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The national influenza epidemic preparedness plan and assessment of health system resources in relation to epidemic response capacity, Ismailia city, Egypt

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Abstract
Influenza can be epidemics and causes a mass casualty. To responses that, health care setting must have a good preparedness for epidemics.
Aim: To estimate the current state of influenza preparedness level in hospitals and primary health care centers, and health workers' perception of institutional preparedness in Ismailia city.
Subjects and Methods: A cross-sectional study design was conducted at three hospitals and four primary health care centers in Ismailia city. 139 healthcare workers (HCWs) were studied in primary health care centers and 176 HCWS in hospitals. Data collection tools included 2 questionnaires and 2 checklists appropriate to the study objectives.
Results: The results of this study showed that hospital and primary healthcare workers (HCWs) in Ismailia assigned relatively low importance to personal protective equipment (PPE), and showed mixed attitudes (anxious but accepting) to the potential risk. The weakest domain in our hospital preparedness was health personnel and supplies while the weakest area of preparedness was for infection control among primary health centers. Concerning the Gini coefficient, our results demonstrated inequalities in the distribution of all resources at the hospital level with the higher level of inequality for physicians, Tamiflu and N95 mask (0.63, 0.56 & 0.46 respectively). On the other hand, the distribution of nurses and Tamiflu was moderate unequal distributed at primary levels (0.34 & 0.41 respectively).
Conclusions: A higher level of institutional preparedness stood out to be an important predictor of individual preparedness.

Keywords: influenza, preparedness, perception, knowledge, attitude, epidemic

Introduction
Influenza is a highly infectious, acute febrile respiratory illness caused by influenza A and B viruses. Influenza viruses infect people of all age groups. The emergence of a new influenza A subtype among humans can cause a worldwide outbreak, known as a pandemic, leading to larger than usual numbers of deaths as well as societal disruption [1]. Previous studies have indicated that influenza comprises a substantial portion of Acute Respiratory Infection (ARI) morbidity and mortality with one estimate that 18% of global ARI deaths were due to influenza infection in 2010 and another that influenza causes 250,000–500,000 deaths each year [2]. Avian respiratory disorder (H5N1) has been endemic in Egypt for nearly a decade. Up to eight Jan 2018, 860 human cases are reportable worldwide; forty seconds of those cases are reportable in Egypt [3]. Throughout a virulent disease, awareness staff is a vital part of the response. It's crucial to grasp their perceptions concerning the effectiveness of enforced measures, and also the degree to that these measures defend them and enhance the preparation of the healthcare system. Achieving trust will increase employees' motivation and temperament to participate actively within the response, whereas inadequate info could result in non-compliance with the recommendations of governing authorities, as was seen within the low rates of vaccination against respiratory disorder A/H1N1 among medical groups in most countries [4]. Preparation may be outlined because of the ability to scale back morbidity and mortality that results from large-scale transmission of infectious diseases like pandemic respiratory disorder, or from alternative natural or synthetic disasters [5]. During an epidemic/outbreak, primary and secondary healthcare facilities will experience a significant increase in the number of respiratory patients (in addition to the usual number of ill persons)

while healthcare workers will also become ill and so be absent from work. There will be an excess demand for healthcare services with potentially fewer healthcare workers to deliver these services. In addition to limited staff, other resources will be stretched, including beds, medicines and mechanical ventilators, and this may last for several months. Hospitals may face a situation where it is necessary to discharge non-critical patients (pandemic and non-pandemic) to free up resources for severely ill patients and to cancel planned non-urgent treatments [6]. Recently, inequity in medical resources and treatment services began to attract attention from researchers: some centered on bound medical conditions; others explored inequity in resources and services inside the first care sector. Decorated argued that a giant gap in resources and services between hospitals and first care establishments exists and it continues to extend despite the government's favorable investment policies for the first care sector. However, there's scarcity within the literature documenting inequity in resources and services between hospitals and first care establishments [7]. Due to the endemic city of avian influenza in Egypt and occurrence of the next influenza epidemic is unpredictable and due to lack studies on assessment of preparedness plan on health care level so we conduct this cross-sectional observational study.

Subjects and Methods

Design

The cross-sectional design was used to estimate the current state of influenza preparedness in hospitals and primary health care centers, and health workers' perception of institutional preparedness regarding influenza epidemic.

