influenza epidemic occurred and infected one-third of human population and caused approximately 50 million human deaths[5]**.**

Influenza infection is caused by the influenza virus, a single-stranded Ribonucleic acid (RNA) virus belonging to the Orthomyxoviridae family, and it is classified into types A, B and C. Types A and B viruses can cause epidemic disease in humans and type C viruses usually cause a mild, cold-like illness. Influenza A virushas sub-types according to the antigenic and genetic nature of their surface glycoproteins haemagglutinin (HA) and neuraminidase (NA). HA subtypes that regularly cause disease outbreaks in humans are H1, H2 and H3 while in NA are N1 and N2 subtypes. Over the past two centuries, seasonal outbreaks of influenza disease in humans have been caused by influenza A (H1N1), A (H1N2), A (H2N2), A (H3N2) subtypes and more recently a pandemic strain influenza A[H1N1] pdm09 caused significant morbidity and mortality[4].

Influenza virus can spread in three main ways: direct transmission, which occurs when an infected person sneezes mucus directly into the eye, nose or mouth of another person; by an airborne route which normally occurs when someone inhales the aerosol produced by an infected person coughing, sneezing or spitting and through hand to eye, nose or mouth transmission, this is either from contaminated surfaces or direct personal contact as handshake[6].

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Infection is characterized by sudden onset of high fever, aching muscles, headache, non-productive cough, sore throat and rhinitis, the infection is short-lived, about one to two weeks, and typically people recover on their own without complications. In the very young, elderly and people having other diseases, influenza can take a more severe course and lead to complicationsand even death.

In Tanzania, the first case(of influenza) was reported on 4th July 2009. Since then, epidemics have been persisting.Although the usual strains of influenza that circulate in the annual influenza cycle constitute a substantial public health concern, far more lethal influenza strains other than those found in Tanzania have emerged periodically[7]. And therefore, regular checkingfor the epidemiological trend of influenza disease and factors associated with influenza positivity is very crucial in the early detection of any strain with pandemic potential.

Tanzania, through the Ministry of Health(MoH) initiated the national influenza sentinel surveillance system in 2008 (S1Fig),intending to determine the characteristics of influenza, proportions of confirmed cases of influenza among Severe Acute Respiratory Illness (SARI) in-patients and Influenza Like Illness (ILI) out-patients, characterize and monitor trends in illnesses and deaths attributable to severe acute respiratory infections, determine burden-of-disease estimates due to influenzain the country as well as detecting and responding to existing and new influenza strains capable of causing pandemic[4].

Data from This secondary review is essential to provide insight to stakeholders on the better way to improve influenza surveillance system inherently, for instance, on proper utilization of the surveillance resources regarding the distribution,trend and burden of the disease in the country. The study also showsthe association of various demographic factors (age, gender, case definition type and sentinel site) with the influenza positivity, and therefore advises the health sector for the appropriate interventions.

The overall purpose of this study was todetermine the distribution, trend and associated demographic factors for influenza cases in Tanzania from 2016 to 2019.This included describing demographic characteristics of patients underinfluenza surveillance, distribution and trend of influenza disease, distribution of influenza viral types, distribution of influenza cases in sentinel sites as well as the association between demographic features and influenza cases from 2016 to 2019.

II. MATERIALS AND METHODS

We conducted a cross-sectional study on Influenza Sentinel Surveillance System (NISSS) of Tanzania by analyzing the secondary data (2016-2019 influenza data set) extracted from national laboratory information system at National Influenza Center (NIC).We extracted and evaluated routinely recorded ILI and SARI data between 2016and 2019.

A. Population under surveillance and Study area

The NISSS cover the entire population of Tanzania, which was approximated to be 56.32million by 2019[9].Case management data was captured from fourteen sentinel facilities which are situated in the regions of Kigoma, Dodoma, Mwanza, Manyara, Arusha, Mtwara, Dar es Salaam and Zanzibar. This analysis covered the sixteen influenza sentinel sites which are located in United Republic of Tanzania (see Fig 1).

