

## ORIGINAL ARTICLE

# Association between human metapneumovirus seroprevalence and hypertension in elderly subjects in a long-term care facility

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Recently, relations between hypertension and infections caused by several pathogens have been reported. However, few studies have examined the relationship between human metapneumovirus (hMPV) and hypertension in elderly inpatients. To assess the association between anti-hMPV-immunoglobulin G (IgG) titer and the prevalence of hypertension, we conducted a case-control study in a Japanese long-term care facility (LTCF). The participants included 84 hypertensive patients aged  $\geq 65$  years, and 84 age- and sex-matched normotensive controls (38 males and 46 females in each group; cases,  $79.9 \pm 8.4$  (s.d.) years; controls,  $80.1 \pm 8.3$  years). Data on underlying chronic clinical conditions were collected. Titers were measured using an immunofluorescence assay kit. The significance of risk factor differences was analyzed using univariate and multivariate comparisons of cases and controls. All serum samples were positive for hMPV, and IgG titers ranged from 40-fold to more than 5120-fold. There were no significant sex- or age-related differences in  $\log_2$  (anti-hMPV-IgG titer/10) among the subjects. Compared with normotensive subjects, hypertensive patients presented significantly higher  $\log_2$  (anti-hMPV-IgG titer/10) values ( $P < 0.001$ ). After adjustment with multiple logistic analysis, the odds ratio for  $\log_2$  (anti-hMPV-IgG titer/10) was 1.42 (95% confidence interval 1.16–1.75,  $P = 0.001$ ) relative to normotensive subjects. In all subjects, stepwise multiple regression analysis revealed that both hypertension and a poor nutritional state independently contributed to increased  $\log_2$  (anti-hMPV-IgG titer/10). These observations suggest that an increased anti-hMPV-IgG titer was closely related to hypertension in elderly subjects in a Japanese LTCF.

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**Keywords:** elderly; human metapneumovirus; seroprevalence

## INTRODUCTION

Human metapneumovirus (hMPV) was first isolated in children with acute respiratory tract illnesses in 2001.<sup>1</sup> This virus is a member of the genus metapneumovirus of the subfamily Pneumovirinae of the family Paramyxoviridae. hMPV induces infections of the lower respiratory tract, including bronchitis, bronchiolitis and pneumonia, in young children<sup>2</sup> and immunocompromised individuals,<sup>3</sup> along with upper respiratory tract illnesses and influenza-like illness.<sup>4</sup> In January 2005, we reported an outbreak of nosocomial hMPV infection in elderly subjects in a long-term care facility (LTCF) in Japan.<sup>5</sup> Several subsequent reports revealed that hMPV infection outbreaks frequently occur in LTCFs,<sup>6</sup> not only in the winter<sup>5,6</sup> but also in summer,<sup>7</sup> with high mortality. Serological responses to hMPV-induced respiratory tract illnesses were frequently found (12.8%) among common viruses during a 52-week intervention period in residents of an LTCF.<sup>8</sup> Unlike other viral infections, which evoke lifelong immunity, hMPV reinfection occurs frequently, despite high rates of perpetual seroprevalence for all age groups. This finding suggests that reinfection occurs because

humoral immune responses have a minor role in the clearance of hMPV.<sup>9</sup> However, the relationship between hMPV infection and the underlying chronic clinical conditions has not been adequately evaluated in elderly subjects. Therefore, the aim of this study was to determine the relationship between the titer of immunoglobulin (Ig) G antibody against hMPV (anti-hMPV-IgG titer) and clinical conditions, including hypertension, in elderly patients in a Japanese LTCF.

## METHODS

### Identification of cases and controls

Our study was conducted in a 640-bed ward of the Department of Internal Medicine of Hanwa-Senboku Hospital, a Japanese LTCF for the elderly. The research protocol was approved by the ethics committee of the hospital. We identified all elderly subjects aged  $\geq 65$  years with hypertension, which was defined as blood pressure of  $> 140/90$  mm Hg or antihypertensive medication use. The controls were a random sample of normotensive subjects aged  $\geq 65$  years admitted to the same ward. The computerized admission lists served as the sampling frame, and we frequency matched the controls to the cases by sex

and age ( $\pm 2$  years) at a ratio of 1:1. The controls met the same eligibility criteria as the cases, but they did not have hypertension. All subjects who gave informed consent were enrolled in our study, and the blood samples were obtained between October and November 2007. Subjects were excluded if they (1) had a clinical diagnosis of secondary hypertension due to other diseases at the beginning of the study; (2) had serum creatinine levels  $\geq 177 \mu\text{mol l}^{-1}$  ( $2.0 \text{ mg dl}^{-1}$ ), (3) were in the critical phase of another acute illness (myocardial infarction, stroke, exacerbation of heart failure, pneumonia or renal failure), (4) received artificial feeding or (5) were immunocompromised because of systemic steroid use, metastatic cancer or cancer therapy.

#### Measurement of IgG titer against hMPV

IgG titer was measured using an indirect immunofluorescence assay kit from Mitsubishi Kagaku Bio-Clinical Laboratories (Tokyo, Japan), as described previously.<sup>10</sup> Serum that reacted with F protein at a dilution of  $\geq 1:10$  was defined as positive for anti-hMPV antibodies. IgG titers were calculated according to  $\log_2$  (anti-hMPV-IgG titer/10) for each serum sample, and the positive results at dilutions of 1:10 to 1:5120 were rated on a scale from 0 to 9.

#### Underlying chronic conditions

In Table 1, we noted the presence of the following clinical features in the enrolled patients: stroke, ischemic heart disease, chronic congestive heart failure, chronic kidney disease,<sup>11,12</sup> dementia,<sup>13</sup> diabetes mellitus, dyslipidemia,<sup>14</sup> a bedridden state, obesity,<sup>14</sup> a poor nutritional state and lung disease. The personal physicians of the patients were involved in the diagnosis of these complications, which were further assessed by a committee consisting of the authors (except MO). Objective and routinely collected medical information was used to enhance the accuracy of the diagnoses. Only chronic conditions were recorded for the cases and their respective control subjects. A computerized pharmacy database was used to assess the drug use. Each pharmacy record included the drug type and dose, date and administration duration. Data collection for the controls commenced after they had been hospitalized the same number of weeks as their corresponding cases. The data were retrieved from medical records (by MO). Of the 84 elderly subjects with hypertension, 21 took angiotensin II-receptor blockers alone, 16 took angiotensin I-converting enzyme inhibitors alone, 18 took dihydropyridine calcium-channel blockers alone and 10 took two or more (out of three) classes of antihypertensives, plus diuretics. In all, 19 subjects with hypertension were not prescribed any antihypertensive agent.

#### Statistical analysis

Data are expressed as mean and s.d. for continuous variables. Between-group comparisons were conducted with a Mann-Whitney *U*-test or  $\chi^2$ -test (Fisher's

exact test when needed). Independently participating factors for hypertension were identified by multiple logistic regression analysis after adjustment for confounding variables. Common pitfalls associated with multivariate regression were avoided using the method described by Concato *et al.*<sup>15</sup> The odds ratio (OR) for hypertension associated with various conditions was calculated using logistic regression analysis, adjusting for age, sex, and all associated variables selected according to their univariate analysis *P*-value ( $P < 0.20$ ).<sup>16</sup> Estimates for OR and the corresponding two-sided 95% confidence intervals (CIs) that demonstrated statistical significance were derived from the regression model. Conditional logistic regression was used to control for potential confounding variables. Independent associations with  $\log_2$  (anti-hMPV IgG titer/10) titer values were assessed by stepwise multiple regression analysis, using age, sex and factors with *P*-values  $< 0.2$  in the univariate analysis. *P*-values  $< 0.05$  were considered significant. The data were analyzed using SPSS (v. 16.0, Chicago, IL, USA).

## RESULTS

#### Confirmation of clinical factors

Table 2 summarizes the clinical background and underlying chronic conditions in the control and hypertension groups. There were no significant differences between the two groups in age, sex, admission period or prevalence of diabetes mellitus, dyslipidemia, or underlying chronic conditions, except that the hypertension group tended toward a higher prevalence of a past history of stroke and chronic kidney disease than the control group.

#### Anti-hMPV-IgG titer in normotensive and hypertensive elderly inpatients

All serum samples were positive for anti-hMPV-IgG. The titer ranged from  $40\times$  to more than  $5120\times$  in the 168 elderly inpatients, and the mean  $\pm$  s.d. value of  $\log_2$  (anti-hMPV-IgG titer/10) was  $6.19 \pm 1.65$ . The mean  $\pm$  s.d. value of  $\log_2$  (anti-hMPV-IgG titer/10) in the hypertension group ( $6.63 \pm 1.52$ ) was significantly higher than in the control group ( $5.75 \pm 1.67$ ;  $P=0.001$ ; Figure 1). There was no significant difference in the mean  $\pm$  s.d.  $\log_2$  (anti-hMPV-IgG titer/10) values between any two subgroups with antihypertensive treatment in the hypertensive elderly subjects:  $6.69 \pm 1.49$  in the angiotensin II-receptor blocker group ( $n=21$ ,  $P=0.038$ );  $6.57 \pm 1.66$  in the angiotensin I-converting enzyme inhibitor group ( $n=16$ ,  $P=0.041$ );  $6.50 \pm 1.46$  in the calcium-channel blocker group ( $n=18$ );  $6.30 \pm 1.64$  in multi-antihypertensive group ( $n=10$ ); and  $6.95 \pm 1.47$  in the non-treatment

