

## Perception in Relation to a Potential Influenza Pandemic among Healthcare Workers in Japan: Implications for Preparedness

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**Abstract: Perception in Relation to a Potential Influenza Pandemic among Healthcare Workers in Japan: Implications for Preparedness: Tepei IMAI, et al. University of Occupational and Environmental Health, Japan**—Due to the potential for an influenza pandemic, preparedness for infection control in healthcare settings is essential from the standpoint of occupational health for healthcare workers. We conducted questionnaire surveys among Japanese hospitals to assess preparedness at the individual and institutional levels and their inter-relationship. Questionnaires were administered at 7 tertiary hospitals in Japan during the spring of 2006. We analyzed 7,378 individual responses of the 10,746 questionnaires administered and all seven institutional responses by hospital infection control committees. Healthcare workers assigned low importance to personal protective equipment and showed mixed attitudes (anxious but accepting) to the potential risk. Institutional gaps existed in preparedness across hospitals and most hospitals lacked the specificity to cope with a pandemic. A higher level of institutional preparedness, as determined by expertise as well as general and specific countermeasures, was an important predictor of individual recognition of preventive measures, perception of institutional measures, and attitude toward coping with risk. A higher level of institutional preparedness stood out to be an important predictor of individual preparedness. Considering the risk of a future influenza pandemic, hospitals should improve preparedness at all levels.

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**Key words:** Influenza, Human, Disease outbreaks, Occupational health, Health personnel, Infection control, Questionnaires, Epidemiology

The H5N1 avian influenza virus, which has been infecting wild birds and domestic poultry populations in many countries<sup>1</sup>, has the ability to cause an influenza pandemic by acquiring human-to-human transmissibility<sup>2, 3</sup>. The World Health Organization (WHO) estimates that such an influenza pandemic may cause 7.4 million deaths globally and 233 million outpatient visits in high income countries<sup>4</sup>. Under such a situation, many healthcare workers would be at a great risk of contracting pandemic influenza; thus, adequate preparedness for such a pandemic is needed in healthcare settings from the stand point of occupational health for healthcare workers. During the SARS epidemic, basic infection control measures were effective at preventing viral transmission among healthcare workers<sup>5, 6</sup>. Although these measures would likely curb pandemic influenza<sup>7</sup>, specific measures for influenza, e.g., antiviral drugs and vaccination<sup>8</sup>, are also warranted.

Preparedness for an influenza pandemic in healthcare settings can be studied at both *institutional* and *individual* levels. At the *institutional* level, preparedness includes the designation and implementation of emergency infection control measures, whereas at the *individual* level, preparedness includes the possession by individuals of positive recognition, attitudes and behaviors for coping with risk. *Individual* and *institutional* preparedness are likely to be intertwined. In a study conducted during the SARS epidemic, we reported that the concept of *institutional* measures was the most important predictor of *individual* perception of risk among Japanese

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healthcare workers<sup>9</sup>). The objective status of preparedness at the *institutional* level may thus influence *individual* perception of risk and preventive measures for pandemic influenza.

Japan was ultimately spared from the SARS epidemic and no institution implemented extensive measures for infection control<sup>10, 11</sup>. Due to this, a lack of sense of urgency could have spread. At the time, Japanese healthcare workers accorded less confidence in preventive measures than their Singaporean counterparts, who experienced the containment of the SARS epidemic<sup>12</sup>. Thus, although the threat of an influenza pandemic is currently hypothetical, it is important to study preparedness in terms of infection control measures within the healthcare sector.

We conducted this study among Japanese healthcare facilities to assess: 1) *individual* preparedness among healthcare workers, as determined by their recognition of preventive measures, perception of institutional measures, and attitude toward coping with risk; 2) *institutional* preparedness, as determined by the reported expertise in dealing with infectious diseases, general measures instituted for infection control, and specific measures related to pandemic influenza; and 3) the inter-relationship between *individual* preparedness and *institutional* preparedness.

## Materials and Methods

### Study population

This survey was conducted at 7 tertiary level hospitals distributed throughout Japan; 4 of the hospitals were university-affiliated, 2 were municipal, and 1 was private. Among these 7 major hospitals, having more than 500 beds, 2 are designated to accommodate patients with severe infectious diseases like SARS. We administered 2 types of questionnaires, one at the *individual* and the other at the *institutional* level, from March through May 2006. At the *individual* level, questionnaires were distributed to 10,746 healthcare workers working at the 7 hospitals, with 7,629 responding (crude response rate 71.0%). After excluding missing or invalid responses related to sex, age, job category, or discipline, the remaining 7,378 responses were analyzed (valid response rate 68.7%) (Table 1). At the *institutional* level, questionnaires were mailed to the person in charge of the infection control practice on each hospital infection control committee; all seven hospital committees responded (valid response rate 100%).

