Impact of pandemic flu training on ability of medical personnel to recognize an index case of avian influenza

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Background: This study investigated the relationship between training programmes for pandemic flu and level of knowledge of health-care professionals with performance in an avian flu exercise. Methods: Training programmes of all general hospitals in Israel for managing a pandemic influenza were evaluated. Spearman’s ρ correlation was used to analyse the relationship between training scores and level of knowledge of medical personnel with performance in an avian flu exercise. Hospital preparedness levels were evaluated at two time points and Wilcoxon signed-rank test was used to determine if overall preparedness scores improved over time. Results: Evaluation of training programmes for pandemic influenza showed high to very high scores in most hospitals (mean 85, SD 22). Significant correlations between training and performance in the exercise were noted for: implementation of training programmes 0.91, P = 0.000; content of training 0.61, P = 0.001; and training materials 0.36, P = 0.05. Overall reliability of the evaluation scores was 0.82 and reliability for two of the sub-scales was: implementation of the programme 0.78; and designating personnel for training 0.37. No significant correlation was found between level of knowledge and performance in the exercise. Discussion: Training programmes for hospital personnel for pandemic flu have a significant role in improving performance in case of pandemic flu. The key component of the training programme appears to be the implementation of the programme. Use of knowledge tests should be further investigated, as they do not appear to correlate with the level of emergency preparedness for pandemic influenza.

Introduction

During the last decade, the possibility of an outbreak of a human pandemic influenza has caused a high level of concern amongst health-care professionals.1 The 2009 A/H1N1 pandemic outbreak has accentuated the need for the development of pandemic influenza preparedness programmes that need to be included as a critical component of the development and improvement of health-care systems.2 It has been suggested that the H1N1 pandemic first evolved several months before the identification of the first cases, indicating the existence of a gap in the preparedness for such threats.3

Preparing health-care professionals to manage pandemics is a complicated, time-consuming and costly process. There appears to be a consensus in the literature that the availability of standard operating procedures (SOPs), effective training programmes and exercises play a significant role in the process of maintaining emergency preparedness.4,5 SOPs provide the guidelines required for effective management of pandemic flu outbreaks, educational programmes provide the opportunity for health-care professionals to acquire and maintain knowledge and skills, and exercises provide the opportunity to practice the implementation of the SOPs. In addition, well-organized exercises provide the opportunity to evaluate the performance of the health-care professionals, and provide feedback that facilitates ongoing improvement of both the SOPs and the training programmes.6,7

There is a growing demand to educate health-care professionals regarding the medical aspects of pandemics, in order to improve their capabilities for dealing with the threats.8 Various issues need to be dealt with in order to achieve preparedness for managing pandemics such as: (i) increased bed availability; (ii) management of potential staffing shortages; (iii) management of critical equipment and pharmaceutical shortages; and (iv) building and maintenance of staff knowledge.8,9 Equally important is the ability of emergency department (ED) personnel to be able to recognize and manage patients who may seek care in the ED. An important factor that has been shown to impact on the ability of hospital health-care professionals’ long-term retention of knowledge and skills required to effectively manage pandemics is the lack of regular training, specifically exercises.10

A variety of methods have been utilized to prepare hospital health-care professionals to manage emergencies, such as lectures, seminars, workshops, table-top exercises and drills. Drills and/or exercises have been identified as the intervention most successful in preparing hospital personnel to manage actual emergencies.11,12 Efficient utilization of exercises require that they be planned, organized and implemented with the goal of providing reliable and valid information on the performance of all personnel. The feedback provided to both medical and administrative personnel facilitates the identification of areas that need to be addressed in order to improve the level of preparedness.13

Undergraduate and postgraduate training programmes of health-care professionals offer little if any of the knowledge and skills required for managing disasters, and as such there is a need for this information to be provided upon entry into practice.14,15 It is important to recognize that even if health-care professionals demonstrate that they have acquired the knowledge required for managing an emergency, this does not ensure that they will do so efficiently.16

The aim of this study was to investigate the quality of training programmes in the 24 general hospitals in Israel for preparing health-care professionals to diagnose and manage patients suspected of having pandemic flu. The quality of each of the training programmes was evaluated and the results analysed in relation to performance of hospital personnel in a simulated avian flu exercise and during the 2009 pandemic H1N1 outbreak. In addition, the study investigated the relationship between the level of knowledge of health-care professionals involved in the management of pandemic flu outbreaks and performance in a simulated avian flu exercise.