**Table 1** Operational definitions for each pre-existing chronic condition were established prior to data collection

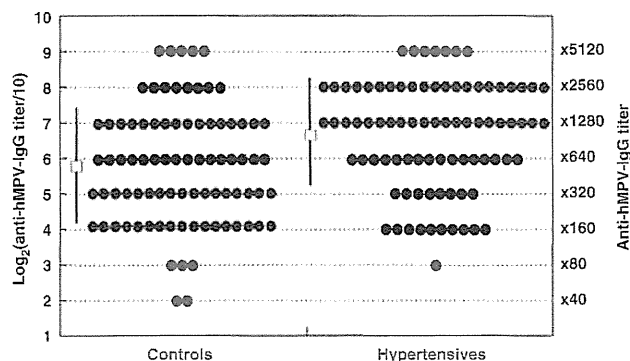
| Clinical feature                 | Definition  |
|----------------------------------|---|
| Stroke                           | Motor deficit and evidence of stroke on CT and/or MRI   |
| Ischemic heart disease           | Evidence on ECG and echocardiography  |
| Chronic congestive heart failure | LVEF $\leq 40\%$  |
| Chronic kidney disease           | Estimated GFR calculated by the MDRD equation <sup>11</sup> with coefficients modified for Japanese patients, <sup>12</sup> $194 \times \text{Cr}^{-1.094} \times \text{age}^{-0.287}$ ( $\times 0.739$ if female) $< 60 \text{ ml min}^{-1} 1.73 \text{ m}^{-2}$             |
| Diabetes mellitus                | Overnight FPG $\geq 7.0 \text{ mmol l}^{-1}$ ( $126 \text{ mg dl}^{-1}$ ) or the use of hypoglycemic agents and/or insulin  |
| Dementia                         | MMSE $\leq 23$ (Folstein <i>et al.</i> <sup>13</sup> )  |
| Dyslipidemia                     | Overnight fasting plasma TC value $\geq 5.72 \text{ mmol l}^{-1}$ ( $220 \text{ mg dl}^{-1}$ ), TG $\geq 1.70 \text{ mmol l}^{-1}$ ( $150 \text{ mg dl}^{-1}$ ), HDL-C $< 1.04 \text{ mmol l}^{-1}$ ( $40 \text{ mg dl}^{-1}$ ), or use of lipid-lowering agent <sup>14</sup> |
| Bedridden state                  | Permanently confined to bed   |
| Obesity                          | BMI $\geq 25$ (Bando <i>et al.</i> <sup>14</sup> )  |
| Hypoalbuminemia                  | ALB level $< 30 \text{ g l}^{-1}$   |
| Lung disease                     | Chronic bronchitis, pulmonary emphysema, severe bronchiectasis, chronic ILD, or sequelae of TB  |

Abbreviations: ALB, serum albumin; BMI, body mass index; CT, computed tomography; ECG, electrocardiography; FPG, fasting plasma glucose; GFR, glomerular filtration rate; HDL-C, high-density lipoprotein cholesterol; ILD, interstitial lung disease; LVEF, left ventricular ejection fraction; MDRD, Modification of Diet in Renal Disease; MMSE, mini-mental state examination score; MRI, magnetic resonance imaging; TB, tuberculosis; TC, total cholesterol; TG, triglycerides.

**Table 2 Clinical factors in hypertensive patients (n=84) and normotensive controls (84)**

|   | Normotensives<br>(n=84) | Hypertensives<br>(n=84) |
|---|-------------------------|-------------------------|
| <i>Clinical background</i>                |                         |                         |
| Age (years)                               | 80.1 ± 8.3              | 79.9 ± 8.4              |
| Male/female                               | 38/46                   | 38/46                   |
| Admission period (weeks)                  | 131 ± 56                | 132 ± 55                |
| Systolic blood pressure (mm Hg)           | 119 ± 13                | 150 ± 28***             |
| Diastolic blood pressure (mm Hg)          | 69 ± 10                 | 86 ± 17***              |
| <i>Anti-hMPV-IgG titer</i>                |                         |                         |
| Log <sub>2</sub> (anti-hMPV-IgG titer/10) | 5.75 ± 1.67             | 6.63 ± 1.52***          |
| <i>Underlying chronic conditions</i>      |                         |                         |
| Stroke                                    | 36 (42.9%)              | 45 (53.6%) <sup>†</sup> |
| Ischemic heart disease                    | 14 (16.7%)              | 20 (23.8%)              |
| Chronic congestive heart failure          | 9 (10.7%)               | 6 (7.1%)                |
| Chronic kidney disease                    | 14 (16.7%)              | 21 (25.0%) <sup>†</sup> |
| Dementia                                  | 48 (57.1%)              | 46 (54.8%)              |
| Diabetes mellitus                         | 4 (4.8%)                | 9 (10.7%)               |
| Dyslipidemia                              | 30 (35.7%)              | 32 (38.1%)              |
| Bedridden state                           | 12 (14.3%)              | 14 (16.0%)              |
| Obesity                                   | 17 (20.2%)              | 25 (29.8%)              |
| Poor nutritional state                    | 13 (15.5%)              | 11 (13.1%)              |
| Lung disease                              | 13 (15.5%)              | 16 (19.0%)              |

Abbreviations: hMPV, human metapneumovirus; IgG, immunoglobulin G. Values are mean (±s.d.) or n (%).  
\*\*\*P<0.001, <sup>†</sup>P<0.20; case-control difference, by  $\chi^2$ -test.



**Figure 1** Anti-hMPV-IgG titer shown as log<sub>2</sub> (anti-hMPV-IgG titer/10) values in elderly inpatients in the control and hypertension groups. Circles indicate individual anti-hMPV IgG titers in elderly subjects. Open squares indicate means, and bars ±s.d. values, in the control and hypertension groups, respectively.

group (n=19). The mean values of log<sub>2</sub> (anti-hMPV-IgG titer/10) in the angiotensin II-receptor blocker (P=0.075), angiotensin I-converting enzyme inhibitor (P=0.339) and non-treatment groups were significantly higher (P=0.005) than in the normotensive elderly subjects.

**Multiple logistic regression analysis for independent association with hypertension**

Multivariate associations between hypertension risk and selected characteristics after adjustment for potential confounders are shown in Table 3. Age, sex, log<sub>2</sub> (anti-hMPV-IgG titer/10) value, chronic

**Table 3 Multivariate association between selected characteristics and odds ratio of hypertension**

| Characteristic (unit)                     | Wald | Odds ratio | 95% Confidence interval | P     |
|---|------|------------|-------------------------|-------|
| Log <sub>2</sub> (anti-hMPV-IgG titer/10) | 8.64 | 1.42       | 1.16–1.75               | 0.001 |
| Chronic kidney disease                    | 2.40 | 1.91       | 0.86–4.33               | 0.122 |
| Stroke                                    | 2.32 | 1.67       | 0.86–3.25               | 0.128 |
| Age (years)                               | 0.29 | 0.99       | 0.95–1.03               | 0.588 |
| Male sex                                  | 0.00 | 1.01       | 0.52–1.95               | 0.972 |

Abbreviations: hMPV, human metapneumovirus; IgG, immunoglobulin G. Analyzed by multiple logistic regression analysis.

**Table 4 Log<sub>2</sub> (anti-hMPV-IgG titer/10) in subjects with and without clinical conditions**

|                                      | Absence (n)       | Presence (n)                  |
|--------------------------------------|-------------------|-------------------------------|
| <i>Clinical background</i>           |                   |                               |
| Age > 80 years                       | 6.12 ± 1.58 (83)  | 6.26 ± 1.73 (85)              |
| Male                                 | 6.09 ± 1.74 (92)  | 6.32 ± 1.54 (76)              |
| <i>Underlying chronic conditions</i> |                   |                               |
| Stroke                               | 6.19 ± 1.64 (81)  | 6.20 ± 1.68 (87)              |
| Ischemic heart disease               | 6.20 ± 1.68 (134) | 6.15 ± 1.59 (34)              |
| Chronic congestive heart failure     | 6.20 ± 1.65 (153) | 6.07 ± 1.71 (15)              |
| Chronic kidney disease               | 6.17 ± 1.63 (133) | 6.29 ± 1.74 (35)              |
| Dementia                             | 6.01 ± 1.63 (74)  | 6.33 ± 1.67 (94)              |
| Diabetes mellitus                    | 6.23 ± 1.66 (155) | 5.69 ± 1.55 (13)              |
| Dyslipidemia                         | 6.12 ± 1.63 (106) | 6.31 ± 1.69 (62)              |
| Bedridden state                      | 6.17 ± 1.66 (142) | 6.31 ± 1.62 (26)              |
| Obesity                              | 6.08 ± 1.70 (126) | 6.52 ± 1.49 (42) <sup>†</sup> |
| Poor nutritional state               | 6.09 ± 1.68 (144) | 6.79 ± 1.38 (24)*             |
| Lung disease                         | 6.14 ± 1.65 (139) | 6.34 ± 1.70 (29)              |

Abbreviations: hMPV, human metapneumovirus; IgG, immunoglobulin G. <sup>†</sup>P<0.20, \*P<0.05; case-control difference, by Mann-Whitney analysis.

kidney disease and stroke history were used as potential confounders. The log<sub>2</sub> (anti-hMPV-IgG titer/10) value was significantly related to an increased hypertension risk after adjustment for age, sex and potential confounding factors, with a matched OR estimate for hypertension of 1.42 (95% CI, 1.16–1.75, P=0.001; Table 3). Conditional logistic regression analysis using the same confounding factors revealed that log<sub>2</sub> (anti-hMPV-IgG titer/10) was significantly related to an increased hypertension risk, both in the hypertension subjects treated with any of the antihypertensive agents (n=65, OR: 1.34, 95% CI: 1.07–1.67, P=0.011) and in untreated hypertensive subjects (n=19, OR: 1.60, 95% CI: 1.10–2.31, P=0.013).