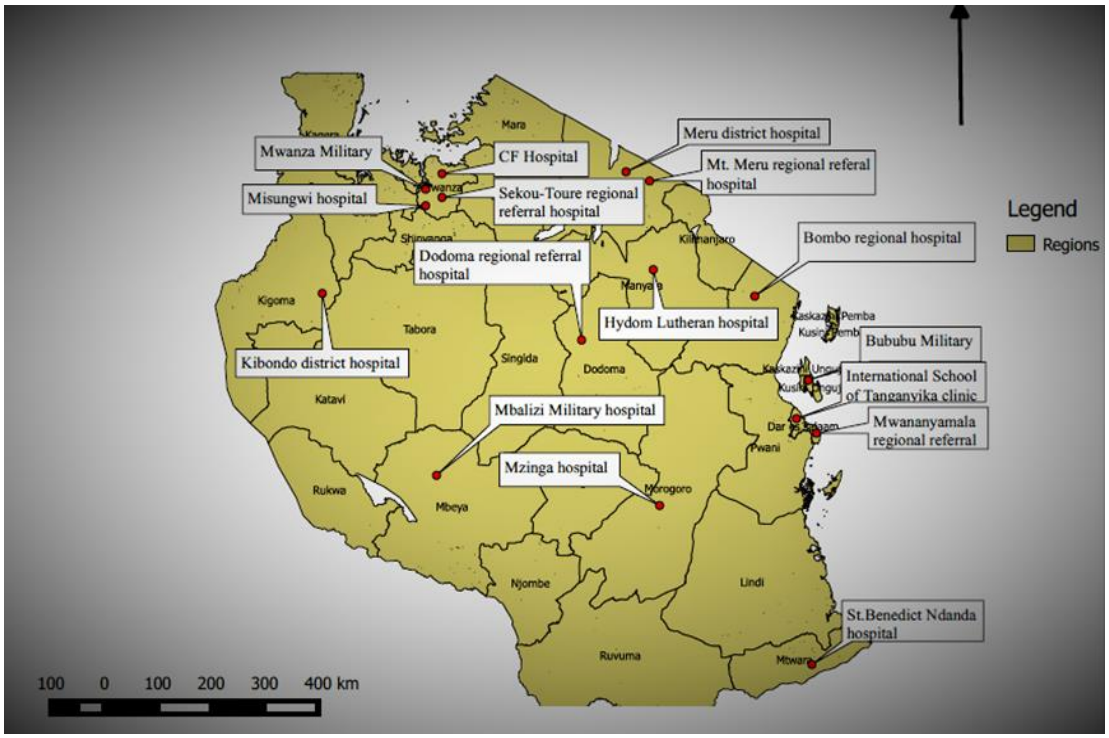

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Fig 1: Sentinel sites of the National Influenza Sentinel Surveillance System in Tanzania, 2016-2019 (N=16).

B. Inclusion criteria

The data of all influenza suspects detected by either Influenza-like illness (ILI) or Severe acute respiratory infections (SARI) case definition enrolled in the surveillance system and therefore included in 2016 to 2019 influenza data set (electronic forms) were used for analysis. *ILI case definition*was defined as "An acute respiratory infection with: measured fever of ≥ 38 C° and cough; with onset within the last 10 days". *SARI case definition*was defined as "An acute respiratory infection with history of fever or measured fever of ≥ 38 C°; and cough; with onset within the last 10 days; and requires hospitalization"[2].

C. Exclusion criteria

All clients whose data were missing important information such as age, case definition type, name of sentinel site , influenza results and sex were excluded in analysis also all clients clients out of this timeline 2016-2019were not involved in this study.

D. Source of data

Data was extracted from Laboratory information system at NIC or National Public Health Laboratory (NPHL). Variables present in the database are demographic characteristics (age, sex, name of sentinel site), results of influenza test (influenza type A or B and influenza A subtypes) and collection date.

E. Specimen collection and Laboratory procedures

The data used in this study was primarily obtained from astructured questionnaire administered (Case-based forms)to each client enrolled in the National Influenza Surveillance System, whereby the variables of age, sex, sentinel site, date of sample collection, case definition type (ILI/SARI) were recorded.Laboratory sample type used was both nasopharyngeal and oropharyngeal swabs.For all patients who met the case definition (ILI/SARI), a nasopharyngeal and an oropharyngeal swab sample were collected.Both swabs were placed into a single cryovial containing viral transport medium. Cryovials containing specimen were immediately refrigerated and transported to the NIC in Dar Es Salaam via courier services. On receipt at NIC, specimens were immediately stored at -80^{0}C in a freezer ready for the testing process.

Samples collected from the sentinel sites were received at NIC by using Laboratory information system.Samples were tested for influenza A and influenza B viruses by real-time reverse-transcription polymerase chain reaction (rRT-PCR), using the CDC protocol for detection and characterization of seasonal influenza virus and 2009 pandemic influenza A virus subtype H1N1(A[H1N1]pdm09) as well as WHO manual for the laboratory diagnosis and virological surveillance of influenza[9].RNA extraction was done from 140-µl aliquots of each specimen, using a QIamp viral RNA minikit (Qiagen, Germany) according to manufacturer's instructions. One steprRT-PCR was carried out using the AgPathkit (Applied Biosystems, Carlsbad. CA). Following the reverse-transcription step, a typical 45-cycle PCR reaction was run and fluorescence was read at the annealing /extension step. Appropriate negative and positive control specimens were run alongside each reaction. The results were recorded as cycle threshold (CT) values. When all controls met the stated requirements, any influenza A and B virus with a CT value of ≤ 39.9 was recorded as positive, and those with a CT reading of ≥40 were recorded as negative.[9]. All specimens positive for influenza A virus were subtyped for seasonal H1(A[H1], H3(A[H3]), H5(A[H5]) and A(H1N1) pdm09, using RT-PCR. Specimens that were positive for influenza A virus by rRT-PCR but were not sub typable were sent to the WHO influenza collaborating center for further antigenic characterization.

