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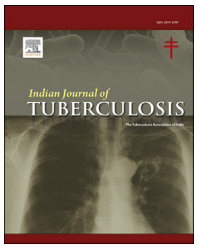

Original Article

Lessons from healthcare personnel screening and management during H1N1 pandemic in preparation for the impending COVID-19 pandemic in a tertiary care hospital in India

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ARTICLE INFO

Article history:
Received 16 May 2020
Received in revised form
13 July 2020
Accepted 23 July 2020
Available online 29 July 2020

Keywords:
Healthcare personnel
Swine flu
H1N1
Acute febrile respiratory illness
COVID-19

ABSTRACT

Background: In the wake of the COVID-19 pandemic caused by a novel corona virus, health care personnel are at increased risk of acquiring the infection. In preparation for the management of health care personnel that are likely to be infected, we looked in to the data collected during the Influenza pandemic in 2009, caused by a novel strain of H1N1 influenza called swine flu. The care of healthcare personnel in our institution, who had an acute febrile respiratory illness (AFRI) during that period was routed through a single channel using a uniform protocol. We retrospectively analysed the available data, during the initial four months of the pandemic, to draw lessons from it.

Objective: To study the prevalence, clinical profile and risk factors of swine flu among health care personnel during the pandemic of 2009 in a tertiary care hospital in South India.

Methodology: This retrospective study enrolled all the health care personnel including students of a tertiary care institution in South India, who presented with an AFRI between June to August, the initial four months of the swine flu pandemic of 2009. The clinical profile and risk factors were extracted. The results of the RT PCR for swine flu was obtained. Prevalence in each demographic group was calculated and compared. Characteristics of those with swine flu were compared with those who turned negative for the swine flu.

Results: The prevalence of all AFRI and only swine flu among health care personnel during the study period was 18 per thousand and 8.7 per thousand respectively. Highest prevalence of swine flu was found among students and office staff. After adjusting for confounding factors, hyperthermia at presentation was significantly higher {OR = 1.97; 95% CI (1.01–3.76)} among those who tested positive for swine flu as compared with those with other AFRI's. Only 2.5% of the entire AFRI group required admission and there was no mortality.

Conclusion: Health care personnel are at increased risk of acquiring infection. Our study demonstrated that students and office staff were the most susceptible. Unprotected

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https://doi.org/10.1016/j.ijtb.2020.07.024

exposure to unknown infectious patients and relatives is likely to have been an important factor. Though the mode of transmission is similar, compared to H1N1, COVID-19 is associated with different comorbidities and has significantly higher mortality. Therefore, in preparation for the COVID-19 pandemic, the personal protective equipment of the healthcare personnel need to be escalated.

1. Introduction

A novel corona virus which emerged from Wuhan, China in late 2019, spread quickly to more than 200 countries, affecting 12,552,765 individuals and causing 561,617 deaths so far[1] as on 12th July 2020. It has been declared a pandemic by the World Health Organization (WHO). Healthcare personnel (HCP) are in the forefront in the management of these patients and are likely to be infected in significant proportions. We looked at our experience during a similar situation during the swine flu pandemic of 2009, to get better prepared for this pandemic.

In 2009, a novel strain of H1N1 influenza called swine flu was spreading fast around the world. The WHO had called it a pandemic and announced it as a public health emergency of concern. Hence, flow of patients infected with swine flu virus tremendously increased in hospitals.[2] HCP are vital in delivering effective and quality care to the patients. They are also a high-risk group, since they get exposed to several infectious patients in their work place.[3] Our hospital is a tertiary care hospital with a high patient load throughout the year and during the pandemic in 2009, there are an influx of swine flu suspects for confirmation, since our institution was among the few centres which could perform RT PCR (reverse transcriptase polymerase chain reaction) for swine flu, at that time period.

Several studies which were done during that period demonstrated that, the HCP have higher seropositive rates, ranging from 5.25 to 25.1% due to higher exposure rates to infected patients as compared to the general population, where the seropositivity was ranging from 5 to 15%.[2] With increased patient load and higher exposure to infectious patients, many of our HCP also fell ill and the rate of absenteeism had gone up. Many of them had presented with an acute febrile respiratory illness (AFRI). Several pathogens are responsible for causing an AFRI among HCP.[3] Some of them turned out to be swine flu, whereas others had alternate causes.