**Relationship between log<sub>2</sub> (anti-hMPV-IgG titer/10) and chronic clinical conditions**

Table 4 compares log<sub>2</sub> (anti-hMPV-IgG titer/10) values between the groups with and without chronic clinical conditions, including older age (> 80 years), male sex, obesity (body mass index ≥25 kg m<sup>-2</sup>), diabetes mellitus, dyslipidemia, stroke, ischemic heart disease, chronic congestive heart failure, chronic kidney disease, dementia, a bedridden state, a poor nutritional state represented by hypoalbuminemia, and lung disease. The log<sub>2</sub> (anti-hMPV-IgG titer/10) value was significantly (P=0.020) higher in the 24 subjects with a poor nutritional state than in the 144 subjects with good nutrition. The log<sub>2</sub>

**Table 5 Stepwise multiple regression analysis to assess independent determinants for log<sub>2</sub> (anti-hMPV-IgG titer/10)**

| Characteristic (unit)  | $\beta$ | <i>t</i> | P      |
|------------------------|---------|----------|--------|
| Hypertension           | 0.261   | 3.610    | <0.001 |
| Poor nutritional state | 1.89    | 2.51     | 0.013  |
| Obesity                | 0.086   | 1.150    | 0.256  |
| Male sex               | 0.067   | 0.906    | 0.369  |
| Age (years)            | 0.036   | 0.481    | 0.622  |

Abbreviations: hMPV, human metapneumovirus; IgG, immunoglobulin G.

(anti-hMPV-IgG titer/10) value tended to be higher ( $P=0.190$ ) in obese subjects (body mass index  $\geq 25 \text{ kg m}^{-2}$ ) than in non-obese subjects. There was no significant difference between the groups with and without other clinical conditions (Table 4). To determine the associating factors for log<sub>2</sub> (anti-hMPV-IgG titer/10) in all elderly subjects, a multiple stepwise regression analysis was carried out using age, sex, hypertension, a poor nutritional state and obesity as confounding factors. The analysis revealed that a poor nutritional state and hypertension were independent contributing factors for increases in log<sub>2</sub> (anti-hMPV-IgG titer/10) values in all subjects (Table 5).

## DISCUSSION

The present case-control study revealed that anti-hMPV-IgG titer was independently associated with hypertension after adjusting for confounding factors in elderly subjects in an LTCF. Moreover, the multiple stepwise regression analysis revealed that hypertension and a poor nutritional state, among many underlying clinical conditions, contributed to increases in serum anti-hMPV-IgG titer in all elderly subjects. Although subjects with a poor nutritional state, reflected by hypoalbuminemia, are known to be susceptible to viral infection,<sup>17</sup> the findings in this study that this condition was also a risk factor for hMPV infection in elderly subjects in LTCFs is novel.

The precise mechanism(s) underlying the role of hypertension in anti-hMPV-IgG titer increases is unclear. One possible explanation is that some antihypertensive agents influenced the hMPV infection. In this study, however, there were no significant anti-hMPV IgG titer differences between any two subgroups of antihypertensive treatment, including the non-treatment subgroup in hypertensive elderly subjects; furthermore, the mean log<sub>2</sub> (anti-hMPV-IgG titer/10) values in the angiotensin II-receptor blocker, angiotensin I-converting enzyme inhibitor and non-treatment subgroups were significantly higher than in the normotensive elderly subjects. These observations suggest that antihypertensive agents have a minimal role in the increased anti-hMPV-IgG titers observed in the hypertensive elderly group.

The second possibility is that hypertension itself may cause higher anti-hMPV-IgG titers in the elderly. It is reported that patients with hypertension have significantly higher serum IgG levels in comparison with normotensive controls,<sup>18</sup> and that serum IgG levels were increased in patients who survived malignant phase hypertension.<sup>19</sup> Meanwhile, there have been several reports regarding the seroprevalence of hMPV infection around the world. Almost all people acquire seropositivity for hMPV by the age of 10 years,<sup>2</sup> and hMPV is known to infect individuals repeatedly throughout adult life and into old age.<sup>5-9</sup> Although there are no reports of IgG titer differences between patients with hypertension and normotensive controls after individual infections with pathogens, including hMPV, it is possible that hypertension itself may increase the anti-IgG titer in response to repeated hMPV infections in the elderly. In this present cross-sectional study,

however, we could not show any time-course data for anti-hMPV-IgG titers in individual subjects.

The third possibility is that hypertension is the result of repeated hMPV infection. Several reports have associated the appearance of hypertension with predisposing repeated and/or chronic infections with many other pathogens, including *Chlamydia pneumoniae*,<sup>20</sup> herpes simplex virus type 2,<sup>21</sup> cytomegalovirus,<sup>22</sup> Coxsackie virus,<sup>23</sup> and *Helicobacter pylori*.<sup>24</sup> All these pathogens are known to directly affect vascular smooth muscle cells and/or vascular endothelial cells and to possibly cause the progression of atherosclerosis.<sup>20-29</sup> On the contrary, there is no evidence to date that hMPV has a direct effect on vascular smooth muscle cells or endothelial cells. hMPV is reported to affect airway epithelial cells and stimulate massive production of interleukin-8,<sup>30,31</sup> and regulate upon activation normal T-cell expressed and secreted.<sup>31</sup> On the other hand, interleukin-8 is known to closely relate to the genesis of hypertension because it enhances membrane permeability to Ca<sup>2+</sup> and induces vasoconstriction in smooth muscle cells<sup>32</sup> and because an antihypertensive calcium channel blocker, azelnidipine, is reported to reduce circulating interleukin-8 levels.<sup>33</sup> Moreover, circulating interleukin-8 is known to predict the development of atherosclerosis in coronary arteries.<sup>34</sup> On the other hand, regulate upon activation normal T-cell expressed and secreted is known to be a peripheral monocyte-related inflammatory marker related to hypertension.<sup>35</sup> It is possible that repeated hMPV infections cause spillover of these cytokines from the respiratory tract into the circulation, laying the foundation for hypertension in the elderly. Consequently, the findings of this study suggest that serum anti-hMPV-IgG titers contribute to the risk factors for hypertension in the elderly in LTCFs. Nevertheless, the specific underlying pathophysiological mechanisms that link hMPV with hypertension in the elderly have not yet been defined. Therefore, the precise mechanisms underlying the association between hMPV infection and hypertension should be determined in future basic and clinical studies.

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TUG groups. The difference in SPMT score at the second follow-up lost significance after additionally controlling for the baseline value.

## DISCUSSION

This study found that the gait speed and mobility were associated with global cognitive function after 3 years and were cross-sectionally associated with executive and memory functions. The results could suggest that slowing of mobility can be observed before decline in global function and coinciding with impairment in executive and memory functions in people aged 80 and older. These findings based on octogenarians and nonagenarians in Okinawa, Japan, known for their longevity, give additional generalizability to previous findings.<sup>2,10</sup> This association has potentially important implications for early detection of cognitive impairment in older people.

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**Sponsor's Role:** None.

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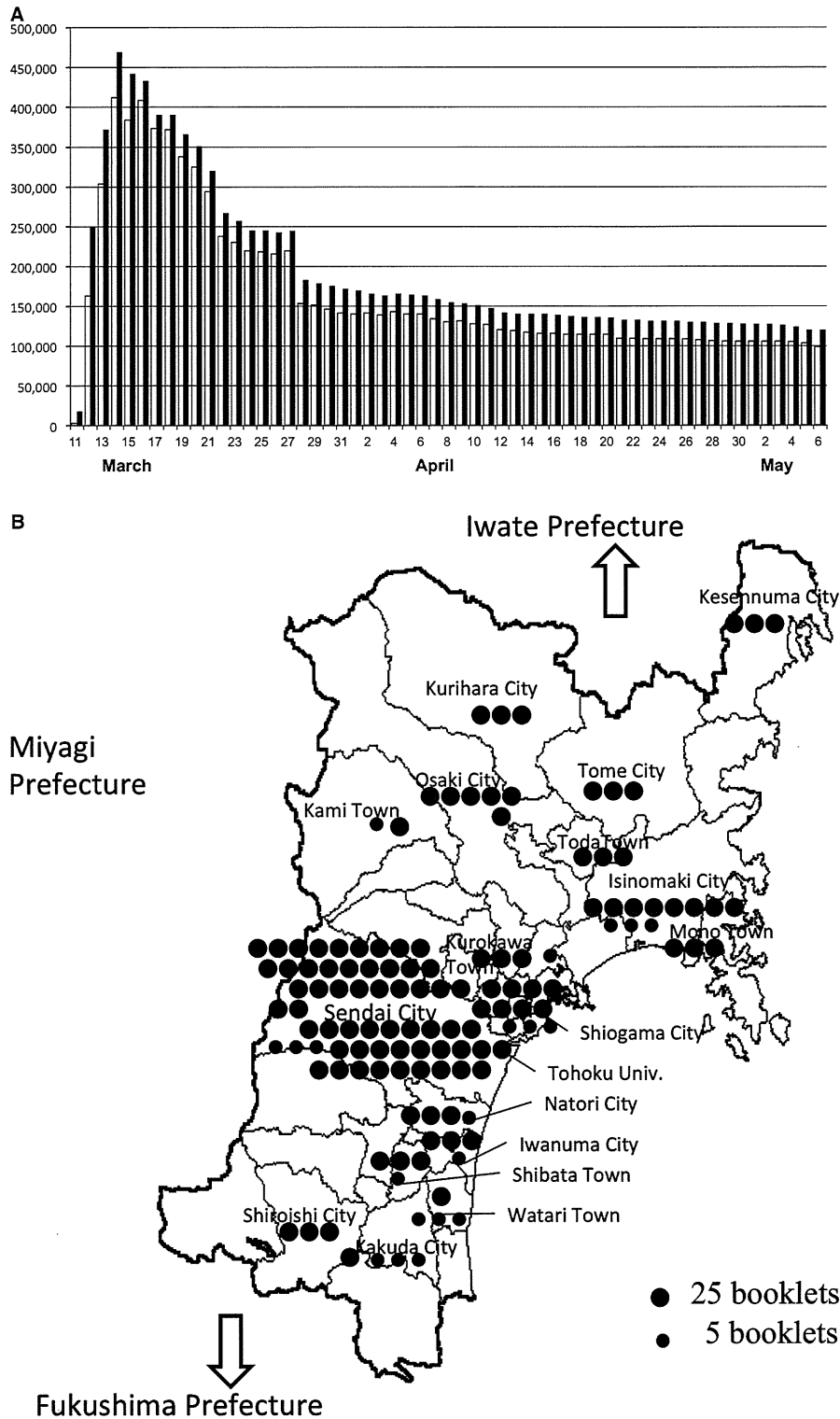
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## COMMENTS/RESPONSES