Methods

In 2005, all the acute care hospitals in the country received a document specifying the national doctrine developed by the Ministry of Health (MOH) for dealing with pandemic influenza outbreaks in preparation for developing a hospital-based training programme. Prior to this, few, if any, hospital personnel had received any formal training in managing pandemics. The MOH provided each hospital with a CD to be used in developing their training programme. The CD contained training
Parameters used to evaluate hospital-based training programmes for managing pandemic influenza

<table>
<thead>
<tr>
<th>Category</th>
<th>Parameter</th>
<th>Level of importance</th>
<th>Spearman’s ρ correlation</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content of training programmes</td>
<td>The hospital training programme includes the following topics:</td>
<td>B</td>
<td>0.62</td>
<td>0.00, one tailed</td>
</tr>
<tr>
<td></td>
<td>- flu and complications;</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- pandemic flu;</td>
<td></td>
<td></td>
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<td></td>
<td>- personal protection equipment;</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- infection control measures.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- for infection control measures;</td>
<td>B</td>
<td>0.35</td>
<td>0.044, one tailed</td>
</tr>
<tr>
<td></td>
<td>Availability of training materials:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>for presenting principles for personal protection in pandemic flu;</td>
<td>B</td>
<td>0.91</td>
<td>0.00, one tailed</td>
</tr>
<tr>
<td></td>
<td>influenza and avian flu;</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Onset of winter training programmes for the following:</td>
<td>B</td>
<td>0.91</td>
<td>0.00, one tailed</td>
</tr>
<tr>
<td></td>
<td>- influenza and complications;</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- treatment of a suspected avian flu or a pandemic influenza patient;</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>- personal protection;</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Implementation of a training programme during the past 6 months for ED</td>
<td>B</td>
<td>0.62</td>
<td>0.00, one tailed</td>
</tr>
<tr>
<td></td>
<td>for pandemic influenza and avian flu;</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Monitoring of attendance of staff in pandemic influenza and avian flu</td>
<td>B</td>
<td>0.62</td>
<td>0.00, one tailed</td>
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<tr>
<td></td>
<td>training;</td>
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<td></td>
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<tr>
<td></td>
<td>Over 90% of designated personnel participated in the training of</td>
<td>A</td>
<td>0.47</td>
<td>0.0121, one tailed</td>
</tr>
<tr>
<td></td>
<td>pandemic influenza and avian flu;</td>
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<tr>
<td></td>
<td>Technical personnel were trained to function as reinforcement to</td>
<td>C</td>
<td>0.47</td>
<td>0.0121, one tailed</td>
</tr>
<tr>
<td></td>
<td>ventilation teams.</td>
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<tr>
<td>Designating personnel for training</td>
<td>Hospital staff was encouraged to be vaccinated against the flu.</td>
<td>C</td>
<td>0.47</td>
<td>0.0121, one tailed</td>
</tr>
<tr>
<td></td>
<td>Designation of staff members from the hospital who will receive</td>
<td>C</td>
<td>0.47</td>
<td>0.0121, one tailed</td>
</tr>
<tr>
<td></td>
<td>preventive medication in the event of avian flu or pandemic influenza;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Appointment of medical officer responsible for hospital preparedness to</td>
<td>C</td>
<td>0.47</td>
<td>0.0121, one tailed</td>
</tr>
<tr>
<td></td>
<td>avian flu and pandemic influenza.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Designation of physicians authorized to prescribe medications to</td>
<td>C</td>
<td>0.47</td>
<td>0.0121, one tailed</td>
</tr>
<tr>
<td></td>
<td>suspected avian flu or pandemic influenza patients.</td>
<td></td>
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<tr>
<td></td>
<td>The hospital identified staff who would undergo training for managing</td>
<td>B</td>
<td>0.47</td>
<td>0.0121, one tailed</td>
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<tr>
<td></td>
<td>avian and pandemic influenza.</td>
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</table>