2. Materials and methods

This is a retrospective study in a tertiary care setting in South India. The Staff and Students Health Service (SSHS) delivers health care to the healthcare personnel and students (hereafter referred together as HCPs) in our institution. During the H1N1 pandemic of 2009, all staff and students with flu symptoms had been advised to proceed for testing to the SSHS and they had been co-managed by SSHS and the department of pulmonary medicine. All HCP, who had presented between June and August 2009, with an AFRI, defined as fever of less than 4 days duration with upper or lower respiratory symptoms were enrolled in the study. These were the initial four months of the pandemic, similar to the current situation with COVID-19. Those who did not have a throat swab testing processed by RT PCR to diagnose swine flu, were excluded. Need for admission was decided by the physician from SSHS and the pulmonologist.

Their demographic data, symptomatology, type of work, level of exposure and co morbidities were extracted. Those who worked in areas where patients with flu like symptoms are likely to present were categorised as 'high exposure'. Those who had no patient contact at all were labelled as 'low exposure'. The rest, who could have had some contact were classified as 'normal exposure'. History of personal protective equipment (PPE) used during 7 days prior to symptom onset had been captured and this was noted. Examination findings and positive findings on chest x-ray were noted. Results of RT PCR for swine flu from the throat swab was also extracted.

We studied the prevalence of AFRI, particularly swine flu among various groups (based on their category of work) of HCP in our institution. We also looked at the need for admission and mortality among them. We compared the clinical profile, level of exposure and co-morbidities between the group which was confirmed to have swine flu and the group with acute febrile respiratory illness other than swine flu.

Data was analysed using SPSS version 16. Mean and standard deviation were calculated for continuous variables. Frequencies and percentages were calculated for categorical variables. Chi square test was performed to check association and statistical significance. Odds ratio was calculated to determine the strength of association. Multiple logistic regression analysis was performed for the variables which were statistically significant in the bivariate analysis to adjust for confounding factors resulting in adjusted odds ratios.

3. Results

The total number of HCP in our institution, during the study period was 8828. The number of health care workers who had presented to the SSHS with an AFRI between June and August 2009 were 207. Due to unavailability of the RT PCR kit for swine flu during a particular period, 48 of them had to be excluded from the study as they had not undergone the test. Throat swab and RT PCR for swine flu results were available for the

remaining 159 individuals. It was found to be positive in 48.4% (77) of the HCP and negative in 51.6% (82).

Table 1 shows the prevalence of AFRI and H1N1 among the health care personnel. They have been categorised based on their category of work in the hospital. In Table 2, the demographics of all health care personnel with an AFRI is tabulated. The mean age was 29 years and there were significantly more females. Nearly half of them were working in areas with significant exposure. Bronchial asthma was the most common co-morbidity; the majority (83%) had no co-morbidity. None of them were diabetic or hypertensive. Although all of them had history of fever, which was mandatory for inclusion, only 47% of them had a temperature >101 F at presentation; other common symptoms being sore throat (82%), head ache (63%) and cough (74%). Nearly 60% of them used neither surgical nor N95 mask in the preceding week of presentation with an AFRI. Only 6 of the 159 had parenchymal infiltrates on chest x-ray.

Table 3 shows the association between various study variables and the swine flu status. In the bivariate analysis, health care workers who were females or had hyperthermia (temp >101 F) at presentation had 2 times higher odds of being swine flu positive. In Table 4, in the multiple logistic regression, after adjusting for confounding factors, only hyperthermia (Temp>101F) at presentation remained statistically significant.

4. Discussion

We found that the prevalence of H1N1 during the initial four months of the 2009 pandemic among HCP in a tertiary care institute in India was 8.7 per thousand. A meta-analysis[4] which was done by Lietz J et al, found that the pooled prevalence of swine flu among health care workers was 6.3%, which is similar to our study. As calculated from Table 1, other flu illnesses during the same period in the same group was 9.3 per thousand. This shows that during a pandemic, the health care personnel are likely to be infected by the pandemic strain in varying proportions, in this case, around half of those who present with an AFRI had swine flu.

Our study also demonstrated highest prevalence among students (25.8 per 1000) and office staff (14.7 per 1000). Students, particularly the nursing students (largest in number) are likely to have had close contact with patients infected with flu. We had earlier reported[5] in a nursing student cohort of our institution, that they were at high risk of contracting latent tuberculosis infection. This, when compared to the national average was 5 folds. It is not surprising, given their close contact with patients for prolonged periods. Another factor that may explain the higher prevalence in this group was the fact that most students were hostel residents, and therefore there was scope for transmission between the students also.