### GUIDELINES FOR NON-MEDICAL CARE PROVIDERS TO DETECT ILLNESSES IN ELDERLY EVACUEES AFTER THE 2011 EARTHQUAKE OFF THE PACIFIC COAST OF TOHOKU

*To the Editor:* On March 11, 2011, at 2:46 p.m. (JST), a strong earthquake occurred off the Pacific coast of Japan and hit the northeast part of the country. Devastating tsunamis followed that destroyed many coastal cities.<sup>1</sup> The magnitude of this quake according to the Japan Meteorological Agency was Mj9.0. A huge number of aftershocks continued after the quake, even now (May 6, 2011). According to the report by the National Police Agency of Japan, as of May 6, 2011, 14,841 people had died in this disaster, and 10,063 were still missing.<sup>2</sup> In addition, 109,086 homes were completely or partially destroyed, and 3,970 roads were disrupted.<sup>2</sup> As shown in Figure 1A, 119,967 displaced people (peak number approximately 470,000 on March 14, 2011) were still living in shelters supplied by the government as of May 6, 2011, because of disruption of community utility services and health risks of nuclear power plant accidents in Fukushima.<sup>2,3</sup> In particular, 37,482, 35,923, and 25,501 persons took refuge in the 357, 403, and 157 evacuation centers located in Iwate, Miyagi, and Fukushima prefectures, respectively.<sup>2</sup>

Drs. Shigeto Morimoto and Takashi Takahashi reported an outbreak of norovirus gastroenteritis in elderly evacuees after the 2007 Noto Peninsula earthquake in Japan.<sup>4</sup> There were 74 evacuees, including 61 elderly persons, in the shelter where the outbreak occurred.<sup>4</sup> Thirty-one evacuees with gastroenteritis, 29 of whom were aged 65 and older (mean age 76 ± 7), were examined and treated.<sup>4</sup> This experience suggests that elderly victims are more susceptible to disaster-related illnesses (i.e., infectious diseases, exacerbation of underlying illnesses, and mental stress) and disaster-related death. Therefore, a plan to establish guidelines to detect illnesses and perform triage rapidly in elderly evacuees was necessary. In April 2010, the six authors of the



**Figure 1.** (A) Variations in number of evacuees from March 11 to May 6. Black and white bars denote total number of evacuees in Japan and number of persons still evacuated in Iwate, Miyagi, and Fukushima prefectures, respectively. (B) Distribution of guideline booklets to detect illnesses in elderly evacuees in Miyagi prefecture. These were distributed in the largest city, Sendai, where most people in this prefecture were living. Large and small closed circles indicate 25 and 5 booklets, respectively.

current letter formed the Study Group of “Guidelines Regarding the First Steps and Emergency Triage to Manage Elderly Evacuees” under a grant-in-aid for scientific research from the Ministry of Health, Labour, and Welfare of Japan.

Two types of guidelines were established: one for medical care providers (MCPs) and the other for non-MCPs (NMCPs, e.g., public health nurses and certified social workers). The guidelines for NMCPs seemed to be more effective

than those for MCPs, because there were limited MCP resources. The guidelines had three chapters: features of critical illnesses and prevention, acute symptoms, and chronic symptoms in elderly evacuees. For NMCPs to be able to understand the contents easily, it was written concisely.

One week after the 2011 earthquake off the Pacific coast of Tohoku, the guideline booklets were sent through members of the Japan Geriatrics Society (JGS) or the Japan Medical Association Team (JMAT) to NMCPs working in Iwate, Miyagi, and Fukushima. JGS and JMAT members were dispatched to these areas to care for evacuees. NMCP staff used the booklets to detect illnesses rapidly in elderly evacuees in shelters or homes. For example, the booklets were distributed in the largest city, Sendai, where most people in Miyagi were living (Figure 1B). The aim was to reduce morbidity and mortality from disaster-related illnesses in elderly evacuees. An investigation of the differences in morbidity and mortality between areas where the guidelines were and were not applied is planned.

The Japanese people had already experienced another strong quake, the Great Hanshin earthquake, which caused serious damage in the Kobe area on January 17, 1995. This disaster also hit the elderly population of an urban society particularly hard. More than half of the deaths were in those aged 60 and older, and in this age group, female mortality was almost double that of men.<sup>5</sup> Surviving older adults were largely left to their own devices and were marginalized in shelters. Elderly evacuees tended not to complain about their problems, so their suffering tended to be underestimated,<sup>5</sup> and it is therefore important for NMCPs to detect medical conditions quickly in elderly evacuees.

The situation of the recent disaster is different from that of the Great Hanshin quake in terms of the presence of tsunamis and nuclear power plant accidents. The recent quake's epicenter was located beneath the sea and caused huge tsunamis, whereas the Hanshin quake's epicenter was under the land and did not cause tsunamis. Most of the deaths were a result of the tsunamis this time, whereas the victims of the Hanshin quake were related to structure collapses and fires. Moreover, the recent evacuees in Fukushima are at short- and long-term health risks from the nuclear power plant accidents.<sup>3</sup> Therefore, a survey of the morbidity and mortality from disaster-related illnesses in elderly evacuees in Iwate, Miyagi, and Fukushima is needed.

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### GAIT VELOCITY VERSUS THE TIMED UP AND GO TEST: WHICH ONE TO USE FOR THE PREDICTION OF FALLS AND OTHER ADVERSE HEALTH OUTCOMES IN PRIMARY CARE?

*To the Editor:* We read with great interest the recent article by Viccaro and colleagues in which they evaluated the predictive ability of the Timed Up and Go Test (TUG test) and gait velocity (GV) for falls and other adverse health outcomes.<sup>1</sup> Gait velocity predicted most geriatric outcomes, as did the TUG, and GV took less time to complete and demonstrated better prediction in individuals with intermediate (TUG = 12–15 seconds, GV = 0.6–1.0 m/s) and slow test performance (TUG < 12 seconds, GV < 0.6 m/s).

An important consideration when applying mobility measures across the spectrum of older people is the level





## COMMISSION REPORT

# Guidelines for non-medical care providers to manage the first steps of emergency triage of elderly evacuees

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On 11 March 2011, a strong earthquake occurred off of Japan's Pacific coast and hit northeastern Japan. The earthquake was followed by huge tsunamis, which destroyed many coastal cities. As a result, the Study Group on Guidelines for the First Steps and Emergency Triage to Manage Elderly Evacuees quickly established guidelines enabling non-medical care providers (e.g. volunteer, helpers, and family members taking care of elderly relatives), public health nurses, or certified social workers to rapidly detect illnesses in elderly evacuees, and 20 000 booklets were distributed to care providers in Iwate, Miyagi, and Fukushima prefectures. The aim of this publication is to reduce susceptibility to disaster-related illnesses (i.e. infectious diseases, exacerbation of underlying illnesses, and mental stress) and deaths in elderly evacuees. *Geriatr Gerontol Int* 2011; 11: 383–394.

**Keywords:** earthquake, elderly evacuee, emergency triage, guidelines, non-medical care provider.

## Background

Japanese people have already experienced a variety of natural disasters including earthquakes,<sup>1</sup> typhoons,<sup>2</sup> tsunamis,<sup>3</sup> and others. It is very important to manage

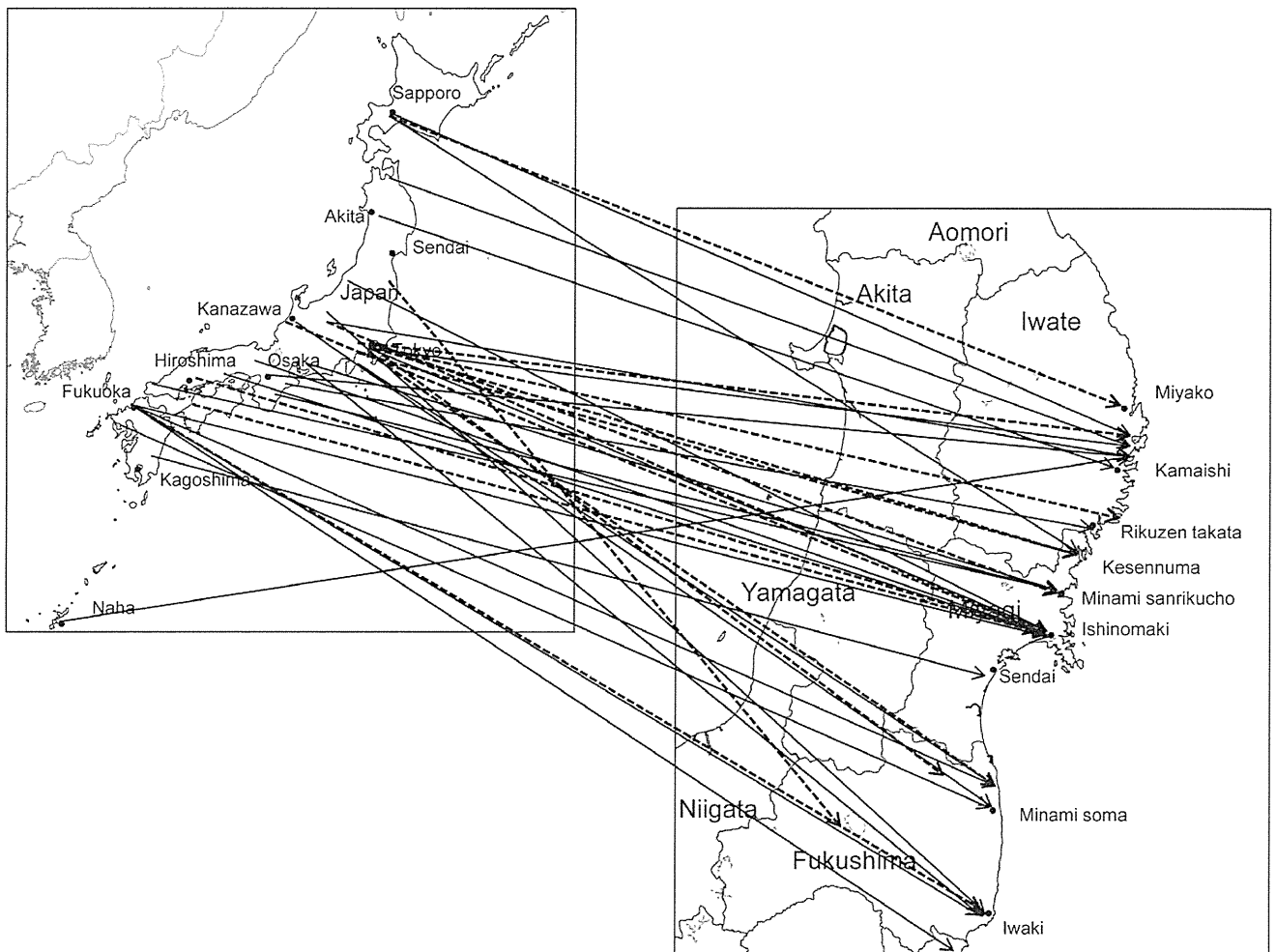
the medical care of elderly evacuees in the wake of disasters because: (i) elderly subjects (especially those needing to live in shelters) may suffer excessive mental and/or physical stress under the altered environment; and (ii) it is difficult to maintain medical management of chronic illnesses (e.g. hypertension, diabetes mellitus, cerebrovascular or cardiac disease) when care has already been started at local medical institutions. It was reported that acute risk factors possibly triggered cardiovascular events in hypertensive elderly patients after the Hanshin-Awaji earthquake.<sup>4</sup> Increased incidence of transient left ventricular apical ballooning (takotsubo cardiomyopathy) was also described after the Mid Niigata Prefecture Earthquake of 2004.<sup>5</sup>