F. Data management and analysis

Data wereextracted from Laboratory information system, then copied into Microsoft excel sheet version 2019. Furthermore, they wereexported to Stata version 15.1 and Epi Info version 7 for analysis. Thebackup copyof data-set was made for any occasion that may need backup during data analysis. Descriptive analysis was done whereby median for continuous data, frequency and percentage were used to summarize the categorical data. In this study, a p-value of <0.2 in the bivariate logistic regression analysis was considered for multivariate logistic regression and those with p-value<0.05 were considered as statistically significantwith 95% confidence level and 5% margin of error.

G. Ethics statement

This analysis was done within the framework of Integrated Disease Surveillance and Response matrix implemented by the Tanzania Ministry of Health and therefore did not have to receive formal review by Ethical Review Committees. The Field Epidemiology and Laboratory Training Programme and National Influenza Center in Tanzania approved the study. Permission was sought and obtained from the Ministry of Health of Tanzania in the epidemiology section and authorities in the sentinel facilities before commencement of the analysis. Data were anonymized before being accessed and all respondents provided informed, written consent prior toenrolment in the surveillance system and were assured of confidentiality.

III. RESULTS

A. Demographic characteristic of suspected influenza cases in Tanzania from 2016 to 2019.

Total samples (oropharyngeal and nasopharyngeal swabs) collected from suspected influenza cases between 2016 to 2019 were 7260.From the samples collected, fifty-eight percent, 58% (4137/7171) were from ILI clients while 42% (3034/7171) were from those with SARIwith median age of 4 years [Interquartile range=25 (26,1)], whereby 53.4% of the samples were collected from patients aged under 5yearswhich is estimated to be equivalent to the sum of allsamples of patients from other age categories(see Table 1). From all samples tested, 50.6% (3605/7122) were

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collected from male patients and 52.8% (658/1245) of total confirmed influenza cases were from female patients.

From 2017-2019 there was a progressive increase in samplecollection ascompared to the year 2016. Both ILI and SARI cases were higher in the first quarter of each year (Jan-March) reaching a peak in late April than the rest of other months. In addition, the number of samples collected from ILI patients are relatively higher as compared to those collected from SARI.

Characteristic	CASE DEFINITION		TOTAL(n=7171)
	ILI (n=4137)	SARI(n=3034)	
Age (in years)			
0-4	1537 (37.2)	2294 (75.6)	3831 (53.4)
5-14	527 (12.7)	207 (6.8)	734 (10.2)
15-24	591 (14.3)	105 (3.5)	696 (9.7)
25-34	596 (14.4)	120 (4.0)	716 (10.0)
35-44	382 (9.2)	119 (3.9)	501 (7.0)
45-54	201 (4.9)	59 (1.9)	260 (3.6)
55-64	156 (3.8)	57 (1.9)	213 (3.0)
≥65	142 (3.4)	75 (2.5)	217 (3.0)
Mean (±SD)	19.4 (±19.8)	8.8 (±17.1)	14.9 (±19.4)
Median (IQR, (p75, p25))	14 (30, (32,2))	1.3 (3.3, (4,0.7))	3.7 (25, (26,1))
Sex			
Female	2184(52.8)	1378 (45.4)	3562 (49.7)
Male	1958(47.3)	1690 (55.7)	3648 (50.9)
Sentinel site			
Bombo regional hospital	2 (0.0)	0 (0.0)	2 (0.0)
Bububu Military	805 (19.5)	6 (0.2)	811 (11.3)
CF Hospital	29 (0.7)	0 (0.0)	29 (0.4)
Dodoma regional referral hospital	47 (1.1)	399 (13.2)	446 (6.2)
Hydom Lutheran hospital	162 (3.9)	298 (9.8)	460 (6.4)
International School of Tanganyika	129 (3.1)	3 (0.1)	132 (1.8)
Kibondo district hospital	301 (7.3)	540 (17.8)	841 (11.7)
Mbalizi Military hospital	947 (22.9)	3 (0.1)	950 (13.2)
Meru district hospital	140 (3.9)	104 (3.4)	244 (3.4)
Misungwi hospital	7 (0.2)	2 (0.1)	9 (0.1)
Mt. Meru regional referral hospital	134 (3.2)	296 (9.8)	430 (6.0)
Mwananyamala regional referral hospital	439 (10.6)	936 (30.9)	1375 (19.2)
Mwanza Military	10 (0.2)	12 (0.4)	22 (0.3)
Mzinga hospital	559 (14.5)	11 (0.4)	570 (7.9)
NPHL	18 (0.4)	16 (0.5)	34 (0.5)
Sekou-Touré regional referral hospital	339 (9.6)	302 (10.0)	641 (8.9)
St. Benedict Ndanda hospital	113 (2.7)	151 (5.0)	264 (3.7)
Influenza virus results			
Influenza A	576 (13.9)	305 (10.1)	881 (12.3)
A(H1N1) pdm09	16 (0.4)	9 (0.3)	25 (0.3)
A(H3N2)	177 (4.3)	92 (3.0)	269 (3.8)
A(Unclassified)	383 (9.3)	204 (6.7)	587 (8.2)
Influenza B	268 (6.5)	105 (3.5)	373 (5.2)

Table 1.Demographic characteristics of and virologic results for patients with Influenza-Like Illness (ILI) and Severe Acute Respiratory Illness (SARI), Tanzania, 2016-2019.