### Questionnaire

For the survey of individual healthcare workers, we modified the questionnaire originally developed for SARS risk perception<sup>9</sup> and included several features specific to influenza (*e.g.*, antiviral drugs and vaccination). The anonymous questionnaire, approved by the institutional

review board of the University of Occupational and Environmental Health, Japan, consisted of 23 items, including 13 items regarding recognition of preventive measures, 5 items regarding perception of institutional measures, and 5 items regarding attitude toward coping with risk (see Appendix for the text of each question). Each of these 23 items was measured on a 7-point scale for response (strongly agree, agree, probably agree, probably disagree, disagree, strongly disagree, and not applicable). In the statistical analyses, we dichotomized this scale into positive responses (strongly agree, agree, probably agree) and negative responses (strongly disagree, disagree, probably disagree) after excluding not applicable.

The questionnaire for the survey of hospital infection control committees consisted of 20 items, including 5 items regarding expertise in dealing with infectious disease, 10 items regarding general measures for infection control, and 5 items regarding specific measures related to pandemic influenza (see Appendix for text of each question). All items pertained to good practice, as advanced by the WHO guidelines<sup>13</sup> and based on other findings<sup>14</sup>. The 20 items were measured on a 3-point scale for responses (YES, NO, and not applicable). The level of the three subscales as well as of overall preparedness, was quantified by calculating the E(xpertise), G(eneral), S(pecific), and T(otal) scores. Each score was defined as the proportion of "YES" answers. As an indicator of *institutional* preparedness, the T-score was subdivided into two groups (higher or lower) by the median value, which was 80%.

### Statistical analysis

The chi-square test was used to evaluate differences in the proportion of individual respondents giving positive responses by sex, age, job category (physician, nurse, and other), and discipline [medical, surgical, emergency room (ER) / intensive care unit (ICU), and other]. Logistic regression analyses were used to identify the factors associated with *individual* recognition of preventive measures, perception of institutional measures and attitude toward coping with risk (as dependent variables) in relation to *institutional* preparedness, measured as the rank (higher or lower) of the T-score, in combination with individual characteristics, *i.e.*, sex (men or women), age (<35 or =35 yr old), job category (nurse or physician/other), and discipline (ER/ICU/surgery or medical/other) [as the independent variables].

Spearman's correlation coefficients among the five independent variables were <0.30 (except for sex - job category, which was 0.49). Data were analyzed using SPSS, version 11.5J (SPSS Inc., Chicago, IL, USA). All reported *p* values were two tailed, and *p*<0.05 was considered statistically significant.

**Table 1.** Demographic characteristics of respondents

Variable	A		B		C		Institutions		E		F**		G		Total	
	N	%	N	%	N	%	Municipal	%	N	%	N	%	N	%	N	%
Sex	1,041	14.1	814	11.0	1,216	16.5	634	8.6	1,365	18.5	919	12.5	1,389	18.8	7,378	100.0
Men	280	26.9	289	35.5	326	26.8	144	22.7	413	30.3	141	15.3	427	30.7	2,020	27.4
Women	761	73.1	525	64.5	890	73.2	490	77.3	952	69.7	778	84.7	962	69.3	5,358	72.6
Age, yr																
<35	542	52.1	371	45.6	684	56.3	282	44.5	777	56.9	345	37.5	949	68.3	3,950	53.5
≥35	499	47.9	443	54.4	532	43.8	352	55.5	588	43.1	574	62.5	440	31.7	3,428	46.5
(Mean ± SD*)		(36.6 ± 11.8)		(38.1 ± 11.2)		(35.3 ± 12.1)		(37.8 ± 10.8)		(35.4 ± 11.7)		(40.1 ± 11.6)		(32.3 ± 10.3)		(36.1 ± 11.6)
Job category																
Physicians	156	15.0	213	26.2	149	12.3	49	7.7	238	17.4	27	2.9	126	9.1	958	13.0
Nurses	534	51.3	358	44.0	612	50.3	363	57.3	681	49.9	511	55.6	622	44.8	3,681	49.9
Others†	351	33.7	243	29.9	455	37.4	222	35.0	446	32.7	381	41.5	641	46.1	2,739	37.1
Disciplines																
Medical	244	24.1	255	32.5	348	29.4	118	19.2	356	26.4	172	19.8	228	16.8	1,721	24.0
Surgical	305	30.2	211	26.9	271	22.9	141	23.0	304	22.6	173	20.0	352	26.0	1,757	24.5
ER/ICU	52	5.1	59	7.5	59	7.5	107	17.5	128	9.5	140	16.1	163	12.0	708	10.0
Others‡	410	40.6	260	33.1	506	42.7	247	40.3	559	41.5	382	44.1	611	45.1	2,975	41.5