Subjects

The study was carried out among health care workers in Ismailia city (physicians, nurses, health supervisors, and Lab. technicians) in both primary health care centers and hospitals in Ismailia city. According to the equation of two proportions, the sample size was 160 for each group with 10% [16] no response to the total sample size for each group was 176 health care workers. Only "139" healthcare workers from primary health centers agreed to participate in our study with a response rate of 79%. And also, directors of health facilities or those responsible for the influenza epidemic plan in the facility.

Setting

This study was conducted at three hospitals and four primary care centers in Ismailia city. One primary care centers refused to participate in the study. For the confidentiality of results, the included hospitals were coded into hospital A, B, C and centers were coded into center A, B, C, and D.

Data collection tools

Data collection tools included: 2 *questionnaires* and 2 *checklists* appropriate to the study objectives. These tools were included: one questionnaire for assessment of health care workers preparedness level, another questionnaire for assessment of preparedness level in hospitals, a checklist for the assessment of primary health care centers preparedness level and another checklist for listing the resources in each health care setting.

Statistical analysis

Data were first cleaned, filtered then coded and entered into Microsoft Excel 201. Statistical analyzes were performed by IBM SPSS Statistics Version 22.0 (The Statistical Package for Social Science). Descriptive statistics of the data were presented. Quantitative data were expressed as a mean and standard deviation while categorical data were expressed as frequency and percentage. Graphs and tables were used as appropriate and according to the type of variables.

Results

Socio-demographic characteristics of health care workers (HCWs) where HCWs in primary health centers (PHC) were significantly older than HCWs in-hospital group (59% vs. 46% with $p < 0.05$). The mean age of them was 35.8. Males were significantly more in primary centers group than hospitals group (89.2% vs. 65.3% with $p< 0.05$). Physicians formed a greater proportion (36.9%) among the hospital HCWs respondents compared to primary care (PC) HCWs (25.9%). On the other hand, nurses were greater in PHC workers than hospitals. The mean of years of experience of study participant was 12.2 ± 8.5 with median 10 years and was statistically different between study groups ($p<0.05$) where 56.3% of the hospital health care workers had < 10 years of experience while 54.7% of primary health care workers had ≥ 10 years of experience. Significantly higher correct knowledge score in females than males ($p< 0.05$) and young age had no significantly higher score than old age. There was no significant difference in knowledge scores of study health care workers according to their job characteristics. The highest scores were encountered to technicians and health supervisors. There are significant differences in correct knowledge score between hospital and primary care centers with the highest scores were encountered to hospitals Table (1). The correct perception score shows that significantly higher perception score in females than males ($p< 0.05$) and there was not statistically different among age groups with a nearly equal score. Significant differences in perception scores of study health care workers according to their facility and job categories with the highest scores were encountered to hospitals, health supervisors and technicians category respectively (table 2). Overall preparedness level across the hospital, the highest mean score for clinical management measures was 7.6 of 31 total scores concerning preparedness plan, while the least mean score for health personnel was 1.6 of 31 total preparedness score(Figure 1). Table (3) shows the distribution of total scores of different items of institutional preparedness among different hospitals. Hospital C obtained the highest score regarding overall preparedness level (76%), while Hospital B obtained the lowest score of the preparedness plan (54%). The weakest domains of preparedness in hospitals were health personnel and supplies (56%). Table (4) shows that center A had highest preparedness level (70%) among all centers with high score on facility plan, surveillance and health network while the center D had lowest overall preparedness level (28%) with zero scores for facility plan. The weakest domain of preparedness in primary centers was infection control measures (41%). The results demonstrate inequalities in the distribution of all resources at the hospital level. At primary health centers demonstrate Tamiflu inequality distribution. The result also demonstrated the unequal distribution of N95 mask between hospitals table (5) & figure (2).