Materials for dealing with different scenarios of pandemic flu outbreaks. The interventions utilized included formal lectures to provide relevant knowledge, and small group-learning to apply the knowledge for the different ED personnel, and for the different stages of the admission process. Table-top exercises were also run in which the different personnel participated.

Hospitals were given a 6-month period to develop and implement a training programme to prepare their staff to deal with a pandemic flu outbreak. Following this preparation period, the MOH evaluated the effectiveness of these training programmes. Each of the hospitals underwent a 1-day site visit during which the structure, content and the educational intervention utilized for the training programme was evaluated. An integral component of the evaluation process was the development and implementation of a simulated avian flu exercise implemented within 6 months of completion of the training programme in all of the hospitals. Hospital personnel who had participated in the training programmes were the subjects of the simulation exercise.

**Evaluation of the training programmes**

A detailed checklist was used to evaluate the quality of the training programmes in all 24 general hospitals. The checklist consisted of the following four categories: (i) content of the training programme; (ii) training materials utilized; (iii) implementation of topics covered in the training programme; and (iv) the manner in which personnel were selected for training. Each category consisted of a number of parameters, ranging from 1 to 6. Due to the fact that not all parameters were seen as having equal impact on the overall preparedness for pandemic influenza, the level of importance of each parameter was determined through a modified Delphi process that was carried out. A total of 16 physicians and other health-care professionals with expertise in infectious diseases and emergency preparedness participated in this process. Parameters were rated as follows: Level A parameters were those that were rated as being essential (accounted for 60% of the total emergency preparedness score); Level B parameters were those rated as being important (accounted for 30% of the total score); and Level C parameters were those rated as not essential (accounted for 10% of the total score) (table 1). The formula used to calculate the overall hospital training programme score was as follows:

$$\text{overall score} = (\text{sum Level A parameters } \times 30\%) + (\text{sum level B parameters } \times 5\%) + (\text{sum level C parameters } \times 2.5\%).$$

**Evaluation of knowledge of ED personnel**

It has been suggested that objective knowledge-based tests can be utilized to evaluate health-care professionals’ preparedness to deal with emergencies. In order to evaluate the pandemic flu level of knowledge of the hospitals’ ED personnel that consisted of certified physicians and registered nurses, a 14-item multiple choice question (MCQ) examination was developed. The questions are detailed in Annex 1 in Supplementary Data. A convenience sample of 589 ED physicians and nurses from the 24 hospitals took the test, within a period of 6 months following the training programme. The scores of the personnel who took the examination were calculated, and the mean score for each hospital, determined. ED personnel who participated in the avian flu-simulated patient exercise were part of the group that received the knowledge test.