In April 2010, the Study Group on "Guidelines for the First Steps and Emergency Triage to Manage Elderly

Accepted for publication 23 August 2011.

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**Authors' contributions:** Shigeto Morimoto and Takashi Takahashi contributed to the study concept and design. Masafumi Kuzuya, Hideyuki Hattori, and Koichi Yokono performed acquisition of data. Katsuya Iijima and Shigeto Morimoto analyzed and interpreted the data. Takashi Takahashi and Shigeto Morimoto prepared the manuscript.



**Figure 1** One week after the 2011 Tohoku earthquake, 20 000 booklets for non-medical care providers were distributed by members of the Japan Geriatrics Society (dotted lines) and Japan Medical Association Team (straight lines), to evacuation centers located in Iwate, Miyagi, and Fukushima prefectures.

Evacuees” was formed, with funding from Japan’s Ministry of Health, Labour and Welfare, to conduct comprehensive research on aging and health. The study group aimed to complete and revise the guidelines based on external reviews by expert medical doctors by March 2012.

By collaborating with the Japan Geriatrics Society after the 2011 earthquake off the Pacific coast of Tohoku, we have quickly published two tentative guidelines to manage elderly evacuees: one for medical care providers and another for non-medical care providers (NMCP), including volunteer, helpers, and family members who are taking care of the elderly, public health nurses (PHN), or certified social workers (CSW). A total of 20 000 guideline booklets have been distributed by members of the Japan Geriatrics Society and the Japan Medical Association Team to NMCP, PHN, or CSW working in Iwate, Miyagi, and

Fukushima prefectures (Fig. 1). The Japan Medical Association Team’s mission is to provide medical assistance at hospitals or clinics in disaster-affected areas and to provide ongoing medical treatment that was started before the disaster.<sup>6</sup>

## Preface

The guidelines for NMCP, PHN, and CSW have three chapters: (i) Features and prevention of critical diseases in elderly in evacuation areas; (ii) Signs of acute diseases in elderly; and (iii) Symptoms of anxiety in elderly in shelters. Ideally, NMCP, PHN, or CSW will use the booklets to rapidly detect illnesses in the elderly in shelters or homes. NMCP, PHN, or CSW should immediately inform attending medical staff when those with the signs or symptoms are detected.

## Guidelines

### I. Features and prevention of critical diseases in elderly in evacuation areas

1-1). *Heart attack.* This condition includes angina pectoris, myocardial infarction, and other illnesses due to myocardial ischemia, a lack of blood flow in arteries.

#### Signs and symptoms of a heart attack

|                      |  |
|----------------------|--|
| Location of symptoms | Central chest to left side of chest<br>Apart from chest discomfort, anginal pain in the upper central abdomen, back, neck, jaw, or shoulders   |
| Detailed symptoms    | Worsening (“crescendo”) chest pain, specifically crushing, burning, or choking sensation<br>Onset of severe oppression or worsening oppression |
| Duration of symptoms | Infrequent or lasting less than 10 min<br>Lasting more than 15 min, suggesting unstable condition  |

Note: Caution is needed because silent or mild symptoms frequently occur in the elderly, especially in those with diabetes. In addition, elderly people sometimes present with atypical symptoms, including breathlessness, nausea, discomfort in the upper central abdomen, or burping.

#### Measures to prevent heart attack in shelters

- NMCP, PHN, or CSW should be aware of elderly who normally take medication for cardiac disease and/or hypertension.
- NMCP, PHN, or CSW should check on the elderly.
- NMCP, PHN, or CSW should ensure that the elderly drink plenty of fluid, including water, to prevent dehydration. They should also advise that the elderly consume a low-salt diet and not smoke.
- If the elderly have any of the above symptoms, medical staff should be alerted.

#### Tips to treat cardiopulmonary arrest in shelters

- NMCP, PHN, or CSW should perform CPR, pushing the central chest strongly and quickly (100 times per minute) and alert medical staff immediately.

1-2). *Hypertension.* Awareness of blood pressure (BP) and its variability in the elderly is necessary because they may have excessive mental and/or physical stress, especially if in an emergency evacuation area or first-aid station, relative to their day-to-day lives before the disaster.

#### Measures to deal with elderly receiving antihypertensive drugs

- First, elderly people who are usually prescribed antihypertensive drugs should be reported to medical staff. NMCP, PHN, or CSW should check on the elderly.

- Elderly people who have been diagnosed as hypertensive should also be checked by medical staff, NMCP, PHN, or CSW.
- BP should be measured frequently. If possible, it is better to measure it daily using an automatic BP machine. In high-risk patients, it is recommended that BP be measured in both the morning and evening.
- If the elderly person’s medication is not known because the prescription record is lost, a doctor or medical staff should be consulted.
- If an elderly person has a headache, palpitations, chest symptoms, and/or flushing, BP should be measured immediately and medical staff consulted.
- No smoking and a low-salt diet are also recommended. Endeavors must be made to ensure the elderly maintain physical activity (e.g. any exercise for at least 30 minutes a day).

### 2. Stroke/cerebrovascular disease (CVD)

Cerebrovascular accidents occur suddenly due to a disturbance in the blood supply to the brain and lead to a loss of cerebral function.

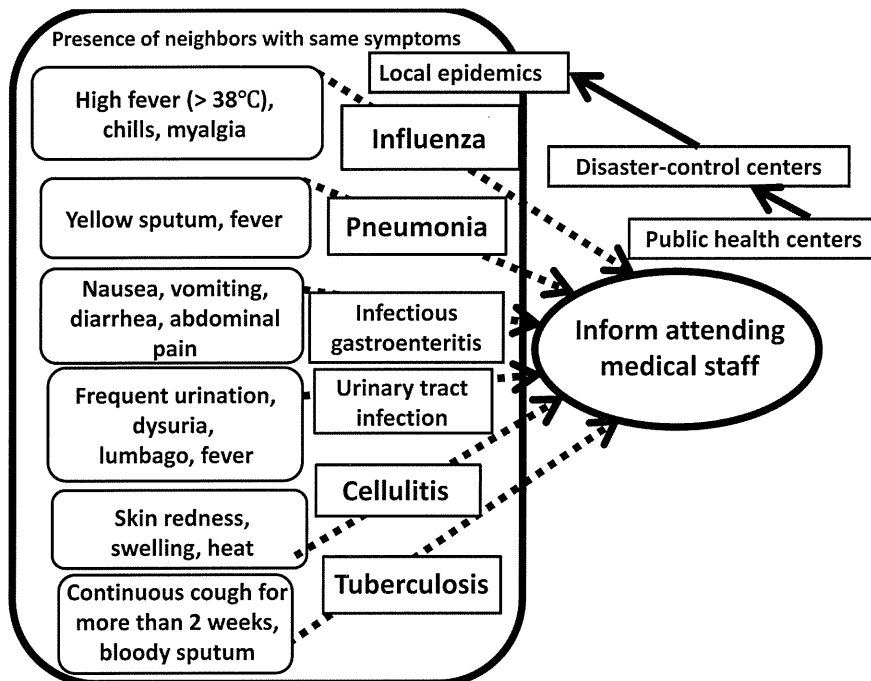
#### Signs and symptoms of stroke/CVD

If elderly people have any of the following symptoms, it is possible that they may have suffered a stroke/CVD. Consult medical staff immediately, because these situations may become medical emergencies.

- Symptoms starting suddenly and lasting from a few seconds to minutes
- Headache (mild to severe)
- Vertigo and/or dizziness (with nausea/vomiting on occasion)
- Disturbance of consciousness (snoring-like breathing, semiconscious state/coma)
- Motor disturbance including hemiparesis/hemiplegia/numbness, exhaustion, muscle weakness of the face (central facial palsy), drooling from one corner of the mouth, eyelid drooping (ptosis)
- Aphasia (difficulty with verbal expression, auditory comprehension)
- Sensory or vibratory disturbance (on one side)
- Visual field defect/hemianopia, double vision/polyopia
- Loss of balance when sitting, standing, or walking; loss of coordination.

#### Measures to prevent stroke/CVD in shelters

- First, medical staff and people around should be aware of elderly people who usually take medication for atherosclerotic diseases and/or lifestyle-related diseases (e.g. hypertension, diabetes, dyslipidemia, and cardiac diseases including atrial fibrillation).
- Also, people around should check on the elderly.