\*SD, standard deviation. \*\* Institution D and F are designated to accommodated patients with severe infectious disease like SARS. †Others include nursing assistant, social worker, pharmacist, clinical and radiologic technologist, physical therapist, occupational therapist, speech therapist, managerial staff, clerk, educational and research staff, building maintenance staff, cleaner, nutritionist, and licensed cook. ‡Others include radiographical services, laboratory services, administrative, and primary care.

## Results

Table 2 shows *individual* responses of healthcare workers to question related to recognition of preventive measures, perception of institutional measures, and attitude toward coping with risk, according to sex, age, job category, and discipline.

1) Recognition of preventive measures: Positive recognition was highest for hand washing (98%) and lowest for temperature checks (44%). Women had significantly more positive recognition than men with statistical significance for 8 of 13 items. The younger (<35 yr) group had significantly more positive recognition than the older group for 5 items. By job category, for which positive recognition differed significantly for 11 of the 13 items, physicians ranked third for 6 items, nurses ranked first for 7 items, and others ranked second for 4 items. By discipline, for which positive recognition differed significantly for 8 of the 13 items, medical ranked third or fourth for 6 items, surgical ranked first or second for 6 items, ER/ICU ranked first or second for 6 items, and others ranked third or fourth for 6 items.

2) Perception of institutional measures: Positive perception was highest for flu vaccination (83%) and lowest for adequate training (23%). Women had significantly more positive perception than men for all five items. By age group, 3 items differed significantly, with the older age group having more positive perception for specialist available and preparedness plan, but less for flu vaccination. By job category, nurses consistently ranked first among the 3 job categories for all 5 items. By discipline, either ER/ICU or surgery ranked first for all items.

3) Attitude toward coping with risk: Rates of positive or negative attitudes were, in descending order, learning about pandemic influenza (79%), acceptance of risk (75%), fear of pandemic influenza (65%), job change (26%), and pointless to take precautions (24%). By sex, 3 items differed significantly, with women having more negative attitudes for fear of pandemic influenza, job change, and acceptance of risk. By age group, 3 items differed significantly, with the older age group having more positive attitudes for learning about pandemic influenza and job change, but less for pointless to take precautions. By job category, 4 items differed significantly, with nurses ranking first for fear of pandemic influenza and job change, physicians ranking first for acceptance of risk, and others ranking first for feeling pointless to take precautions. By discipline, 3 items differed significantly, with fear of pandemic influenza being highest among surgical (70%) and lowest among others (59%), job change being highest among surgical (30%) and lowest among others (22%), and feeling pointless to take precautions being highest among others (27%) and lowest among ER/ICU personnel (20%).

Table 3 shows the level of *institutional* preparedness, as reported by the infection control committees at the seven studied hospitals. The three aspects assessed were expertise, general measures for infection control and specific measures related to pandemic influenza.

1) Expertise in dealing with infectious disease: All 7 hospitals were staffed with bacteriology specialists: although 6 had physicians specializing in infectious diseases, only 2 had hospital epidemiologists. Six hospitals maintained beds for patients with severe infectious diseases, but only 3 had special infectious disease clinics. Among the 7 institutions, the score for this aspect (E-score) ranged from 20% to 80% (mean, 69%).

2) General measures for infection control: Most hospitals reported positive adherence: all 7 implemented surveillance, and 6 provided periodic information on infection control, as well as training in the use of personal protective equipment (PPE) and standard precautions. Five hospitals designated/implemented other measures such as education and training regarding hand washing as well as stocking PPE. Among the 7 institutions, the score for this aspect (G-score) ranged from 30% to 100% (mean, 79%).

3) Specific measures related to pandemic flu: All 7 hospitals reported administration of influenza vaccine, 6 had designated areas for isolating patients, 5 provided special training for an influenza pandemic, while 3 stocked antiviral drugs and developed protocols for an influenza pandemic. Among the 7 institutions, the score for this aspect (S-score) ranged from 40% to 100% (mean, 69%).