B. Distribution of confirmed influenza cases in Tanzania from 2016 to 2019

From the year 2016 -2019, 17% (1254/7260) of all samples collected from suspected influenza cases were confirmed to have influenza virus, whereby 12% (881/7260)

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had influenza A and 5% (373/7260) had influenza B. Sixty seven percent, 67% (844/1254) of positive samples were from patients who had ILI symptoms.The number of cases decreases as the age increases. However, the age group of 0-4 years was the most affected group than other age categories.

C. Distribution of Influenza cases according to sentinel sites in Tanzania from 2016 to 2019

The sentinel sites which contributed to higher number of influenza cases include: Mbalizi military hospital, Sekou Touré regional referral hospital, Mwananyamalaregional referral hospital as well as Bububu military hospital. In addition to this, regardless of the case definition type,the distribution of influenza A cases istwicehighercompared to influenza B. It also shows that those who presented with ILI symptoms were more likely to be detected positive for influenza B as compared to those with SARI (see Fig 2).

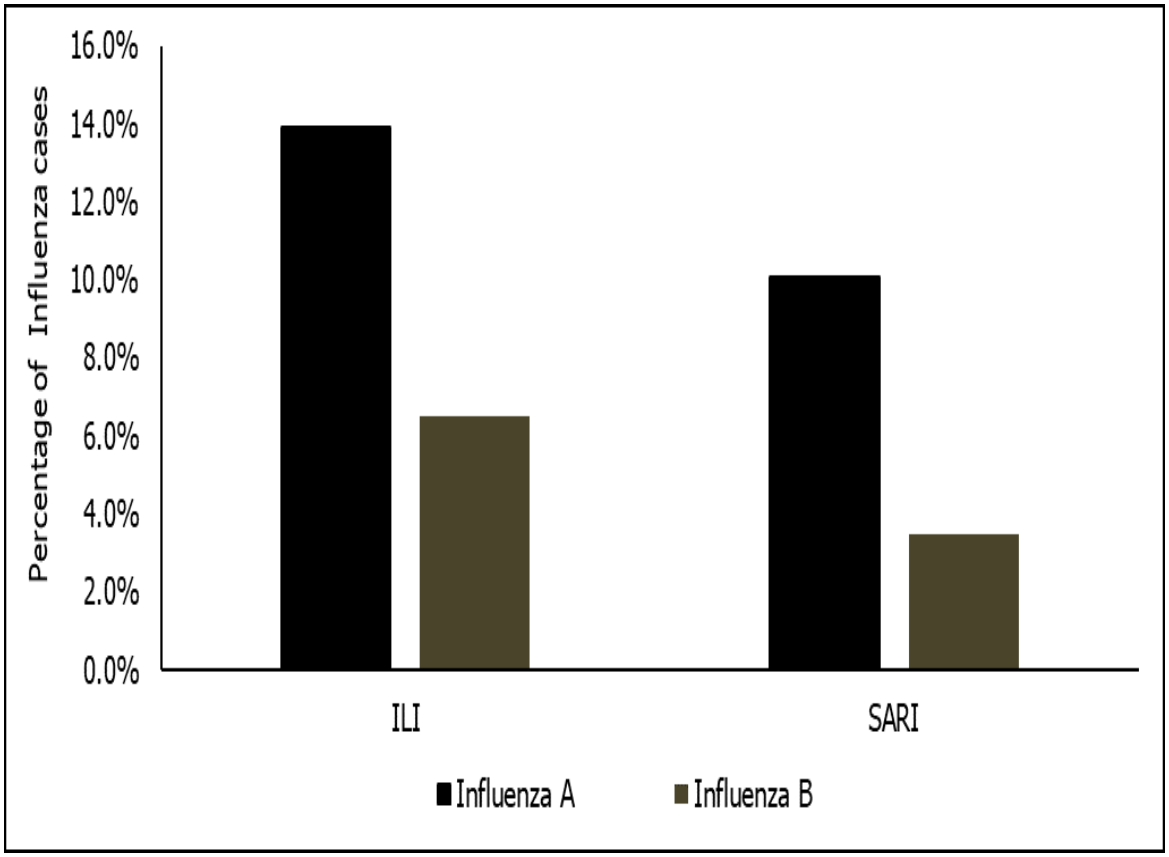

Fig 2: Distribution of influenza cases in Tanzania according to case definition used among confirmed cases of influenza from 2016 to 2019 (N=1254)

D. Epidemiological trend for influenza cases and distribution of influenza types in Tanzania, 2016-2019

Epidemiological trend shows that: the number of influenza A cases have been relatively higher as compared with influenza B from 2016 to 2019 (see Fig 3).By reviewingantigenic characterization of the influenza virus, we observed higher distribution of influenza A (70.3%), whereby most of them were influenza A(H3N2) subtype,which contributed to 30.6% of the total influenza A virus isolated between 2016 to 2019.

Sixty six percent (66.6%) of the total influenza A virus were not identified for its antigenic characteristics. The distribution of influenza A subtypes among sentinel sites showed that Influenza A(H3N2) subtype was observed to circulate among all sentinel sites except Mount Meru regional referral hospital and NPHL (see Fig 4).