The next highest prevalence was among the office staff. This category includes those who are at the front desk and cash counters, where they encounter patients and relatives regularly and offices where patients come to make several enquiries for services. Unlike those involved in direct patient care, the office staff generally don't use any personal protective equipment. Therefore, even though they all had 'low exposure' only, they had a high prevalence. Overall, among our subjects, unprotected exposure to unknown infectious patients and relatives is likely to have been an important factor in contracting the infection. A case control study[6] which was done by Marshall C et al in Australia found that the health care workers had a slightly higher risk for developing swine flu as compared to the front desk staff, but the difference was not statistically significant. Another study[7] also found that seroconversion rate for swine flu was 11.2% among health care workers and 10.3% among office staff. These two studies included doctors and nurses as major health care workers and front desk staff as nonclinical staff, who also come in contact with patients and showed that they have similar risk of acquiring swine flu.

Age of the health care workers ranged from 18 to 60 years with a mean age of 29 years. Analysis using various age cut offs, did not reveal age as a risk factor. Similar results were found in a cohort study[8] which was done in Ontario, Canada, comparing health care workers and non-health care workers to assess the risk factor for influenza. They found that age was not a risk factor for swine flu. Another study,[9] done in rural India found 15–29 years age group was the high-risk age group, however this was not among health care workers. In COVID-19 also, among healthcare workers, age does not seem to be a risk factor for contracting infection.[10] However, age seems to be a risk factor for poor outcomes {OR = 1.10 (95% CI = 1.03–1.17) p = 0.0043} in the study which has looked at outcomes among all admitted in the Wuhan COVID-19 cohort.[11] The risk of mortality increases by 10% with every unit increase in age. In the bivariate analysis of our study, being a female health worker had 2 times higher odds {OR = 2.09; 95% CI (1.05–4.18)} to be swine flu positive,

Table 1 – Prevalence of acute febrile respiratory illness (AFRI) and H1N1 based on category of work.

Category	Total no. in each category	No. with acute febrile respiratory illness (AFRI)	Prevalence of AFRI (per 1000)	No. tested positive for swine flu	Prevalence of swine flu (per 1000)
Doctors	1210	11	9.1	5	4.1
Nurses	2395	49	20.5	18	7.5
Technicians	1587	13	8.2	4	2.5
Ward assistants	1349	5	3.7	3	2.2
Students	1200	45	37.5	31	25.8
Office staff	1087	36	33.1	16	14.7
TOTAL	**8828**	**159**	**18**	**77**	**8.7**

Table 2 – Clinico-demographic characteristics of the study population (n = 159).

Variables	Frequencies (n = 159)	Percentages (%)
Age (mean)	29 years	–
Gender		
• Male	50	31
• Female	109	69
Level of exposure		
• No exposure	16	10
• Low exposure	69	43
• High exposure	74	47
Co Morbidities		
• Bronchial Asthma	18	11.3
• COPD	1	0.6
• Smoking	4	2.5
• Alcohol	1	0.6
• Pregnancy	2	1.3
• Chronic Renal Failure	1	0.6
• No co morbidities	132	83
Symptomatology		
• Fever	159	100
• Sore throat	131	82
• Running Nose	99	62
• Sneezing	69	43
• Cough	118	74
• Dysponea	36	23
• Conjunctivitis	7	4
• Diarrhoea	16	10
• Nausea	27	17
• Vomiting	21	13
• Head ache	99	63
• Myalgia	58	37
• Arthralgia	46	29
Features at presentation		
• Hyperthermia >101F	75	47.2
• Tachypnoea (RR>30)	28	17.6
• Oxygenation (SPO2<90%)	2	1.3
• Systolic BP (<90 mm of Hg)	4	2.5
• Infiltrates on chest Xray	6	3.6
• Crackles	3	3.7
• Wheeze	2	1.2
• Required Admission	4	2.5
Usage of PPE during work in the last 7 days		
• Surgical mask	11	6.9
• N 95 mask	53	33.3
• Gloves	15	19.4
• Gowns	40	25.2
Required admission	4	2.5
Required ICU care	0	0
Died	0	0
Absenteeism due to H1N1(mean)	4.3 days	–

however this association did not persist in the multivariate analysis. An epidemiological study[12] done in China in 2010 among outpatients who had influenza like illness found that female sex is not a risk factor. Similar results were found in the Ontario healthcare worker study.[8] Hence, gender doesn't seem to be a risk factor for swine flu. In the healthcare COVID-19 cohort from Wuhan,[10] proportionately more males were in the infected group as compared to the group that did not contract infection.