Among the seven institutions, the total score (the averaged sum of the E-, G-, and S-score) ranged from 40% (E) to 90% (F and G), with a mean of 74%.

Table 4 shows the inter-relationship between *individual* recognition of preventive measures, perception of institutional measures and attitude toward coping with risk (as dependent variables) and *institutional* preparedness as measured by T-score rank in combination with individual characteristics, i.e., sex, age, job category and discipline (as independent variables).

For the 5 items evaluating recognition of preventive measures, higher T-score rank and individual characteristics, namely the job category of nurse and higher age, were comparatively important predictors. Recognition of N95 masks as a preventive measure was positively associated with older age [odds ratio (OR) 1.30, 95% confidence interval (CI) 1.12–1.51] and the job category of nurse, (OR 1.20, 95% CI 1.01–1.43), but was negatively associated with the discipline ER/ICU or surgery (OR 0.79, 95% CI 0.67–0.92). Recognition of gloves was positively associated with higher T-score rank (OR 1.29, 95% CI 1.14–1.46), female sex (OR 1.38, 95% CI 1.19–1.61), and nurse (OR 1.36, 95% CI 1.17–

**Table 2.** Level of individual recognition of preventive measures, perception of institutional measures, and attitude toward coping with risk by sex, age, job category, and discipline as reported by individual healthcare workers\*

	Sex		Age		Job category			Discipline			Total		
	Men %	Women %	<35 yr %	≥35 yr %	Physician %	Nurse %	Others %	Medical %	Surgical %	ER/ICU %	Others %	p-value	%
Total	27.4	72.6	53.5	46.5	13.0	49.9	37.1	24.0	24.5	9.9	41.5	-	100.0
Recognition of preventive measures													
1. Hand washing	96.0	98.1	98.2	96.8	94.3	98.2	97.9	97.8	97.5	97.3	97.5	<0.01	97.6
2. Area isolation	94.7	96.4	95.4	96.5	93.8	96.6	95.7	95.9	96.2	96.3	95.8	<0.01	95.9
3. Alcohol rubs	88.3	93.4	93.9	89.7	83.5	92.8	93.8	91.3	91.1	93.1	92.6	<0.01	92.0
4. Prominent notices	84.5	91.7	90.8	88.5	85.0	93.2	86.7	90.3	91.4	92.2	87.9	<0.01	89.7
5. N95 mask	87.5	86.6	85.6	88.3	89.7	87.0	85.7	88.4	85.1	85.4	87.4	0.01	86.9
6. Screening for fever	76.9	85.0	84.3	81.0	80.6	88.1	76.3	84.6	87.8	87.2	77.7	<0.01	82.8
7. Gloves	76.5	84.1	82.5	81.5	73.6	85.5	80.3	82.5	82.2	89.6	79.8	<0.01	82.1
8. Surgical mask	77.7	77.8	78.1	77.4	77.0	77.3	78.7	77.5	76.2	78.6	78.6	0.33	77.8
9. Antiviral drugs	69.1	67.1	65.3	70.4	64.4	66.5	70.4	64.3	68.4	65.7	69.2	<0.01	67.6
10. Gown	55.1	62.2	62.2	57.9	57.5	67.3	51.3	63.1	64.9	68.8	53.5	<0.01	60.2
11. Goggles	53.7	51.9	49.8	55.5	57.2	52.6	50.4	53.3	51.2	56.5	51.3	<0.01	52.4
12. Limiting visitors	42.3	48.4	45.5	48.3	47.9	54.2	36.1	49.8	53.3	52.8	39.9	<0.01	46.8
13. Temperature checks	43.6	44.2	45.0	42.9	40.6	45.0	44.0	42.4	48.1	42.7	42.6	0.06	44.0
Perception of institutional measures													
1. Flu vaccination	77.5	85.0	84.6	80.9	81.8	87.2	77.3	84.5	85.7	85.6	79.9	<0.01	82.9
2. Specialist available	43.5	54.1	48.8	53.9	41.0	57.0	46.6	50.9	55.1	57.8	46.8	<0.01	51.2
3. Preparedness plan	42.9	50.7	45.4	51.9	41.1	54.7	42.1	51.1	49.4	53.4	44.8	<0.01	48.4
4. Effectiveness	36.0	44.9	43.2	41.6	31.4	49.3	36.9	45.0	45.6	43.6	38.3	<0.01	42.5
5. Adequate training	18.7	24.8	22.6	23.7	17.3	28.7	17.4	24.5	25.9	27.7	18.5	<0.01	23.1
Attitude toward coping with risk													
1. Learning about pandemic influenza	78.6	79.0	73.4	85.3	80.4	78.6	78.8	78.8	79.7	78.1	78.8	0.48	78.9
2. Acceptance of risk	77.4	73.4	75.0	74.0	80.2	74.3	72.8	74.4	76.0	74.9	73.5	<0.01	74.5
3. Fear for pandemic influenza	62.4	65.3	64.9	63.9	64.9	68.4	58.9	65.8	69.8	68.1	59.2	<0.01	64.5
4. Job change	17.8	29.7	29.5	22.7	16.8	31.3	23.1	28.7	30.3	29.8	21.5	<0.01	26.4
5. Pointless to take precautions	22.2	23.9	19.7	27.8	16.4	19.7	31.2	20.9	21.0	20.1	26.5	<0.01	23.5