**Evaluating level of performance in avian flu exercise**

The simulated patient avian flu exercise used to evaluate the performance of hospital personnel has been previously described. Briefly, the exercise involved an unknown and unannounced ‘simulated patient’ arriving in the ED reporting the following symptoms: fever with...
temperature ≥ 38.5°C, coughing and respiratory distress. If asked, the ‘patient’ reported to the admission officer that he/she had recently visited a country in which there had been an outbreak of avian flu, and that during the visit had been in contact with an ill relative. Each ‘simulated patient’ was accompanied by a ‘family member/evaluator’, who was responsible for evaluating the performance of the hospital staff. The hospital staff was not aware of the fact that a simulated patient was being used, neither were they informed that this was an exercise. The use of a single-standardized patient has been previously reported.16,19 All simulated patients had health-care insurance and were trained to present the signs and medical history in a reliable and valid manner. Performance of the ED staff was evaluated independently by both the ‘family member/evaluator’ and the ‘simulated patient’ at the conclusion of the visit utilizing a pre-determined checklist (table 2). The checklist contained: (i) items related to the ability of staff to recognize a patient suspected of having a pandemic flu; and (ii) the management of the patient, including personal protection of patient and staff, utilization of isolation facility, relevant laboratory investigation and other additional elements. The Delphi process described above was also used to review and validate the checklist.

The checklist score was determined separately for both the ‘simulated patient’ and the ‘family member/evaluator’ by summing all items that were performed by the staff during the interaction with the patient. The final score was calculated from the consensus score of the two evaluators for each of the parameters evaluated. Scores for all parameters, were summed to provide an overall score for each hospital.17 The exercise was conducted once in each of the hospitals within 6 months following the training programmes.

### Evaluation of emergency preparedness and performance in 2009 pandemic influenza outbreak

In 2005, the MOH carried out an evaluation of the hospital preparedness, and an overall preparedness score was calculated for each hospital. During the 2009 H1N1 outbreak the MOH conducted a similar evaluation of preparedness of a stratified sample of eight hospitals to manage the pandemic influenza. The sample included both tertiary-care hospitals (two out of six) and non-tertiary hospitals (6 out of 18). The identical evaluation tool was utilized to measure level of preparedness in both the 2005 and 2009 evaluations. In addition, overall monitoring of admitting and treating suspected and identified patients was carried out based on epidemiological investigations carried out by MOH personnel.

### Statistical analysis

The following analyses were carried out using SPSS 17 (SPSS Inc., Chicago, Illinois, USA, 2010):

(i) Overall hospital training programme scores were analysed in relation to performance in the simulated avian flu exercise.

(ii) Spearman’s ρ correlations were used to investigate the relationship between the different parameters of the training programme.

(iii) Cronbach’s α and item total correlations were used to determine the reliability and validity of items of two of the scales.

(iv) Wilcoxon signed-rank test was used to test if there was a significant improvement in hospital preparedness (2005 compared to 2009).

### Results

#### Training process

The overall scores of the training programmes for pandemic influenza of the 24 general hospitals, ranged from a low of 23% to a high of 100%. As can be seen in table 3, 62.5% of the hospitals received satisfactory ratings (90–100%); 20.8% of the hospitals received reasonable ratings (70–89%); 4.2% of the hospitals received poor ratings (30–69%); and 12.5% of the hospitals received very poor ratings (<29%). The training parameter that appeared to be most problematic for the hospitals was the implementation of the training programme with 45.8% of the hospitals receiving poor to very poor ratings.

Internal consistency of the overall four-item scale used to evaluate the quality of the training programmes was high: α = 0.82. All four-scale items appeared to be worthy of retention. Item–total correlations ranged from 0.64 to 0.78 (Mean item–total correlation for the four items was 0.70).

Internal consistency of two sub-scales was as follows: internal consistency of the six-parameter scale used to evaluate the implementation of the training programme was, α = 0.78. All items, with the exception of encouragement of personnel to be vaccinated, correlated well with the total score for the scale. Item correlations ranged from 0.36 to 0.77. Removal of the lowest item–total correlation resulted in a minor increase in the internal consistency of the scale.

Internal consistency of the four-parameter scale used to evaluate designation of personnel for training was α = 0.37. Two out of the four sub-scale parameters had item–total correlations that were above or close to 0.40, namely physicians certified to write prescriptions (0.48)
and staff designated to receive preventive medication (0.39). The remaining two items correlated poorly, and when removed from the scale resulted in an increase in internal consistency of the scale to $\alpha = 0.60$.