**Figure 2** Measures to rapidly detect infectious diseases.

- Continue usual drugs including anticoagulation drugs if possible.
- In cases of unidentified medical conditions because of loss of an elderly person's prescription record, medical staff should be consulted.
- Anticoagulation drugs are generally essential. However, it is better to consult medical staff because it is necessary to check for external wounds or bleeding from the gastrointestinal tract, including stress-induced ulcer.
- CVD is strongly associated with hypertension. Measure BP regularly.
- No smoking is strongly recommended.
- Drink any fluid, including a lot of water, to prevent dehydration.
- A low-salt diet is strongly recommended. Endeavor to take dietary fiber in vegetables including seaweed and mushrooms.
- Endeavor to do any type of exercise or walk for at least 30 minutes a day regularly.
- Prevent constipation.
- Be careful about changes in temperature, especially in winter.

### 3. Infectious diseases

#### Signs and symptoms of infectious diseases

It is useful to have information on epidemics of infectious diseases in stricken areas before and after disasters, in order to quickly detect illness. In particular, this measure is beneficial for diseases, such as influenza, food poisoning and viral gastroenteritis, with a short

incubation time from infection to the onset of symptoms (i.e. several hours up to 3 days). Pay special attention to elderly persons with these symptoms and immediately inform medical staff if there is suspicion that an elderly person has such an illness. In relation to this point, it is important to collect epidemiological information from district public health centers through disaster-control centers (Fig. 2).

In fact, many evacuees in shelters developed vomiting and diarrhea after the 2007 Noto Peninsula Earthquake. It was possible to immediately predict an outbreak of norovirus gastroenteritis among evacuees since a local epidemic of this infectious disease had already been observed in the Noto area before the quake.

However, local epidemics are not always useful for detecting infectious diseases, particularly those with a long incubation period (i.e. several months up to 2 years) such as pulmonary tuberculosis.

#### Measures to prevent transmission of infectious agents in shelters

- The environment in shelters induces an increased risk for outbreaks of infectious diseases because many evacuees are living together in a very limited space.
- It is very important to wash hands and gargle as standard precautions. Please apply hand disinfectant when it is not possible to use water. It is essential to wash hands or use hand disinfectant after using the toilet.
- NMCP, PHN, or CSW should not directly touch human bodily fluids (e.g. blood, urine, feces, nasal discharge, and sputum) with their hands because the fluids may include infectious microorganisms.

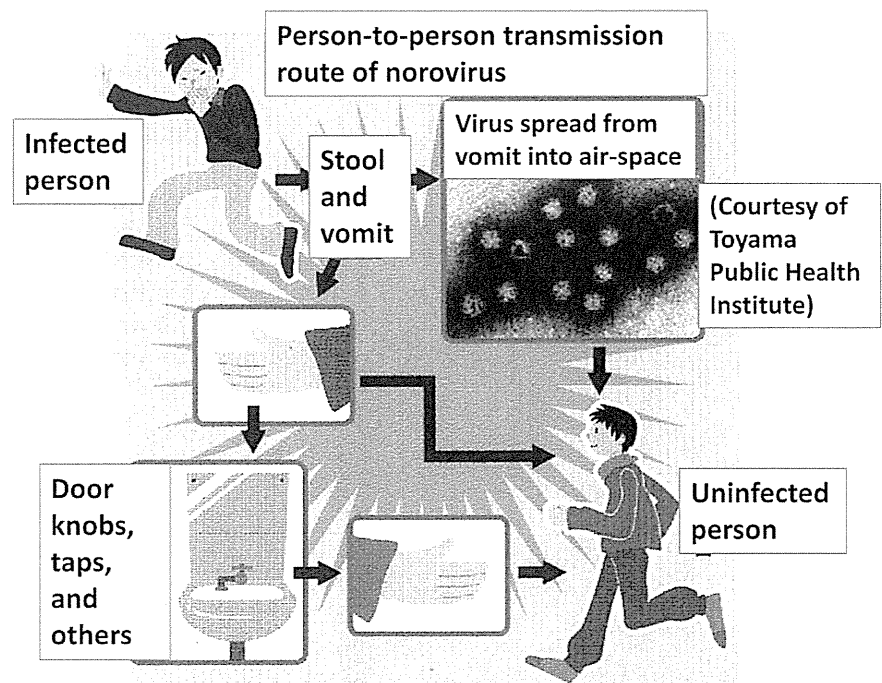


Figure 3 Person-to-person transmission route of norovirus.

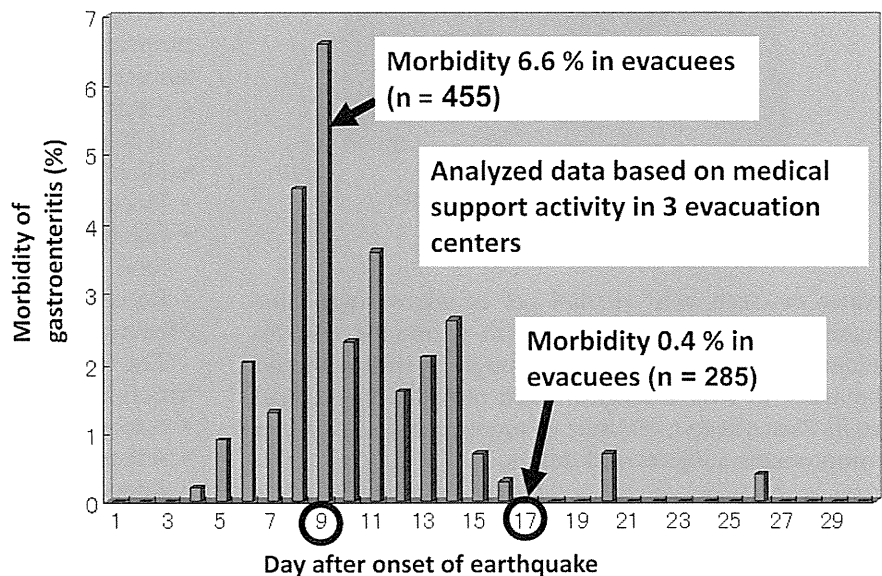


Figure 4 Morbidity of gastroenteritis in evacuees in shelters after the 2007 Noto Peninsula Earthquake.

If NMCP, PHN, or CSW are aware that the environment (floors in shelters, portable toilets, and temporary water-suppliers) has been contaminated with vomitus or diarrheal matter, contact medical staff. Do not clean the contaminated environment yourself. The staff can deal with this using 0.1% sodium hypochlorite disinfectant.

- Norovirus can spread via person-to-person transmission and lead to gastroenteritis outbreaks (Fig. 3).<sup>7</sup> However, it is unnecessary to isolate subjects with gastroenteritis from the stricken areas. The outbreak

in shelters after the Noto quake was quelled after one week of interventions including personal hand hygiene, gargling, and the use of disinfectant on environmental surfaces (Fig. 4).<sup>8</sup>

In addition, respiratory hygiene (cough etiquette) is recommended to prevent respiratory infections.<sup>9</sup> With respect to coughing, rhinorrhea, sneezing, and sputum, please instruct evacuees to behave as follows: (i) use a tissue to cover your mouth and nose when you cough or sneeze (Fig. 5); (ii) drop used tissue in a special waste basket; and (iii) wash your hands with soap and warm



**Figure 5** Respiratory hygiene (cough etiquette).

water or clean with alcohol gel or wipes since your hands may be contaminated with secretions (Fig. 5). Elderly people who frequently cough or sneeze should be asked to wear a surgical mask provided by medical staff. Please keep a distance of more than 1 m between symptomatic subjects and others.

#### 4. Dehydration

##### Signs and symptoms of dehydration

If an elderly person has some of the more severe symptoms of dehydration listed below, call medical staff immediately.

- Muscle weakness
- Physical fatigue
- Increased body temperature
- Decreased urine production
- Dry skin, even under the armpits.

##### Measures to prevent dehydration in shelters

- When elderly people feel thirsty, they are already dehydrated, so do not restrict water intake.
- To prevent dehydration, an elderly person without particular illness such as heart failure or kidney failure

**Table 1** Risks for dehydration in the elderly

---

|  |
|--|
| Inability to feed oneself                              |
| Appetite loss (decrease in food intake)                |
| Swallowing problems                                    |
| Diarrhea or vomiting                                   |
| Thirsty or dry mouth                                   |
| Taking a diuretic                                      |
| Increased body temperature                             |
| Decreased urination                                    |
| No air conditioning/not using air conditioning         |
| Limitation of water intake to avoid frequent urination |

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simply needs to replenish fluids with at least one liter of water per day.

- When elderly people have any of the risks for dehydration listed in Table 1, they should be carefully assessed by a doctor for dehydration.

#### 5. Malnutrition

##### Signs and symptoms of malnutrition

When an elderly person has any of the risks for malnutrition listed below, the person should be carefully assessed by medical staff.

- Consumed less than half the usual dietary intake for at least 1 week
- Diarrhea or vomiting for more than 2 or 3 days
- Decrease in body weight of more than 5% for 2 weeks
- Insufficient intake or dysphagia due to inadequate food
- Receiving enteral or parenteral nutrition.

##### Measures to prevent malnutrition in shelters

The following general precautions to prevent malnutrition should be considered:

- Adequate food supply
- Adequate types of food consumed
- Adequate feeding assistance
- Dental issues such as gum disease, cavities, and poorly fitting dentures
- Regular assessment of nutritional status and weight loss.

#### 6. Gastrointestinal disorders

##### Signs and symptoms of gastrointestinal disorders

When elderly evacuees have any of the signs and symptoms of gastrointestinal disorders listed below, they should be carefully assessed by medical staff.

- Upper central abdominal pain after meals (on suspicion of stomach ulcer)
- Upper central abdominal pain when hungry (on suspicion of duodenal ulcer)
- Gastric discomfort

- Appetite loss
- Heartburn
- Tarry (black) stool or blood in the stool.