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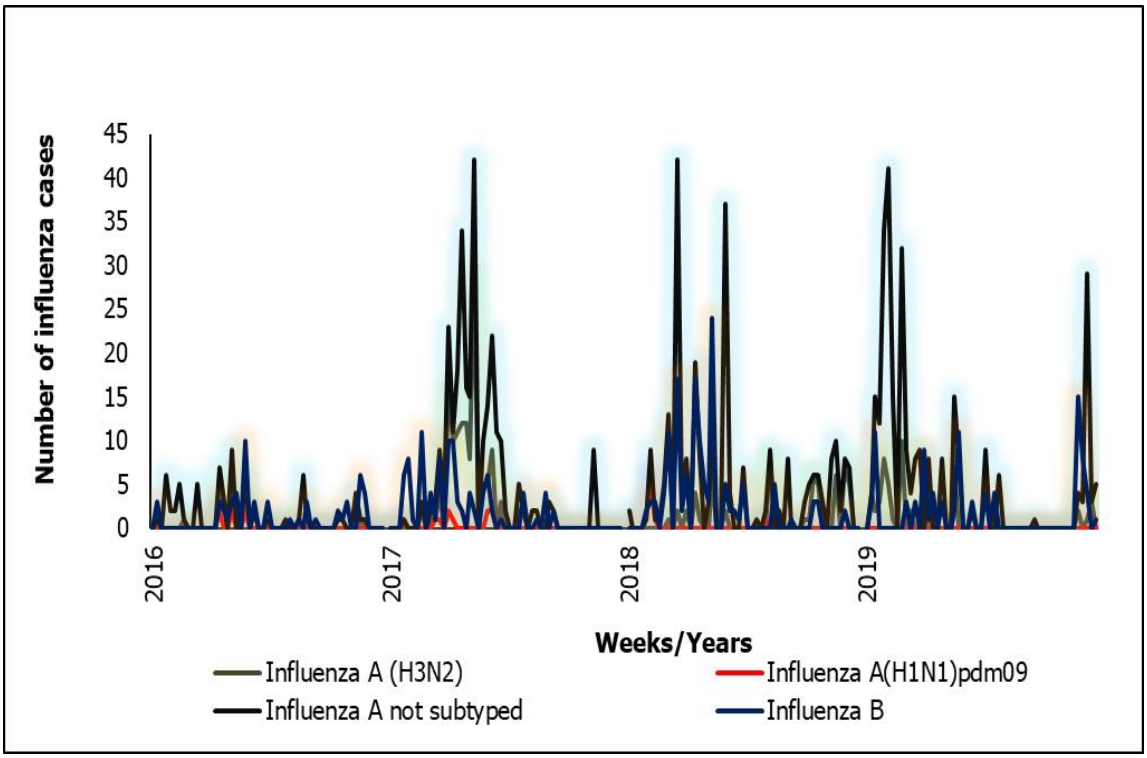

Fig 3: Weekly distribution of influenza cases in Tanzania from 2016 to 2019 (N=1254).