Table 1: The score of correct answer regarding knowledge according to gender, age, job categories and type of facility

Characteristics	**Mean ± SD**	
Total knowledge score (maximum score=12)	8.2 ± 2.7	
Characteristics	**Mean ± SD**	***p*-value**
Gender		
Male	7.9 ± 2.9	.000*
Female	9.4 ± 1.4	
Age		
<35	8.8 ± 1.7	.182
≥35	7.8 ± 3.4	
Job category		
Physicians	8.6 ± 1.6	.526»
Nurse	7. 9 ± 3.4	
Technicians and health supervisors	9.02 ± 1.09	
Type of facility		
Hospitals	9.8 ± 1.5	.000*
Primary health centers	6.2 ± 2.6	

*Mann-Whitney test is statistically significant at level of confidence of 95% (p< 0.05)
»Kruskal Wallis test is statistically significant at level of confidence of 95%.

Table 2: The Score of positive answer regarding perception of institutional preparedness according to gender, age, job categories and type of facility

Characteristics	**Mean ± SD**	
Total perception score (maximum score=7)	4.9 ± 2.27	
Characteristics	Mean ± SD	*p*-value
Gender		
Male	4.7 ± 2.3	.000*
Female	5.9 ± 1.9	
Age		
<35	5.1 ± 2.1	.249
≥35	4.8 ± 2.3	
Job category		
Physicians	5.5± 2.0	.000*
Nurse	4.5 ± 2.3	
Technicians and health supervisors	5.6 ± 1.9	
Type of facility		
Hospitals	5.7 ± 1.7	.000*
Primary health centers	3.9 ± 2.4	

P-values are based on Mann-Whitney test (age, gender and type of facility) and Kruskal Wallis test for job category. *****Statistically significant at level of confidence of 95% (p< 0.05)

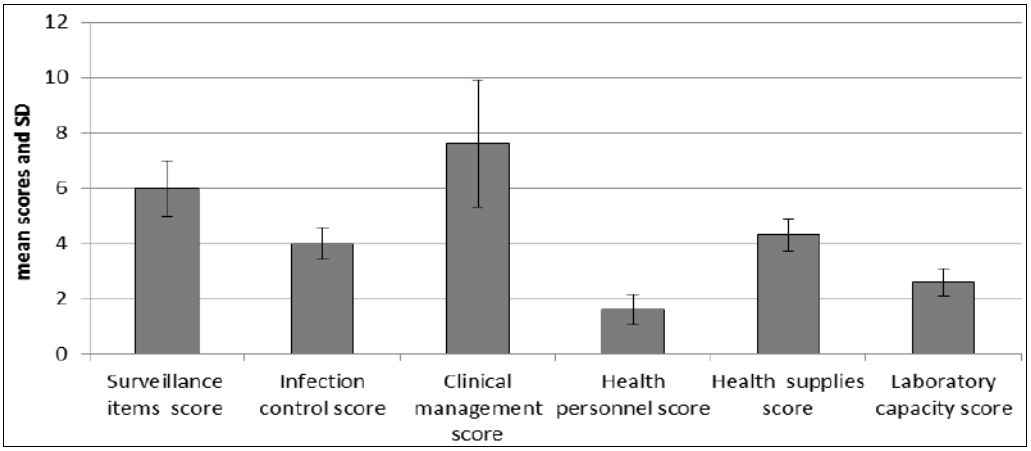


Fig 1: The mean and standard deviation scores of different items of hospital preparedness

Table 3: The percentage score of different items of preparedness among different hospitals

Items of preparedness	**hospital A**	**hospital B**	**hospital C**	**Total of each item**
Surveillance and plan items score	67%	56%	78%	67%
Infection control score	50%	63%	63%	58%
Clinical management score	90%	50%	90%	77%
Health personnel score	67%	33%	67%	56 %
Health supplies score	56%	56%	56%	56%
Laboratory capacity score	100%	67%	100%	89%

Overall preparedness level	72%	54%	76%	67%

Each score was defined as the proportion of "Yes" answers in each hospital. The overall level was quantified by calculating all items scores in each hospital

Table 4: The percentage score of different items of preparedness among different hospitals