The results of the Spearman's $\rho$ correlations for the four training programme domains with performance in the avian flu exercise are as follows: significant positive correlations were found between the implementation of the training programme and performance in the exercise ($\rho = 0.91, P = 0.000$) (figure 1); content of the training programme ($\rho = 0.62, P = 0.001$); designating personnel for training ($\rho = 0.87, P = 0.000$); and training materials ($\rho = 0.35, P = 0.05$).

Knowledge of health-care personnel and performance in an avian flu exercise

The overall mean score for the 14-item MCQ for ED medical personnel was 75.6% (+6.9%), median 77.0%, minimum 61.0%, maximum 88.0%. Chronbach's $\alpha$ for the 14 items was 0.82.

The correlation between the level of knowledge related to pandemic flu and the performance in the avian flu exercise was not significant ($\rho < 0.25$) (not satisfactory).

Evaluation of emergency preparedness and performance in 2009 pandemic influenza outbreak

The overall preparation score for eight hospitals for both the 2005 and 2009 evaluations was used to determine if there was any change in the level of preparedness for managing a pandemic influenza outbreak. Overall preparation scores for the 2005 evaluation ranged from 70% to 98% with an overall mean score of 86%. In the 2009 evaluation, overall preparedness scores ranged from 93% to 100% with an overall mean score of 97%. Comparison of the distribution of scores in the two evaluation cycles by Wilcoxon signed-rank test showed a significant improvement in the level of preparedness for dealing with a pandemic, influenza outbreak ($z = 2.521, P = 0.012$).

Discussion

Developing and maintaining preparedness for dealing with a potential outbreak of a pandemic influenza requires that health-care providers implement effective training programmes. It has been shown that providing health-care professionals with the knowledge relevant for managing biological events assists in achieving emergency preparedness; however, these tests provide limited information about the ability to determine readiness.

The evaluation of the training process for dealing with pandemic influenza, conducted in this study, showed that the majority of general hospitals in Israel have implemented effective training programmes to deal with this threat. Analysis of the relationship between the various components of the training programmes with performance in the exercise identified one parameter as having a high significant correlation, namely, the implementation of the training programmes. A significant medium correlation was found in two other categories: content of training programmes and designating personnel for training. Training material was found to have a poor correlation with performance in the exercise. This can possibly be explained by the fact that all hospitals were rated very highly on this item as the hospitals were provided with teaching materials by the MOH to develop their training programmes.

The findings of this study support the conclusions of previously conducted research which reported that development and implementation of training programmes are very important in assuring emergency preparedness. It would appear from the results of this study that the key domain of training is the implementation of the training programme.

The 2009 pandemic outbreak provided an opportunity to evaluate the readiness of hospitals in real time. The findings of this study demonstrated that the training programmes implemented enabled the hospitals to maintain a high level of preparedness and thus were effective in providing a response to the A/H1N1 pandemic.

The reliability of the scale for designating personnel for training improved when one of the criteria was removed, but none the less needs further improvement. The significant correlation between designating

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Table 3 Overall score and programme parameter ratings; percent of hospitals rated very poor, poor, reasonable and satisfactory in pandemic influenza training

<table>
<thead>
<tr>
<th>Evaluation (%)</th>
<th>Overall Score (%)</th>
<th>Content of training (%)</th>
<th>Training materials (%)</th>
<th>Implementation of training (%)</th>
<th>Plan for utilizing personnel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very poor 0–29</td>
<td>12.5 (3)</td>
<td>8.3 (2)</td>
<td>–</td>
<td>4.2 (1)</td>
<td>–</td>
</tr>
<tr>
<td>Poor 30–69</td>
<td>4.2 (1)</td>
<td>4.2 (1)</td>
<td>4.2 (1)</td>
<td>41.6 (10)</td>
<td>8.4 (2)</td>
</tr>
<tr>
<td>Reasonable 70–89</td>
<td>20.8 (5)</td>
<td>4.2 (1)</td>
<td>–</td>
<td>4.2 (1)</td>
<td>20.7 (5)</td>
</tr>
<tr>
<td>Satisfactory 90–100</td>
<td>62.5 (15)</td>
<td>83.3 (20)</td>
<td>95.8 (23)</td>
<td>50 (12)</td>
<td>70.9 (17)</td>
</tr>
</tbody>
</table>