\* Data are presented as percentages, number of positive responses divided by number of respondents answering each question. Positive responses include “probably agree”, “agree”, and “strongly agree”; negative responses are “probably disagree”, “disagree”, and “strongly disagree”. p-values are based on chi-square test for difference in proportions.

**Table 3.** Level of institutional preparedness as reported by hospital infection control committees

	Institutions							Total <sup>‡</sup>
	A	B	C	D	E	F	G	
Expertise in dealing with infectious disease								
1. Specialist in bacteriology	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
2. Specialist physician for infectious diseases	Yes	No	Yes	Yes	Yes	Yes	Yes	6/7
3. Beds for severe infectious disease	Yes	No	Yes	Yes	Yes	Yes	Yes	6/7
4. Special clinic for infectious disease	No	No	No	Yes	No	Yes	Yes	3/7
5. Hospital epidemiologist	Yes	No	Yes	No	No	No	No	2/7
E(xpertise)-score <sup>†</sup>	80%	20%	80%	80%	60%	80%	80%	–
General measures for infection control								
1. Implementation of surveillance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
2. Periodically provide information to staff on infection control	Yes	No	Yes	Yes	Yes	Yes	Yes	6/7
3. Training in the use of PPE (personal protective equipment)	Yes	Yes	Yes	Yes	No	Yes	Yes	6/7
4. Training for standard precautions	Yes	Yes	Yes	Yes	No	Yes	Yes	6/7
5. Policy for infection control	NA	Yes	Yes	Yes	No	Yes	Yes	5/7
6. Utilization of PDCA* cycle etc. for improvement	Yes	Yes	Yes	Yes	No	No	Yes	5/7
7. Protocol for infection control	NA	Yes	NA	Yes	Yes	Yes	Yes	5/7
8. Education and training (E/T) on hand washing	Yes	Yes	Yes	Yes	No	Yes	–	5/7
9. Stocking PPE	Yes	Yes	NA	Yes	No	Yes	Yes	5/7
10. Reporting system for in-house infectious diseases	No	Yes	Yes	Yes	No	Yes	Yes	5/7
G(eneral)-score <sup>†</sup>	70%	90%	80%	100%	30%	90%	90%	–
Specific measures related to pandemic influenza								
1. Recommendation of annual influenza vaccine	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7/7
2. Area designated for isolating patients for pandemic influenza	Yes	No	Yes	Yes	Yes	Yes	Yes	6/7
3. Special training for an influenza pandemic	No	Yes	Yes	Yes	No	Yes	Yes	5/7
4. Stocking antiviral drugs	Yes	No	No	No	No	Yes	Yes	3/7
5. Protocols for an influenza pandemic	–	–	Yes	No	No	Yes	Yes	3/7
S(pecific)-score <sup>†</sup>	60%	40%	80%	60%	40%	100%	100%	–
Total (Sum of the above three aspects)								
T(otal)-score <sup>†</sup>	70%	60%	80%	85%	40%	90%	90%	–

\*PDCA: plan, do, check, and act. <sup>†</sup>Each score was defined as the proportion of “Yes” answers in each aspect. <sup>‡</sup>“Total” was the total number of “Yes” answers to each item.

1.59). Recognition of gowns was positively associated with higher T-score rank (OR 1.14, 95%CI 1.03–1.26), nurse (OR 1.74, 95%CI 1.54–1.96), and ER/ICU/surgery (OR 1.24, 95%CI 1.12–1.39). Recognition of goggles was positively associated with older age (OR 1.30, 95%CI 1.18–1.44).