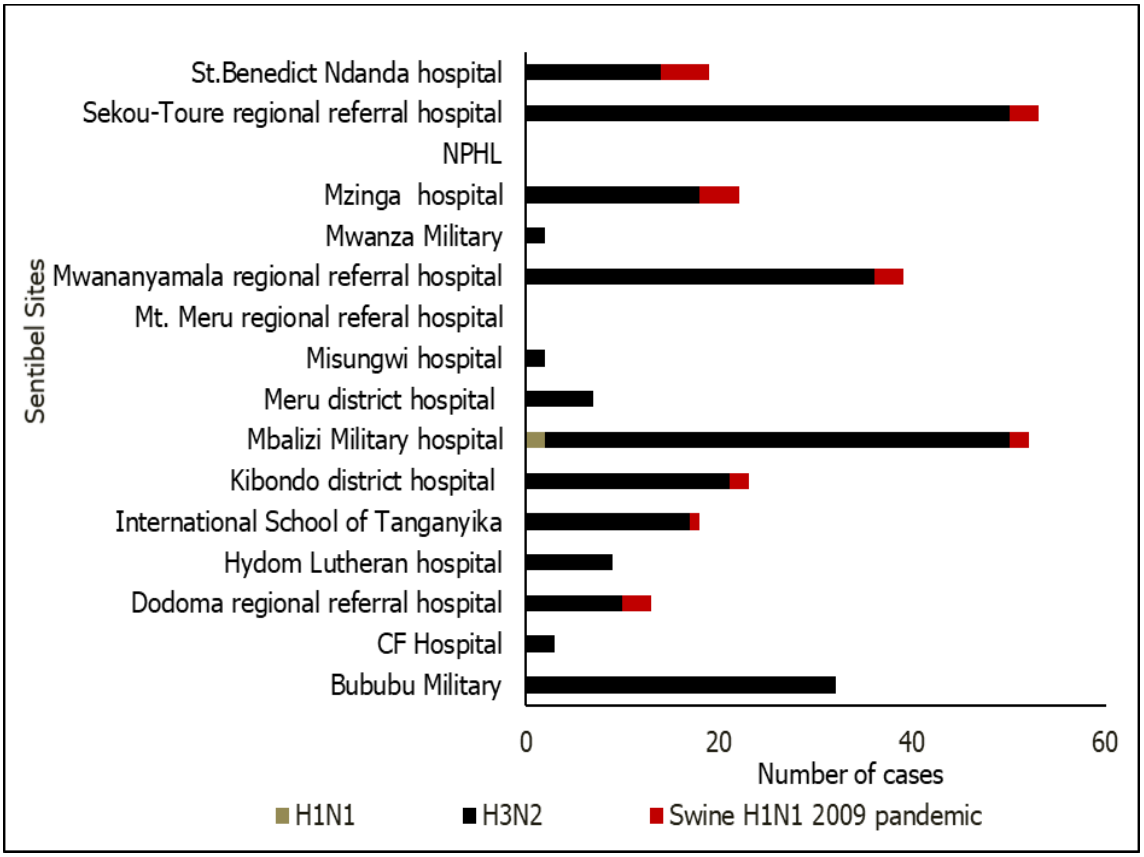

Fig 4: Distribution of influenza subtypes in Tanzania according to sentinel sites among confirmed cases of influenza from 2016 to 2019 (N=1254).

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E. Factors associated with influenza in Tanzania from 2016 to 2019

The variables of sentinel sites, age group, sex and case definitiontype (SARI/ ILI) wereanalyzed to see their association with influenza. Logistic regression results showed that 50% (8/16) of the total sentinel sites had a significant association with influenza disease.We also observed thatthe probability of having influenza disease is estimated to be 8 times less forpatients attended at international school of Tanganyika (IST) Clinic as compared to Mwananyamala regional referral hospital (cOR 7.64, 95% CI [5.20-11.23], p<0.001).Furthermore**,**we also observed that the probability of having influenza disease is 25% lessamong patients who presented with SARI as compared to those who had ILI symptoms (aOR 0.75, 95% CI [0.64-0.89], p=0.001) (see Table 2).The probability of having influenza disease among patients with age group 5-14 years is almost twice less compared to patients under 5years of age (cOR 1.83, 95% CI [1.51-2.21], p<0.001).The variables (Sentinel sites, case definition type (ILI/SARI)and age group) were significantly associated with influenza disease.

Variables	Influenza result		Crude OR (95% CI)	*Adjusted OR (95% CI)	P value
	Negative n (%)	Positive n (%)			
Sentinel site					
Mwananyamala regional referral hospital	1181 (87.9)	162 (12.1)	1(Ref)	1(Ref)	
Bububu Military	667 (83.3)	134 (16.7)	1.46 (1.14-1.88)	1.08 (0.81-1.43)	0.593
Hydom Lutheran hospital	375 (82.1)	82 (17.9)	1.59 (1.19-2.13)	1.51 (1.12-2.02)	0.006
International School of Tanganyika	62 (48.8)	65 (51.2)	7.64 (5.20-11.23)	6.21 (4.14-9.32)	<0.001
Mbalizi Military hospital	739 (78.5)	203 (21.6)	2.00 (1.60-2.51)	1.47 (1.14-1.90)	0.003
Mzinga hospital	460 (81.3)	106 (18.7)	1.68 (1.29-2.20)	1.27 (0.95-1.70)	0.100
NPHL	24 (72.7)	9 (27.3)	2.73 (1.25-5.98)	2.74 (1.24-6.06)	0.013
Sekou-Touré regional referral hospital	475 (74.6)	162 (25.4)	2.49 (1.95-3.17)	2.28 (1.78-2.93)	<0.001
St. Benedict Ndanda hospital	184 (70.0)	79 (30.0)	3.13 (2.29-4.27)	2.97 (2.16-4.07)	<0.001
Case definition					
Influenza Like illness (ILI)	3293 (79.6)	844 (20.4)	1(Ref)	1(Ref)	
Severe Acute Respiratory Illness (SARI)	2624 (86.5)	410 (13.5)	0.61 (0.54-0.69)	0.75 (0.64-0.89)	0.001
Gender					
Male	3018 (83.7)	587 (16.3)	1(Ref)	1(Ref)	
Female	2859 (81.3)	658 (18.7)	1.18 (1.05-1.34)	1.07 (0.94-1.21)	0.324
Age group (years)					
0-4	3294 (85.2)	572 (14.8)	1(Ref)	1(Ref)	
5-14	552 (75.9)	175 (24.1)	1.83 (1.51-2.21)	1.58 (1.29-1.94)	<0.001
15-24	535 (77.6)	154 (22.4)	1.66 (1.36-2.02)	1.42 (1.14-1.77)	0.002
25-34	560 (79.4)	145 (20.6)	1.49 (1.22-1.83)	1.28 (1.02-1.61)	0.031
45-54	210 (81.4)	48 (18.6)	1.32 (0.95-1.82)	0.96 (0.67-1.36)	0.805
55-64	174 (81.7)	39 (18.3)	1.29 (0.90-1.85)	1.01 (0.69-1.47)	0.974

Table2.Multivariate logistic regression analysis showing association of demographic factors for patients under national influenza surveillance with qualitative influenza results, Tanzania, 2016-2019 (n=7171).