#### **Measures to prevent gastrointestinal disorders in shelters**

The following general precautions to prevent gastrointestinal disorders should be considered:

- Avoid psychological stress.
- Eat substantial meals at regular mealtimes.
- Wash hands, gargle, and disinfect cooking utensils to prevent infectious enteritis.
- Flush or discard any vomit, and change diapers with rubber gloves while wearing a flu mask. Thoroughly clean and disinfect contaminated surfaces with a bleach-based household cleaner immediately after an episode of illness.
- Drink sufficient liquid and take a lot of exercise to avoid constipation.
- Do not ignore the urge to defecate and maintain a regular bowel habit.

### *7. Diabetes mellitus (DM)*

#### *7-1). Hyperglycemia*

##### **Signs and symptoms of exacerbation of DM**

If elderly people have any of the symptoms described below, their DM might be worsening. Please contact medical staff if any of the following symptoms are detected:

- Frequent urination
- Increasing incontinence
- Thirst
- Fatigue
- Not looking well.

##### **Measures to prevent exacerbation of DM in shelters**

- Eat meals regularly and take medication with meals.
- Patients with DM type 1 should not skip basal insulin injections.
- Drink enough water to prevent dehydration.
- If someone has a fever or little appetite, monitor blood glucose more frequently than usual or consult a doctor promptly.

*7-2). Hypoglycemia.* In addition, if elderly evacuees are taking hypoglycemic medication, be alert for symptoms of hypoglycemia.

##### **Signs and symptoms of hypoglycemia**

The symptoms described below might be caused by hypoglycemia. Please contact medical staff if any of the following symptoms are detected:

- Strong feeling of hunger
- Cold sweats
- Palpitations
- Weakness

- Sleepiness
- Slurred speech
- Blurred vision
- Convulsion.

##### **Measures to prevent hypoglycemia in shelters**

- Elderly people should avoid exercise or working when hungry.
- Eat meals regularly.
- Eat carbohydrates (e.g. rice, bread, noodles, or potatoes).
- If people cannot eat a meal, they should reduce or skip their hypoglycemic medication.
- Set a higher goal of glucose control (150–200 mg/dL) than usual.

##### **Tips to treat hypoglycemia in shelters**

- NMCP, PHN, or CSW should ask those with the above symptoms to take a glucose tablet.

### *8. Bronchial asthma*

##### **Signs and symptoms of exacerbation of bronchial asthma**

If elderly people have any of the following symptoms, bronchial asthma might be worsening. Please contact medical staff if the following symptoms are detected:

- Paroxysmal wheezing or coughing, or reoccurrence of these symptoms
- Breathlessness during the night
- Breathlessness when moving, speaking, or lying down
- Cyanosis or edema
- Drowsiness.

##### **Measures to prevent exacerbation of bronchial asthma in shelters**

- Let NMCP, PHN, CSW, or medical staff know that if an elderly person is taking medication.
- Continue taking medicine.
- Wash your hands and gargle regularly, wear a mask if available, and be careful about infectious diseases such as colds.
- Keep warm.

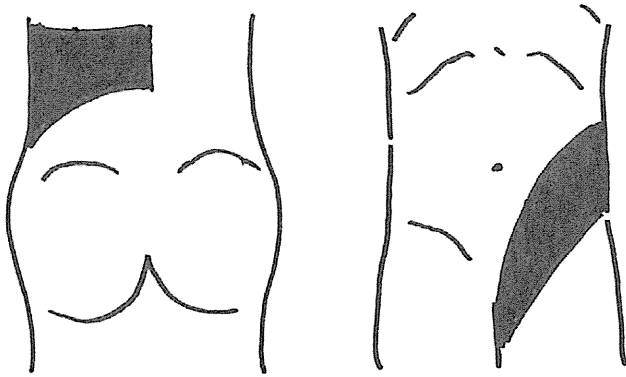
### *9. Chronic obstructive pulmonary disease (COPD)*

##### **Signs and symptoms of exacerbation of COPD**

If an elderly person has any of the following symptoms, COPD might be worsening. Please contact medical staff if the following symptoms are detected:

- Increased respiratory rate and shortness of breath
- Worsening of dyspnea on exertion or at rest
- Increased frequency or severity of cough and excessive sputum production
- Mucopurulent sputum (change in sputum character)
- Cyanosis or edema
- Drowsiness.

##### **Measures to prevent exacerbation of COPD in shelters**



**Figure 6** Areas where pain occurs due to urinary tract diseases.

- Let NMCP, PHN, CSW, or medical staff know if an elderly person is taking medication.
- Continue taking medication and inhaling bronchodilators.
- Avoid exposure to smoke and dust.
- Try to wash your hands and gargle regularly.
- Keep warm and do not stay in the cold.

#### 10. Chronic kidney disease (CKD)

##### Signs and symptoms of CKD

If elderly evacuees have any of the following symptoms, CKD might be worsening. Please contact medical staff if the following symptoms are detected:

- Inactivity, fatigue, or weakness
- Edema
- Appetite loss
- Nausea and/or vomiting
- Pruritus.

##### Measures to prevent CKD in shelters

- Let NMCP, PHN, CSW, or medical staff know if an elderly person is taking medication.
- Continue taking medicine.
- Have regular blood pressure checks.
- Restrict salt intake.
- Drink enough water to prevent dehydration.
- Keep warm.
- Be careful about infectious diseases such as colds.

#### 11. Urinary diseases

##### Signs and symptoms of urinary diseases

If an elderly person experiences some of the more severe symptoms of urinary diseases listed below, call medical staff immediately.

- Pain on urination
- Lower abdominal pain (Fig. 6)
- Back pain, lumbago (Fig. 6)
- No urination for half a day or longer

- Distention of lower abdomen
- Bloody urine
- Cloudy smelly urine
- Frequent urination
- Incontinence
- High fever (in cases of pyelonephritis, 38°C or higher)
- Limiting water intake in order to avoid frequent urination or incontinence.

##### Measures to prevent urinary diseases in shelters

- Replenish fluids with at least one liter of water per day in persons without particular illness such as heart failure or kidney failure.
- Do not avoid going to the toilet.

#### 12. Post-traumatic stress disorder (PTSD)

##### Signs and symptoms of PTSD

Please contact medical staff if an elderly person has any of the following symptoms. Please contact medical staff if the following signs are detected:

- Sudden change in personality
- Absent-mindedness and the inability to respond quickly
- Restlessness
- Frequent hyperventilation
- Frequent palpitations
- Panic attacks.

##### Measures to prevent PTSD in shelters

- If elderly people feel distressed or pain, they should confide in someone (a medical staff member, NMCP, PHN, or CSW).
- It may be necessary for the elderly to take medication if they cannot sleep or feel distressed and there is no alternative.

#### 13. Depression

##### Signs and symptoms of depression

It is not unusual for an elderly person to experience grief after suffering from severe stress. Please contact a medical staff member if the following symptoms of depression are detected:

- Cannot help thinking of bad things
- Not knowing what to do despite actually having many things to do
- Feeling too sluggish to move, although the results of a medical checkup and blood tests are normal
- Unable to sleep at night
- Always thinking of dying.

##### Measures to prevent depression in shelters

- It is important to maintain a routine, including waking up and going to sleep at the same time daily.
- If elderly people feel distressed or pain, they should confide in someone (a medical staff member, NMCP, PHN, or CSW).



- It may be necessary for the elderly to take medication if they cannot sleep or feel distressed and there is no alternative.
- If an elderly person has been attending a clinic for the treatment of depression, please tell a medical staff member. It is important that the person continues to receive treatment.

#### 14. Behavioral and psychological symptoms of dementia (BPSD)

##### Signs and symptoms of BPSD

Please contact a medical staff member if the following symptoms of dementia are detected:

- Restlessness and speaking in a disjointed manner
- Paranoid or having delusions (e.g. a false idea of being robbed)
- Becoming angry or starting to cry suddenly.

##### Measures to prevent BPSD in shelters

- Create an environment in which dementia patients can spend time with familiar people.
- Prepare a quiet environment so that dementia patients can get adequate sleep at night.
- Preparations should be made so that a dementia patient can be transferred to a professional medical institute when psychological symptoms or behavioral abnormality is observed.

#### 15. Delirium

##### Signs and symptoms of delirium

Please contact medical staff if any of the following physical symptoms are detected in elderly persons who had previously been well and not experienced any decrease in cognitive function:

- Speaking or behaving in an erratic manner
- Absent-mindedness or being distracted
- Emotional instability (e.g. becoming angry, starting to cry, or getting excited suddenly).

##### Measures to prevent delirium in shelters

- Particular attention should be paid to dehydration, infections, and other underlying physical disorders, which can cause delirium in the elderly. Please be aware that elderly people with physical disorders are potential delirium patients.
- Keeping the elderly company and talking to them to provide stimulation are effective for preventing lethargy during the daytime. At night, create a quiet environment to help them achieve a regular sleeping pattern.

#### 16. Dental diseases

##### Signs and symptoms of dental diseases

If an elderly person is showing some of the more severe symptoms of dental disease listed below, call medical staff immediately.

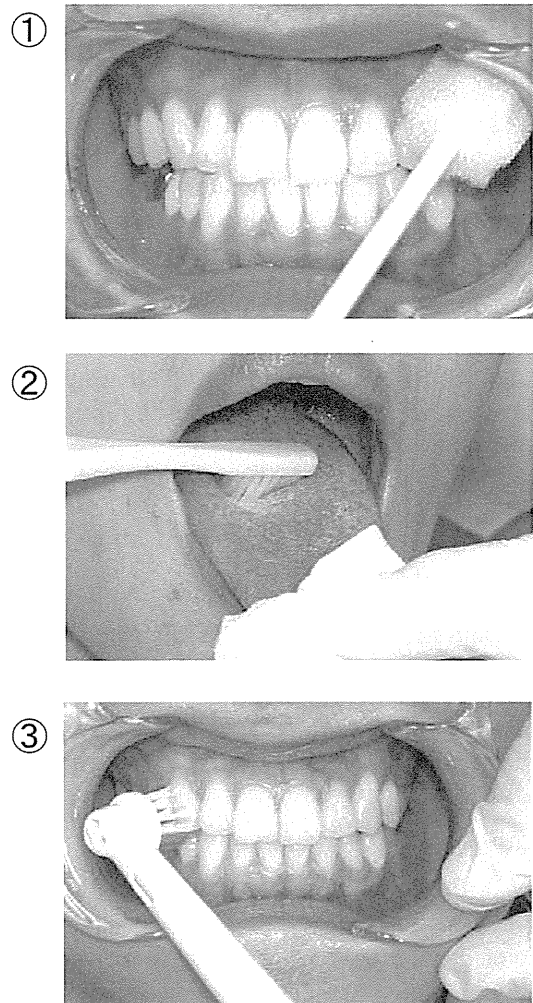


Figure 7 Systematic oral care program.