In our study, we found that only 10% of the HCP who presented with an AFRI were in the 'no exposure' category. This suggests the message that the vast majority of AFRI acquired by the health care workers is from their work places. A study[2] which was performed among health care workers who worked in higher and low risk settings found that emergency room nurses had higher odds as compared to operation theatre nurses, the latter not exposed to patients with flu symptoms, since these patients were unlikely to be operated upon. In our study, only 40% of the HCP used surgical or N95 mask in the week preceding their onset of illness. A study[13] done in California by Jaeger JL et al among health care workers found that wearing either a surgical mask or an N95 mask helps remaining seronegative, while being exposed to swine flu. Our study did not have a control group without disease, so we were unable to assess the benefits of using masks. The early reports[10] from Wuhan, China, on the risk factors for health care workers for contracting COVID-19, concluded that those who worked in high risk areas, those who used sub-optimal hand hygiene measures and those who worked for long hours were at increased risk of contracting COVID-19. Hence, the importance of personnel protective equipment as appropriate for COVID-19 and the diligence of hand hygiene methods need to be emphasized.[14]

Bronchial asthma was the commonest comorbidity in our study. A systematic review[15] looking at the associations between influenza and asthma, found that asthma was among the commonest comorbidities during the swine flu pandemic of 2009. There were none with diabetes, hypertension or ischaemic heart disease. The most important reason is likely related to the mean age of 29 years. However, in a multicentre study[11] of all COVID-19 patients who were admitted in two hospitals in Wuhan, hypertension was the commonest comorbidity followed by diabetes; chronic obstructive lung diseases were prevalent only in 3% of the cohort. At the outset, it appears that the comorbidities encountered in these situations are different. More information may be needed to confirm this.

The only symptom which helped differentiate H1N1 from other AFRI's in the bivariate analysis was fever at presentation {OR = 1.97; 95% CI (1.05–3.71)}. In the multivariate analysis, after adjusting for confounding factors, hyperthermia (>101 F) at presentation continued to be favouring swine flu{OR = 1.97; 95% CI (1.01–3.76)}. Fever is an important symptom of flu. However, higher grade of fever at presentation was more a feature of swine flu, as compared with other AFRI's. This probably supports the need for screening with non-contact thermometers which is a common practice currently being used for screening COVID19.

Only 2.5% of the HCP who presented with an AFRI required admission, as deemed necessary by the respiratory physician. However, none of them required ICU care or succumbed to their illness. This lays to rest the fear among health care workers of caring for patients with swine flu. However, the initial data from Wuhan and preliminary information other

Table 3 – Association of symptoms between variables and swine flu status.

Variables	Groups	Swine flu Positive (n = 77)	Swine flu Negative (n = 82)	P value	Odds ratio	95% CI
Age in years	<30 (n = 99)	52.5% (52)	47.5% (47)	0.19	1.54	0.81–2.95
	>30 (n = 60)	41.7% (25)	58.3% (35)			
Gender	Female (n = 109)	54.1% (59)	45.9% (50)	0.04	2.09	1.05–4.18
	Male (n = 50)	36% (18)	64% (32)			
Sore throat	Yes (n = 131)	48.9% (64)	51.1% (67)	0.83	1.102	0.48–2.49
	No (n = 28)	46.4% (13)	53.6% (15)			
Running nose	Yes (n = 99)	49.5% (49)	50.5% (50)	0.74	1.12	0.58–2.12
	No (n = 60)	46.7% (28)	53.3% (32)			
Sneezing	Yes (n = 69)	43.5% (30)	56.5% (39)	0.33	0.704	0.37–1.32
	No (n = 90)	52.2% (47)	47.8% (43)			
Cough	Yes (n = 118)	50% (59)	50% (59)	0.58	1.27	0.62–2.61
	No (n = 41)	60% (21)	40% (14)			
Dyspnoea	Yes (n = 36)	61.1% (22)	38.9% (14)	0.09	1.94	0.91–4.14
	No (n = 123)	44.7% (55)	55.3% (68)			
Conjunctivitis	Yes (n = 7)	42.9% (3)	57.1% (4)	1.00	0.79	0.17–3.65
	No (n = 152)	48.7% (74)	51.3% (78)			
Diarrhoea	Yes (n = 16)	68.8% (11)	31.3% (5)	0.11	2.56	0.84–7.76
	No (n = 143)	46.2% (66)	53.8% (77)			
Nausea	Yes (n = 27)	48.1% (13)	51.9% (14)	1.00	0.98	0.43–2.25
	No (n = 132)	48.5% (64)	51.5% (68)			
Vomiting	Yes (n = 21)	47.6% (10)	52.4% (11)	1.00	0.97	0.39–2.45
	No (n = 137)	48.2% (66)	51.8% (71)			
Head ache	Yes (n = 100)	46% (46)	54% (54)	0.51	0.76	0.40–1.46
	No (n = 59)	52.5% (31)	47.5% (28)			
Myalgia	Yes (n = 59)	55.9% (33)	44.1% (26)	0.18	1.61	0.84–3.08
	No (n = 100)	44% (44)	56% (56)			
Arthralgia	Yes (n = 47)	48.9% (23)	44.1% (24)	1.00	1.02	0.52–2.03
	No (n = 112)	48.2% (54)	51.8% (58)			
Temp>101F	Yes (n = 75)	57.3% (43)	42.7% (32)	0.03	1.97	1.05–3.71
	No (n = 84)	40.5% (34)	59.5% (50)			
RR>30/mt	Yes (n = 28)	57.1% (16)	42.9% (12)	0.405	1.53	0.67–3.48
	No (n = 131)	46.6% (61)	53.4% (71)			