IV. DISCUSSION

The total sample of suspected influenza cases from 2016 to 2019 was 7260 swabs (both nasopharyngeal and oropharyngeal swabs); this is highest number collected since initiation of the national influenza surveillance system in Tanzania. The samples were collected fromclients of age varying from 17 days to 98 years witha median age of 4 years [IQR=25; (26,1)]. Among the suspects,17% were confirmed to have influenza infection,whereby 12% had influenza A and 5% influenza B. This is almost twice compare to the findings of the previous study done by Mmbaga et al,which found that: eight percent (8.0%) of total Clients were influenza positive, whereby6.9% had influenza A, and 1.1% had influenza B in the same surveillance system[10]. These differences can be simply explained by the increasednumber of sentinel sites from 5 sites in 2010 to 16 sites by 2019[10].Although this study showed a huge difference in proportions of influenza A and influenza B, we observed different results from the study done in Bangladesh that showed no significant difference in the proportion of influenza A and B[11]. Although sample collection was low in 2016, peaks of increased sample collection was observed from 2017 to 2019. This increase might have been contributed by the increased number of sentinel sites with time from 5 (in the year 2010) to 16 at

the end of the year 2019 as described in the previous evaluation reports [10].

The seasonality of influenza was also observed whereby the number of influenza cases was higher in the rainy and cold seasons (October to April) where the peak was seen at the end of April and decreases with time from May to September in the hot season. These findings are similar to the previous evaluation reports for the National Influenza Surveillance System which indicated the same distribution of influenza cases during rainy and cold seasons[10].In addition to this, the findings from CDC report for emerging infectious diseases (2004-2013) showed thatthe outbreak of influenza A (H5N1) was occurring among humans and poultry whereby half of human cases occurred in January to March of the year[12]. Also, the Morbidity and Mortality Weekly Report (MMWR)of the United States of America (USA) in 2012-13 by CDC thatshowed an increased influenza activity through November and December before peaking in late December[7]. We also observed different results from the study done in southeast Nigeria which showed the percentage hospitalization due to SARI cases being highest in July[13].Having known this trend which was established based on the evidence from this national influenza sentinel surveillance provides room for proper prediction and preparation in terms of planning and resource utilization. Moreover, this is one of the key attributes of a good surveillance system to provide critical evident information that discoursethe proper mobilization of resources and fortify the entire process of attaining surveillance objectives.

The study also revealed that the majority of confirmed influenza ILI and SARI cases in Tanzania occurred in children,for instance,those agedunder five years. This is similar to the previous study which revealed that most of influenza affected group being children and young people of the age less than 18 years[10], which is also similar to other developing countries in tropical regions such as Nigeria [13].

The higher frequency of ILI and SARI cases among children under five years of age and the rarity of cases among elderly individuals, for instance above 65years old, do not reflect the age structure of Tanzania as described in Tanzania population projection report of 1989-2025[14].This difference could be explained by the variability in health care utilization by age in Tanzania, even thoughlittle is known about health care utilization by age in Tanzania[10]. In rural Bondo district in Kenya, older people sought health care significantly less compared to children for acute respiratory illness, and seeking healthcare was more likely for children from higher economic status or symptoms of severe illness[10, 15]. Most of the casesunder 5 years of age were identified using SARI case definition which is different from other age groups where ILI cases are slightly higher than SARI cases. Most samples were collected from Mwananyamala regional referral hospital (19%), Mbalizi Military hospital (13%) and Kibondo district hospital (12%). This is also similar to the previous reports which showeda higher number of sample collections from these sites[10]. For Mwananyamalacan be associated with high population density in Dar es salaam[8], but also for that hospital, increased number of refugees from the neighboring countries might be one of the main contributors for the higher prevalence which was also explained in previous studies[16].

From this secondary review,we found that those people who presented with ILI symptoms were more likely to be detected for influenza B as compared to those with SARI.

The probability of having influenza disease was 75% higher among patients who presented with SARI as compared to those who had ILI symptoms (AOR 0.75, 95% CI [0.64-0.89], P value=0.001). This is also observed in a previous study done in Tanzania for evaluation of influenza surveillance system, which showed that influenza patients identified by/or enrolled in influenza surveillance with SARI weremore likely to have positive virologic testing as compared to ILI cases[10].This study revealed that; sentinel sites and age were significantly associated withinfluenza positivity($P < 0.005$).

V. CONCLUSION

Having known the seasonality of the disease,more surveillance activity including resources must be appropriately allocated. Laboratory capacity needs to be improved in terms of antigenic characterization or subtyping of all isolated influenza A viruses.This will help to notice any antigenic drifts of the virus.Since co-circulation of influenza A and seasonal influenza viruses among humans and animals could lead to coinfections, reassortment, and emergence of novel viruses with pandemic potential, a continued surveillance evaluation and data review will provide an outline for detecting and following future influenza outbreaks and even pandemics and will also provide epidemiological awareness pertaining seasonality of influenza disease in our country.