Figure 1 Evaluation of comprehensiveness of training for pandemic influenza vs. avian flu exercise score
personnel for training with performance in the exercise highlights the need to put an emphasis on early planning of manpower allocation and training. Allocating defined roles to the staff members ahead of time, and providing them with appropriate training, in addition to the tools to function in these roles, contributes to the effective functioning of ED personnel.

Especially interesting is the low correlation between the levels of knowledge with performance in the avian flu exercise. Knowledge is an important factor in contributing to preparedness, and studies have shown that knowledge tests have a role in evaluating preparedness. This study suggests that there are other factors that need to be considered in order to predict ability to manage pandemic outbreaks.

The results of these evaluations, while providing valuable information concerning the quality of the training programmes in hospitals, also highlight the need for additional effort to be put into improving the reliability and validity of the scale used to evaluate the training programme. Two of the training domains, content of the programme and training materials provided scores that were found to correlate poorly with performance in the exercise. The scale used to evaluate designating personnel for training had reasonable reliability, when the poorly performing item was removed. More objective measures of the content of training and training materials need to be developed.

Training health-care personnel to manage emergencies is regarded as an important component in emergency preparedness, and exercises are generally considered to be part of the training programmes. We suggest that exercises should serve a dual purpose: (i) a component of the training; and (ii) an evaluation tool to determine the effectiveness of the training programmes.

Limitations of the study

The main limitation of this study was the use of an avian flu exercise utilizing a single simulated patient presenting to the ED with the symptoms of H5N1. The assessment was carried out only once in each hospital. It should, however, be kept in mind that this sentinel exercise represents the initial contact with the first patient to enter the ED in a biologic event, and therefore it realistically tests the ability of the hospital to detect, identify and handle such an event. As effective handling of pandemic influenza is based on early detection of such an event, the recognition of the single patient is the aim of both the SOPs and the training programmes and, as such, this exercise justifiably simulates the reality of this situation. This finding is strengthened by previous findings which showed that a single standardized patient was reliable to rate physician performance.

Conclusions

Development of a training programme is very important in assuring emergency preparedness. This study reviewed the important components of training programmes aimed to prepare hospital personnel to manage an avian and pandemic influenza event. Components of the training programmes that impact on the level of performance in an exercise were identified. The key domain of training appears to be the implementation of the training programmes. Use of knowledge tests should be further investigated, as they do not appear to correlate with the level of emergency preparedness for pandemic flu, as displayed in an exercise.

There is a need to conduct similar training programmes and evaluation studies in the community public health settings.

Based on the national training programme that was conducted, we recommend central development of training tools and utilization of national standards to evaluate the level of emergency preparedness of medical facilities to pandemics. Efforts should be made to train the instructors from the different hospitals in order to ensure their competencies.

Implications for public health policy and practice

- The study can assist health-care policy makers and those in charge of development and implementation of training programmes to invest resources in those components of training programmes that were shown to correlate with performance in exercise.
- Use of knowledge tests should be further investigated, as they do not appear to correlate with the level of emergency preparedness for pandemic flu, as displayed in an exercise.

Supplementary data

Supplementary data are available at EURPUB online.

Conflicts of interest: None declared.

Key points

- National training programmes can significantly contribute to preparedness and response to pandemic outbreaks.
- Standardization of the evaluation process is needed in order to promote preparedness and response to pandemic outbreaks.
- Development of benchmarks facilitates the achievement and retention of preparedness levels for pandemic outbreaks.

References