- Pain from dental caries
- Swelling and bleeding of the gingival
- Severe halitosis
- Fur on the tongue.

##### Measures to prevent dental diseases in shelters

- Keep cleaning the mouth.
- Brush the teeth every day.
- Those who are unable to do the above independently need to receive a systematic oral care program (Fig. 7)<sup>10</sup>

- 1 Remove oral-mucosal and gingival saburra by using an oral care sponge for one minute.
- 2 Remove fur from the tongue with a tongue brush for half a minute.
- 3 Remove bacterial flora from the tooth surface with an electric toothbrush for 2.5 minutes, if an electric power supply is available.
- 4 Rinse the mouth for 1 minute.

## 17. Functional inactivity

### Signs and symptoms of functional inactivity

Elderly people often may not complain of their subjective symptoms accurately, or they may not be aware of a decline in their health. Thus, it is important for NMCP, PHN, or CSW to be aware of elderly persons' health conditions as well as the whereabouts of subjects who require support and/or nursing care.

If an elderly person shows some of the more severe symptoms of functional inactivity listed below, call medical staff and/or shelter staff.

- Being isolated, with no attempt to communicate
- Narrow range of activities and staying indoors
- Lying down all day long

### Measures to prevent functional inactivity in shelters

- Encourage subjects to greet each other and make small talk in the shelter.
- Exercise regularly.
- Bend and stretch your arms and legs often, even in the narrow living space in the shelter.
- NMCP, PHN, or CSW should evaluate the reserve capability of elderly subjects with functional inactivity promptly.

## 18. Decubitus

### Signs and symptoms of decubitus

NMCP, PHN, or CSW should actively survey the onset of decubitus ulcer, particularly on the hip, the backbone, the heel, and the back of the head, in bedridden subjects. Since this illness needs long-term management, contact medical staff and arrange transport to the hospital.

### Measures to prevent decubitus in shelters

- Change bedridden subjects' position every 2 hours a day.
- Keep the skin clean.

## 19. Heat stroke

### Signs and symptoms of heat stroke

In summer, pay special attention to heat stroke in elderly people in shelters. The main features are hot skin (body temperature  $\geq 40^{\circ}\text{C}$ ) without sweat and drowsiness. Call medical staff immediately as this condition will cause fatality.

### Measures to prevent heat stroke in shelters

- Keep cooling the neck or under the arms.
- Do not restrict water intake.

## II. Signs of acute diseases in elderly

If any of the following symptoms is encountered in the elderly, they may be severely ill due to acute disease.

These signs of acute diseases are sensitive enough to rapidly detect a severe state in elderly evacuees. NMCP, PHN, or CSW should consult attending medical staff immediately. Asterisks denote signs indicating the need for emergency transport.

### 1. Disturbance of Consciousness (Japan Coma Scale [JCS] Scoring)

- Rousable by being spoken to but reverts to previous state if stimulus stops (JCS II-10)
- Rousable with loud voice but reverts to previous state if stimulus stops (JCS II-20)
- Rousable only by repeated mechanical stimuli (JCS II-30)
- \* Unrousable using any forceful stimuli but responds to avoid the stimuli (JCS III-100 to III-300).

### 2. Shock

- \* Anemia (e.g. pallor of lips and/or nails)
- \* Bleeding due to external injuries
- \* Disturbance of consciousness (JCS III-100 to III-300)
- Abnormal skin turgor, a physical sign of dehydration
- Dry tongue
- \* A decline in BP: systolic BP  $< 90$  mmHg
- \* An increase or decrease in pulse rate (i.e. resting pulse rate of more than 120 beats/minute or less than 50 beats /minute).

### 3. Dyspnea

- Shallow and rapid respiration, puffing (shallow breathing)
- Shoulder breathing (accessory muscle use)
- Flaring of wings of the nose and dilated nostrils (nasal alar breathing)
- Violet color to lips and nails (cyanosis)
- Wheezing or whistling while breathing (wheeze/stridor)
- Sleeping with the upper body raised in order to breathe (orthopnea)
- Weak breathing, suspended on occasion (apnea)
- Pursing the lips when exhaling (pursed lips breathing)
- \* Collapse of supraclavicular or intercostal spaces when inhaling (inspiratory retraction)
- \* Distension of the abdomen/shrinking of the chest when inhaling, and shrinking of the abdomen/ distension of the chest when exhaling (seesaw breathing)
- \* Obvious asymmetric movement of the chest during respiration
- \* Respiratory rate less than 10/minute or more than 30/minute.

### 4. Acute abdomen

- \* Uncontrollable abdominal pain

- \* Hematemesis, vomiting blood
- \* Tarry (black) stool, visibly bloody stools not due to hemorrhoids
- \* Frequent vomiting
- \* Abdominal swelling, abdominal distension
- \* Severe anemia (pallor of face or lips).

#### 5. *Neurological abnormalities.*

- \* Motor disturbance including hemiparesis/hemiplegia/numbness, muscle weakness of the face (central facial palsy), eyelid drooping (ptosis)
- \* Aphasia (difficulty with verbal expression, auditory comprehension)
- \* Sensory or vibratory disturbance (unilateral)
- \* Visual field defect/hemianopia, double vision/polyopia
- \* Loss of balance when sitting, standing, or walking; loss of coordination
- \* Pupils not isocoric
- \* Convulsions or cramps.

#### 6. *Chest pain*

- \* Chest pain, oppression, burning, or choking sensation in anterior chest
- \* Increasing frequency and worsening angina attacks compared with 2 weeks earlier
- \* Chest symptoms even at rest or at night
- \* Continuation (without improvement) of these symptoms in spite of aspirin or nitroglycerine use
- \* Duration of chest symptoms: more than 20 minutes.

#### 7. *Hypertensive emergency*

- \* Hypertension (systolic BP  $\geq$  200 mmHg).

#### 8. *High fever*

- Shivering (shaking chills) coinciding with high fever and potential severe infectious diseases (i.e. bacteremia)
- Burning forehead and poor response to being called.

#### 9. *Hematuria*

- Red and/or tea-colored urine.

### **III. Symptoms of anxiety in elderly in shelters**

If an elderly person is showing some of the symptoms listed below, immediately ask medical staff to assess the presence of serious diseases.

#### 1. *Dysphagia, difficulty in swallowing*

- Coughing or breathing in food while swallowing

- Aspiration (i.e. escape of food or liquid into the lungs) or labored breathing while swallowing
- Recurrent pneumonia, respiratory infections, or choking experiences
- Wet vocal quality (“gurgly” voice) after swallowing
- Irritability during feeding or failure to thrive
- Prolonged feeding times (more than one hour)
- Unexplained weight loss.

#### 2. *Diarrhea*

- Subject has diarrhea and a fever.
- Similar symptoms (diarrhea) are observed in surrounding evacuees.
- If diarrhea persists for two days or more, ask medical staff to assess, in order to avoid dehydration.

#### 3. *Constipation*

- Change in bowel habit
- Constipation with abdominal pain
- Constipation for 2 or more days.

## **Discussion**

On 11 March 2011, an earthquake with a 9.0 magnitude occurred off of Japan’s Pacific coast and hit northeast Japan. The earthquake was followed by huge tsunamis, which destroyed many coastal cities.<sup>11,12</sup> A total of 14 841 people died in these events, and 10 063 persons are still missing as of 6 May 2011.<sup>13</sup> In addition, 109 086 homes were completely or partially destroyed, and 3970 roads were damaged.<sup>13</sup> There are still 119 967 displaced people (down from approximately 470 000 on March 14) living in shelters because of disrupted community utility services and/or health risks related to the nuclear power plant accidents in Fukushima.<sup>13-15</sup> Specifically, 37 482, 35 923, and 25 501 persons took refuge into the 357, 403, and 157 evacuation centers located in Iwate, Miyagi, and Fukushima prefectures, respectively.<sup>13</sup>

There were several reports concerning medical needs following the 2011 earthquake off the Pacific coast of Tohoku. For instance, reports have highlighted the importance of managing the exacerbation of chronic illnesses (e.g. hypertension, cardiac disease, DM, and chronic pulmonary disease) as well as dehydration in elderly evacuees, especially as it was difficult to source enough medication for their chronic illnesses.<sup>16,17</sup> Health workers should pay attention to the possible spread of acute diseases such as gastroenteritis, diarrhea, and other illnesses associated with dirty water.<sup>16</sup> In addition to physical health problems, it is important to rapidly detect long-term mental problems in the elderly (e.g. PTSD, depression, BPSD, and delirium) triggered by the disaster.<sup>16,17</sup> Medical specialists have indicated

that thousands of victims will be in need of long-term counseling to cope with the loss of their relatives, friends, and homes.<sup>16</sup>

There were some cases that previous guidelines failed to cover because of the unexpected phenomena following the Tohoku earthquake. Therefore, it is essential that we are mindful of the difficulties in establishing general guidelines that can cover a wide (and unexpected) range of disasters. Feedback regarding the booklets will need to be collected from NMCP, PHN, or CSW to assess the guidelines' usability. We further need to investigate the morbidity and mortality from disaster-related illnesses among the elderly in order to clarify efficacy of these guidelines.

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## Conflict of interest

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