For perception of institutional measures, higher T-score rank, as well as older age and nurse, were comparatively important predictors, with each of these independent variables positively and significantly associated with the three aspects. For attitude toward coping with risk, older age was a comparatively important predictor. Learning about pandemic influenza was positively associated with higher T-score rank (OR 1.22, 95%CI 1.09–1.38) and

older age (OR 2.23, 95%CI 1.96–2.53). Pointless to take precautions was positively associated with female sex (OR 1.56, 95%CI 1.35–1.80) and older age (OR 1.46, 95%CI 1.29–1.64) and negatively associated with nurse (OR 0.62, 95%CI 0.54–0.71).

## Discussion

This study was conducted at a time when the global community was under threat of a possible influenza pandemic, a situation that is ongoing. The safety and health of healthcare workers is a first-line defence for public health in a pandemic situation, so adequate preparedness in healthcare settings is essential. Utilizing questionnaires directed toward individual workers and

**Table 4.** Factors associated with individual recognition of preventive measures, perception of institutional measures, and attitude toward coping with risk\*

	T-score rank <sup>†</sup> (Higher)		Sex (Women)		Age (≥35 yr)		Job category (Nurse)		Discipline (ER/ICU/surgery)	
	OR <sup>‡</sup>	95%CI <sup>‡</sup>	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Recognition of preventive measures (5 items)										
1. N-95 mask	0.97	0.84 – 1.12	0.90	0.74 – 1.08	1.30	1.12 – 1.51	1.20	1.01 – 1.43	0.79	0.67 – 0.92
2. Gloves	1.29	1.14 – 1.46	1.38	1.19 – 1.61	1.12	0.98 – 1.27	1.36	1.17 – 1.59	1.14	0.99 – 1.31
3. Surgical mask	1.00	0.89 – 1.12	1.03	0.89 – 1.20	0.95	0.84 – 1.07	0.93	0.81 – 1.07	0.94	0.83 – 1.07
4. Gown	1.14	1.03 – 1.26	0.95	0.83 – 1.07	1.00	0.90 – 1.11	1.74	1.54 – 1.96	1.24	1.12 – 1.39
5. Goggles	0.91	0.83 – 1.01	0.92	0.82 – 1.05	1.30	1.18 – 1.44	1.12	0.99 – 1.26	1.03	0.93 – 1.15
Perception of institutional measures (3 items)										
1. Preparedness plan	1.82	1.62 – 2.03	1.22	1.05 – 1.41	1.68	1.49 – 1.89	1.33	1.16 – 1.53	0.99	0.87 – 1.12
2. Specialist available	1.31	1.19 – 1.45	1.26	1.11 – 1.43	1.51	1.36 – 1.67	1.56	1.38 – 1.76	1.21	1.09 – 1.35
3. Adequate training	1.22	1.08 – 1.37	0.98	0.83 – 1.15	1.30	1.15 – 1.47	2.05	1.77 – 2.39	1.14	1.01 – 1.30
Attitude toward coping with risk (2 items)										
1. Learning about pandemic influenza	1.22	1.09 – 1.38	1.15	0.98 – 1.33	2.23	1.96 – 2.53	1.10	0.95 – 1.27	1.08	0.95 – 1.23
2. Pointless to take precautions	1.07	0.96 – 1.20	1.56	1.35 – 1.80	1.46	1.29 – 1.64	0.62	0.54 – 0.71	0.94	0.83 – 1.07

\*Goodness-of-fit was satisfactory: ranged from [goodness-of-fit statistics=3.16 with 8 df ( $p=0.92$ )] for gown to [goodness-of-fit statistics=9.71 with 8 df ( $p=0.29$ )] for goggles, except for [goodness-of-fit statistics=16.50 with 8 df ( $p=0.02$ )] for N-95 mask and [goodness-of-fit statistics=17.82 with 8 df ( $p=0.02$ )] for pointless to take precautions.

<sup>†</sup>Each T-score was categorized into two groups by the median: higher (T-score=80%); lower (80%>T-score).

<sup>‡</sup>OR, odds ratio calculated by logistic regression; CI, confidence interval.

the institutional infection control committees, we were able to assess the status of preparedness at *individual* and *institutional* levels, as well as their inter-relationships. Logistic regression analyses (Table 4), demonstrated that a higher T-score rank, an indicator of better *institutional* preparedness, was a significant positive predictor of *individual* recognition of preventive measures (gloves and gowns), perception of institutional measures (three aspects), and attitude toward coping with risk of pandemic influenza (learning about pandemic influenza). These findings corroborate earlier studies reporting that administrative support enhances compliance with universal precautions<sup>15–17</sup> and hand washing<sup>14, 18</sup>. These findings thus indicate that for pandemic influenza, *institutional* preparedness, in terms of expertise as well as general and specific countermeasures enhances *individual* preparedness, in terms of knowledge, perception, and attitude.