Table 4 – Multiple logistic regression analysis of study variables associated with H1N1 status.

Variables	Groups	H1N1 Positive (n = 77)	H1N1 Negative (n = 82)	Crude Odds ratio (95% CI)	Adjusted Odds ratio[a] (95% CI)	P value
Age in years	<30 (n = 99)	52.5% (52)	47.5% (47)	1.54 (0.81–2.95)	1.25 (0.63–2.48)	0.52
	>30 (n = 60)	41.7% (25)	58.3% (35)			
Gender	Female (n = 109)	54.1% (59)	45.9% (50)	2.09 (1.05–4.18)	1.71 (0.83–3.55)	0.14
	Male (n = 50)	36% (18)	64% (32)			
Diarrhoea	Yes (n = 16)	68.8% (11)	31.3% (5)	2.56 (0.84–7.76)	2.16 (0.67–6.89)	0.19
	No (n = 143)	46.2% (66)	53.8% (77)			
Dyspnoea	Yes (n = 36)	61.1% (22)	38.9% (14)	1.94 (0.91–4.14)	1.70 (0.76–3.78)	0.19
	No (n = 123)	44.7% (55)	55.3% (68)			
Temp>101F	Yes (n = 75)	57.3% (43)	42.7% (32)	1.97 (1.05–3.71)	1.95 (1.01–3.76)	0.04
	No (n = 84)	40.5% (34)	59.5% (50)			

[a] Adjusted for age, gender, diarrhoea, dyspnoea and temp>101F at the time of presentation.

parts of the world suggests that healthcare worker disease and mortality was significant.

The strength of our study is that all HCPs with flu-like symptoms were included. A unique feature of our study is that, we included all the students in a tertiary care teaching medical institution. Our study does have limitations. The true prevalence of H1N1 among HCPs is likely to be higher as forty-eight did not get tested. Also, there was no control group with absence of flu-like illness. This could have given us a better insight into the risk factors. Use of hand hygiene methods by HCPs and such other details were not recorded.

5. Conclusion

Health care personnel are at increased risk of acquiring infection. Our study demonstrated that students and office staff were the most susceptible. Unprotected exposure to

unknown infectious patients and relatives is likely to have been an important factor. Though the mode of transmission is similar, compared to H1N1, COVID-19 is associated with different comorbidities and has significantly higher mortality. Therefore, in preparation for the COVID-19 pandemic, the personal protective equipment of the healthcare personnel need to be escalated.

Authors contribution

Barney T J Isaac: Research And Study Design, Data Collection, Data analysis, Interpretation & conclusion, Preparation Of Manuscript; **Henry Kirupakaran**: Research And Study Design, Interpretation & conclusion, Review of Manuscript, Guide & critical revision, Administration; **Anitha M Barney**: Research And Study Design, Data analysis, Interpretation & conclusion, Preparation Of Manuscript, Review of Manuscript; **Devasahayam J Christopher**: Research And Study Design, Interpretation & conclusion, Review of Manuscript, Guide & critical revision, Administration.

Conflicts of interest

The authors have none to declare

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