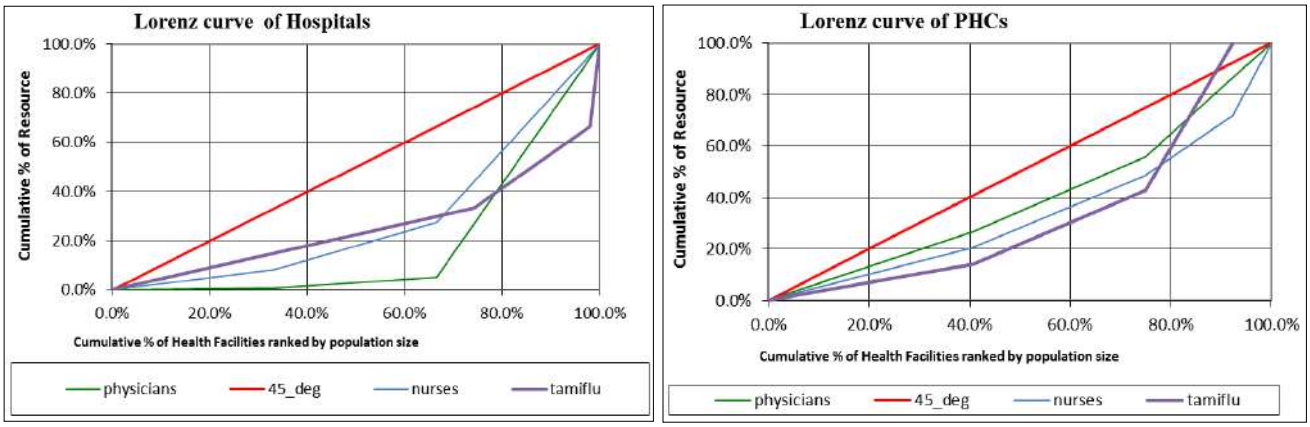
Items of preparedness	Center A	Center B	Center C	Center D	Total of each item
Facility plan	100%	100%	50%	0	63%
Surveillance	75%	38%	50%	63%	57%
Risk communication	33%	67%	67%	33%	50%
Infection control	64%	50%	29%	21%	41%
Health alert networks	75%	50%	50%	25%	50%
Overall preparedness level	70%	61%	49%	28%	52%

Each score was defined as the proportion of "Yes" answers in each hospital. The total level was quantified by calculating all items scores in each hospital

Table 5: Inequality in the distribution of the health resources in hospitals and primary health care centers

Setting	Gini coefficients				
	Physicians	Nurses	Tamiflu	Inpatients beds	N95 mask
Hospitals	.63	.43	.56	0.19	0.46
Primary health care centers	0.23	0.34	0.41	-	-

Gini coefficients for each of the key resource items by hospitals and primary health care centers. Resources exhibiting high levels of inequality in distribution (Gini coefficient > 0.3) are in bold.



One of primary health care centers didn't have Tamiflu

Fig 2: Lorenz curve for Inequality in the distribution of physicians, nurses, and Tamiflu in hospitals and primary health care centers

Discussion

Accordingly, the knowledge (K)-score distribution and mean in our study indicated a significantly higher score for females, and hospital facilities while higher non-significant in young age, technicians & health supervisors then physicians. This study results are consistent with the study in Japan Imai *et al*., (2010) [8] in a higher score in females and hospital but differed in the Japan study had higher K-score in old age and nurses. The young age and technicians in our study had infection control diploma and participated in infection control committee of their workplace. Also, technicians participated in laboratory safety measures workshops. Accordingly, the perception score distribution and mean in our study indicated a significantly higher score for females, technicians & health supervisors then physicians and hospital facilities while higher non-significant in young age. This study results are consistent with the study in Japan Imai *et al*., (2010) [8] in a higher score in females and hospital but differed in the Japan study had higher perception score in old age and nurses. The mean score of perceived preparedness among hospitals in our study was 5.7 with standard deviation 1.7 this finding was consistent with study of Adini *et al*., (2014) [4] conducted on Twenty-three hospitals in Israel The mean perceived preparedness score was 4.5 (standard deviation 0.598). In our study perception and knowledge score was high in technicians due to they had courses in laboratory safety measures, use of PPE and how to transfer the specimen of influenza case to central laboratory. The level of our preparedness in health personnel was 56% that had an average level near to Mahdaviazad, (2013) [9] 52% and Daneshmand *et al*.'s study (2010) [10] 4.3 % while less than study of Simatupang, (2017) [11] was 71% where their hospitals have inventoried the number of health workers owned and established mechanisms for mobilizing health personnel assistance in the event of a pandemic disaster characterized by mass casualties. The highest percentage of health personnel items in our result (100%) was assigned to train our employees on the guide of dealing with influenza cases that more than the study of Reidy *et al*., (2015) [12] was (26%) and the study of Damery *et al*., (2012) [13] was 24.6%. Among hospitals we found that the highest mean score for clinical management measures was 7.6 of 31 total scores concerning preparedness plan, while the least mean score for health personnel was 1.6 of 31 total preparedness score was different to Hui *et al*., (2011) [14] where the highest mean score for plan and surveillance 7.9 and the least mean score for laboratory capacity 1.10 of 46 total preparedness