Regarding *individual* recognition of preventive measures, many respondents assigned relatively low importance to PPE, especially gowns (60%) and goggles (52%), whereas the WHO guidelines consider the use of PPE is important for preventing healthcare workers from contracting pandemic influenza<sup>7</sup>, suggesting the need to reinforce this area of recognition. The non-availability of guidelines written in Japanese at the time might have affected the fairly negative recognition of preventive measures among the Japanese healthcare workers. In fact, official guidelines for preventing influenza pandemic<sup>19</sup> were published by the Japanese authorities in Mar 2007, which was one year after our survey. We also found that only 23% of the individual respondents believed they had received adequate training in the use of PPE. To further examine this, recognition of PPE (*e.g.*, gowns, goggles) was classified by the perceived status of adequate training: those with positive perception had a significantly greater recognition of PPE than those with a negative perception, 68% vs 58% for gowns and 59% vs 51% for goggles, respectively (data not shown). These findings agree with those of earlier studies, reporting that adequate training enhances compliance with hand washing<sup>14</sup>, standard precautions<sup>20</sup>, and safe needle precautions<sup>21</sup>. These results thus indicate that institutions should adequately train their workers to enhance their recognition of preventive measures.

*Individual* attitudes toward coping with risk were emphasized by our finding that close to 65% of respondents felt fear, and more than 26% would even consider job change in response to it. These numbers attest to the high level of anxiety of this population toward a potential epidemic. Furthermore, 24% of respondents had an extremely negative attitude toward coping with risk, *i.e.*, “pointless to take precautions”. However, it is important to note also that these negative attitudes were balanced by positive risk-coping attitudes such as intent

to learn about pandemic influenza (79%) and accepting risk (75%). These response patterns probably reflect the mixed feelings of individuals towards risk (fearful but accepting and willing). Earlier reports have also shown mixed attitudes among healthcare workers toward coping with infectious diseases. For example, during the SARS epidemic, 79% of Taiwanese healthcare workers perceived fear and 37% reported they would accept the risk<sup>22</sup>. Such perceptions may reflect the level of threat perceived by the responders at that time. Thus, the anxiety felt among Japanese healthcare workers, at a time that a pandemic has not actually materialized, was remarkably high (nearly two-thirds).

At the *institutional* level, most of the hospitals had expertise in dealing with infectious diseases, as assessed by the presence of bacteriology and infectious disease specialists and beds for severe infectious diseases. However, many of these hospitals did not have special clinics for infectious disease or hospital epidemiologists. One university hospital (B) reported having only a bacteriology specialist. Most of these hospitals had instituted general measures for infection control, with the notable exception of one university hospital (E), which responded positively to only 3 of the 10 studied measures. Specific measures related to pandemic influenza were even less frequently present in these hospitals; in particular, only 3 of the 7 hospitals stocked antiviral drugs and had attuned protocols. Hence, the preventive measures implemented in these hospitals tended to be of a general nature and lacked the specificity to cope with an influenza pandemic. Implementing general measures<sup>7</sup>, in combination with specific measures, such as stocking antiviral drugs and vaccination<sup>8</sup>, are important aspects of preparedness. The experience with SARS demonstrates the importance of clear policies<sup>23</sup>. In view of the imminent threat of an influenza pandemic, our results emphasize the need for designating and implementing specific measures to counter this pandemic.

Overall, two university hospitals (E and B) fared worse than other hospitals across multiple aspects, indicating a substantial gap in preparedness status across the studied institutions, as reported by their infection control committees. Because all were reputable tertiary level hospitals, it is likely that institutional gaps would be greater in the entire healthcare sector. Wide gaps have also been reported in pandemic preparedness of European nations<sup>24</sup>. Although our study was confined to 7 tertiary-level hospitals, a similar situation is likely in Japan.

Based on multi-variate analyses, older age and job category (*i.e.*, nurse) were significant positive predictors of individual recognition of preventive measures, perception of institutional measures, and attitude toward coping with risk, except for pointless to take precautions. Older age is likely associated with greater experience in acquiring positive recognition. It is also possible that



older workers, having adjusted to a given work environment, may have more receptive attitudes to it. However, it is not clear if the apparent association between older age and greater willingness to learn about pandemic influenza, was due to a birth-cohort effect or aging. The job category of nurse was clearly related to positive attitudes toward taking precautions. Compared with other medical professions, nurses have shown better compliance with standard precautions<sup>14, 18, 25</sup>. Nurses may also receive more formal training in infection control than other job categories, which may positively influence their level of knowledge as well as their perception of institutional measures and attitudes toward coping with risk. In addition, job descriptions of nurses may influence these results. For example, among healthcare workers in the ICU setting, nurses have the greatest opportunity for direct patient care<sup>26</sup>.