A. What is already known on this topic:

- Influenza is the disease of public health importance and have causative agents with pandemic potential
- Prevalence of influenza A type is relatively higher than influenza B
- The higher prevalence of influenza cases is observed in rainy and cold seasons

B. What this study adds:

- The study has shown that children aged under 5 years are the most affected
- The study reveals that there is association between case definition type and influenza positivity. And thus, improving case definition will ensure proper utilization of surveillance resources.

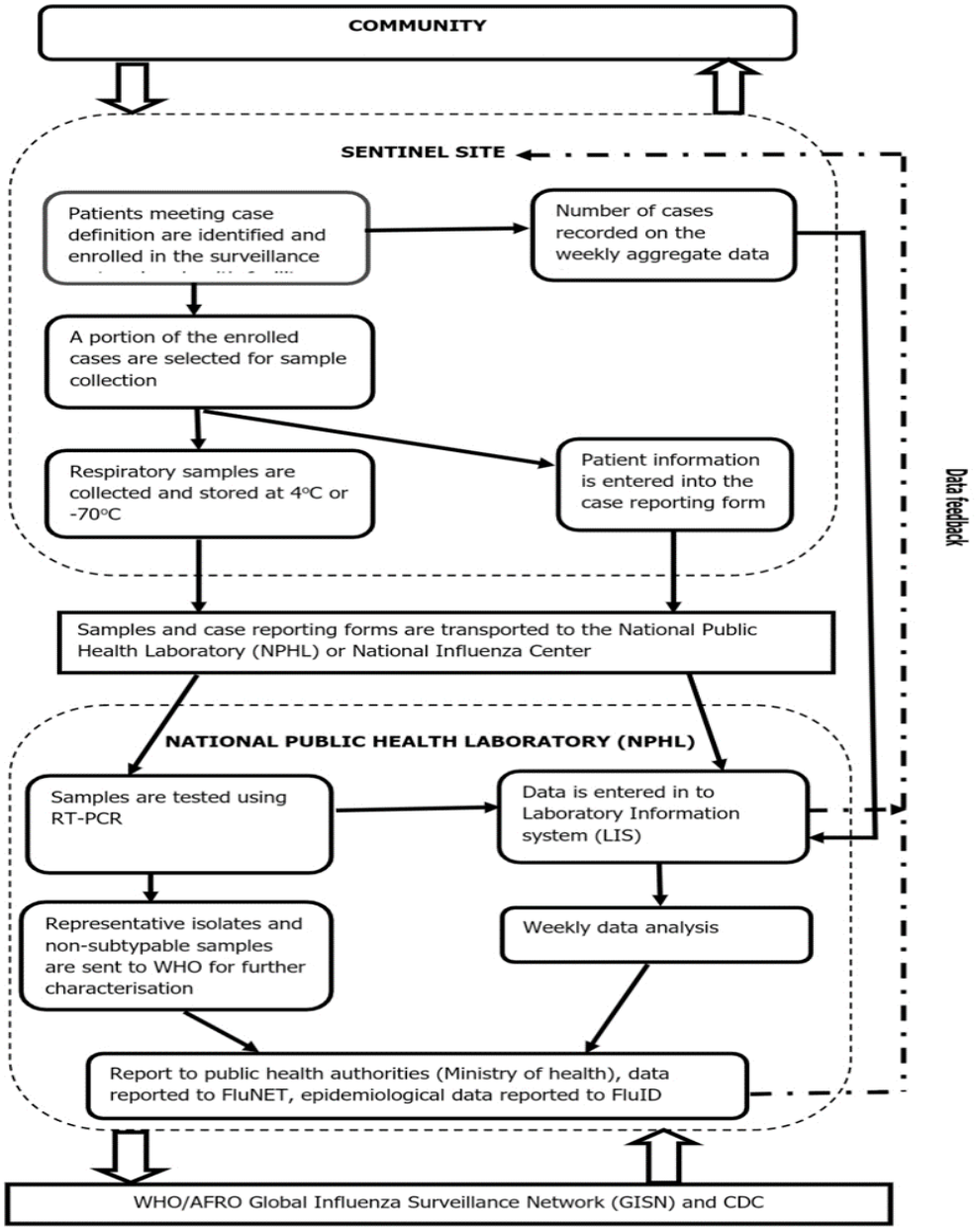
C. Limitation of the study

This secondary review is based only on laboratory investigation forms found electronically on the laboratory information system which may have fewer variables compared to case-based forms which have many variables. Also, most influenza A virus results (66.6%) were not characterized into subtypes which may compromise the

distribution of influenza A results**.** The study didn't involve the most recent data and therefore further studies are needed

D. Supporting documents:

for the continual review of the system, in order to obtain the most current information.



S1 Fig. Data flow of the National Influenza Sentinel Surveillance System in Tanzania

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- **Authors' contributions:** All authors have read and approved the manuscript and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design*: Vulstan Shedura, GeofreyMchau, Doreen Kamori; *Data cleaning, analysis and interpretation*: Vulstan Shedura, Doreen Kamori, Ally Hussein;*Drafting of manuscript*: Vulstan Shedura, GeofreyMchau, Doreen Kamori.

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