score. This difference related to the difference in the maximum score among the preparedness items between two studies. On an average, the overall preparedness level in our hospitals was moderate level (67%), which more than the study of Mahdaviazad, (2013) [9] 59.5 % and less than the study of Mai *et al*., (2014) [15] was 74%. This difference is related to the type of hospitals and their mission where Mai *et al*., conducted their study on tertiary hospital while Mahdaviazad conducted their result on teaching and private hospitals. The weakest domain in our hospital preparedness was health personnel and supplies that similar to the study of the study of Simatupang, (2017) [11]. Regarding the mean and standard deviation scores of different items of primary health centers preparedness revealed that the highest mean scores were infection control and surveillance (5.7 & 4.5 respectively) while the least mean score item was facility plan 1.25 this result was similar to the study of Prateepko, & Chongsuvivatwong, (2012) [16] that conducted on Thailand primary health care revealed that the highest mean score for infection control and surveillance were (12.5& 8.4 respectively). Our results differed from those found in an exceedingly study of Yung *et al*., (2011) [17] in Taiwan, that showed high average share of analysis (78%), whereas our level of preparation was fifty-two this distinction associated with that study evaluated parts addressed within the native plans via direct observation from associate degree exercise, whereas our study assessed preparation among the first health centers by requesting data from heads of health centers. additionally, the targeted areas or indicators of assessments were somewhat totally different. Our study additionally differed from a study of Doxtator, (2011) [18] among rural health units in an exceeding region of Ontario that conducted evaluations via a work surface exercise. The weakest area of preparedness was for infection control among primary health centers. This result was similar to the study of Prateepko, & Chongsuvivatwong, (2012) [16]. Concerning the Gini coefficient, our results demonstrated inequalities in the distribution of all resources at the hospital level with higher level of inequality for physicians, Tamiflu and N95 mask (0.63, 0.56 & 0.46 respectively) similar to Khilji *et al*., (2013) [19] demonstrated inequalities in distribution of all resources at the hospital level with Oseltamivir and doctors showed very high levels of inequality in distribution (0.57 & 0.88 respectively), in large part due to their scarcity throughout most of the country. While the study of Zhang *et al*., (2017) [7] conducted on hospitals and primary care in China revealed that equal distribution of health workers (0.23). This shows the disproportionate and unfair distribution of these resources.

Conclusion

The majority of healthcare workers in this study lacked any specific training or education about the importance of personal protective equipment for the influenza epidemic. The weakest domain in our hospital preparedness was health personnel and supplies while the weakest area of preparedness was for infection control among primary health centers.

Compliance with ethical standards

a) *Funding:* This study was funded by the corresponding author.
b) *Conflict of Interest: corresponding author* declares that she has no conflict of interest. Author 1 declares that he has no conflict of interest. Author 2 declares that she has no conflict of interest. Author 3 declares that she has no conflict of interest. Also, author 4 declares that he has no conflict of interest.
c) *Approval*: Medical Research Ethics Committee at the faculty of medicine at Suez Canal University granted approval for conducting this study.
d) *Permissions* for conducting this study were obtained from the preventive sector of the Ministry Of Health and Population.
e) *Agreements* from the responsible authority (Ismailia Directorate of health) were obtained for each hospital and Ismailia health District.
f) *Agreements* from the Ismailia health District to each primary health care center.
g) *Informed consent* was signed by the participants indicating their consent for data to be collected, analyzed and presented as part of this thesis. The consent was approved by the medical research ethics committee, Suez Canal University.
h) *Confidentiality* of the collected data: the collected data was kept secret for only research use.
i) *The participants* were informed that responding is voluntary and that they can refuse to respond without stating any reason.

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