Our study had several limitations. First, its cross-sectional nature prevents the determination of cause and effect. Second, there may have been responder bias, in that only workers with a strong interest in pandemic influenza may have been motivated to respond to our questionnaire, although this is counteracted to some extent by the fairly high response rate. Third, there may have been a selection bias, in that the number of institutions surveyed was small, although we made an effort to select major hospitals distributed throughout Japan. On the other hand, we assessed *institutional* factors that may affect the preparedness level of *individual* healthcare workers from various aspects, allowing a more comprehensive assessment of the level of preparedness in the healthcare sector.

## Conclusion

We found that healthcare workers in Japan assigned relatively low importance to PPE and showed conflicting attitudes to the risks posed by an influenza pandemic. Healthcare workers had high levels of both anxiety and risk acceptance. We also found a substantial gap in the status of preparedness at *institutional* levels, with most hospitals lacking the specific measures to cope with a pandemic. However, a higher level of *institutional* preparedness, in terms of expertise and both general and specific countermeasures, was an important predictor of *individual* preparedness, in terms of recognition and perception of preventive measures and attitude toward coping with risk. Due to the risk of a future influenza pandemic, institutions should improve preparedness at all levels to protect their workers' safety and health.

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## Appendix. Excerpts from the questionnaires

### A. Questionnaire items administered to individual healthcare workers

#### Recognition of preventive measures

Do you believe that the following measures are useful in protecting you from contracting pandemic influenza?

1. Hand washing
2. Area isolation
3. Alcohol rubs
4. Prominent notices
5. N95 mask
6. Screening for fever (for patients/visitors)
7. Gloves
8. Surgical mask
9. Antiviral drugs
10. Gowns
11. Goggles
12. Limiting visitors
13. Temperature checks (for staff)

#### Perception of institutional measures

1. Did your hospital recommend that you receive an annual influenza vaccination?
2. Do you have someone to turn to when you have a problem in using PPE (personal protective equipment)?
3. Does your hospital have a preparedness plan for an influenza pandemic?

4. Do you feel that your hospital is well prepared for an influenza pandemic?
5. Was adequate training provided to you in the use of PPE?

Attitude toward coping with risk

1. Have you personally coped with the threat of pandemic influenza by learning as much as you can about it?
  2. Do you feel that you would accept the risk of contracting pandemic influenza at work in the event of an influenza pandemic?
  3. Do you feel that you would be afraid of falling ill with pandemic influenza in the event of an influenza pandemic?
  4. Do you feel that you might look for another job or consider resigning because of the risk of contracting pandemic influenza?
  5. Do you feel that it is pointless to take precautions?
- 

B. Questionnaire items administered to hospital infection control committees

Expertise in dealing with infectious disease

1. Does your hospital have a specialist in bacteriology?
2. Does your hospital have a specialist physician for infectious diseases?
3. Does your hospital have beds for patients with severe infectious diseases?
4. Does your hospital accommodate a special clinic for infectious diseases?
5. Does your hospital have a hospital epidemiologist?

General measures for infection control

1. Does your hospital implement a surveillance system for specific infectious disease?
2. Does your hospital periodically provide information to staff on infection control?
3. Does your hospital provide staff with training in the use of PPE?
4. Does your hospital provide staff with training in standard precautions?
5. Does your hospital have a policy for infection control?
6. Does your hospital have a system for continuous improvement in infection control by using PDCA\* cycle?
7. Does your hospital have a protocol for infection control?
8. Does your hospital provide education and training on hand washing?
9. Does your hospital stock sufficient PPE for infection control?
10. Does your hospital have a reporting system for staff to give notification of an in-house epidemic of a specific infectious disease?

Specific measures related to pandemic influenza

1. Does your hospital recommend annual influenza vaccination to staff?
  2. Does your hospital have a designated area for isolating patients?
  3. Does your hospital provide special training for an influenza pandemic?
  4. Does your hospital stock sufficient antiviral drugs for staff?
  5. Does your hospital have a protocol regarding infection control for an influenza pandemic?
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\*PDCA: plan, do, check, and act.