PANDHUB

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D5.3 – Improvement of communication tools

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Summary

This deliverable forms part of work package 5 – *Incident response coordination, cooperation and communications tool set* – which also includes Deliverable 5.1 – *Review of communication flows* – and Deliverable 5.2 – *Communication tools* – which reviews the current communications within transport hubs and between transport hubs and other stakeholders. This deliverable considers communication forms that may be utilised during an infectious disease outbreak. Besides traditional risk communication (section 4) focus is on cross-border (section 2), electronic communication (section 3) and mental health considerations (section 4) for psychological care of affected passengers and staff.

Key points for traditional communication methods are outlined in section 4.1, which could be used to construct a message from transport hub operators to the public, also encompassing main points that could be expanded upon for use in other communication scenarios such as electronic communication and cross-border communication. In terms of electronic communications, evidence for the use of websites, social networking sites, and mobile applications has been considered.

We consider that common preparedness and communication plans between transport hub operators within European Union Member States could improve cross-sector communication and consider best practices when planning for cross-border threats. Communication plans involving the use of electronic communication may require standard operating procedures as this communication form is not one-way. Alternative approaches may be needed for groups who don't use electronic communication. The severity of the infectious disease outbreak will determine the level of psychological first aid that might need to be administered. It is suggested that a communication expert is appointed to ensure information communicated regarding the outbreak and response measures continues to be of high-quality, requiring an effective communication strategy.

Abbreviations

EC	European Commission
EU	European Union
GPS	Global Positioning System
HIV	Human Immunodeficiency Virus
ICT	Information and Communications Technology
IHR	International Health Regulations
MERS-CoV	Middle East respiratory syndrome-related coronavirus
mHealth	Mobile Health
PFA	Psychological First Aid
PTSD	Post-Traumatic Stress Disorder
SARS	Severe Acute Respiratory Syndrome
SNS	Social Networking Sites

Contents

1. Introduction

During naturally-occurring or intentional infectious disease incidents involving transport hubs with international points of entry, the need for effective communication with the public, decision makers, and other stakeholders is paramount. Without proper risk communication, efforts to increase resilience and mitigation to disease threats are considerably weakened.

One of the core themes of the 2005 International Health Regulations [1] is that of effective communication, which they state, is “perhaps the greatest determinant of the success or failure of any plan and emergency response”. This includes timely operational communication among internal stakeholders and decision-makers and should include knowing:

- Who needs to communicate
- When to communicate
- What key information to communicate and
- What communication method would be most effective

A key consideration of emergency response is communication with the public and the media. These considerations should be a key part of any planning process and reflected in response plans; the 2009 H1N1 influenza pandemic was pivotal in highlighting the important role of media and public messaging [1].

In this deliverable we present a series of considerations for improving communication flows between the decision makers and actors managing prevention and response, but also with the general public during a crisis. To this end we consider:

- Cross-border communications
- Electronic public communication methods (including social media and apps)
- Traditional public risk communication methods
- Mental health first aid considerations for communications

2. Cross-border communications

A serious cross-border health threat is defined under Decision no. 1082/2013/EU of the European Parliament and of the Council as “a life-threatening or otherwise serious hazard to health of biological, chemical, environmental or unknown origin which risks spreading across the national borders of member states”. This includes novel and emerging threats: sudden and large-scale *e.g.,* influenza, Ebola virus disease, severe acute respiratory syndrome (SARS) or Middle East respiratory syndrome-related coronavirus (MERS-CoV) or long-term threats: known or foreseeable *e.g.,* multi-drug resistant tuberculosis, human immunodeficiency virus (HIV), polio and sexually transmitted infections. The diseases of interest in the PANDHUB project (pneumonic plague, influenza, MERS-CoV, Ebola virus disease, and anthrax) are categorised as novel and emerging threats, and therefore outbreaks would necessitate cross-border investigation. Section 2.1 outlines the importance of cross-border communication and section 2.2 presents considerations for such communication.

2.1 Importance of cross-border communication in incident response

Cross-border cooperation between Member States in Europe during mass casualty incidents should be fostered [2; 3], particularly as there may be differences in prior pandemic knowledge among Member States as seen in [4]. For infectious disease incidents, the European Commission (EC) have researched options for prevention and control, such as "SARScontrol" [5], and created early warning systems for influenza [6]. In order for such communications to work, there must be understanding among participants regarding what other members of the communication network do [7]. Stewart-Evans *et al.* have proposed ways of improving emergency response through cross-border communication [8] and Stoto *et al.* have created a model allowing for assessment of such communications [7]. Having a good communication network can lead to improved responses [9]. Cross-border communication requires good information and communications technology (ICT) [10; 11] which should be interoperable [12]. It should also consider relationship building and knowledge sharing [13].

The 2009 H1N1 influenza pandemic and more recently the 2014-2016 Ebola virus disease outbreak in West Africa highlighted gaps and weaknesses in the management of transport hub responses to a major cross-border threat. Incident management for security-related incidents such as fire, bombs, and suspicious packages are well-rehearsed and prepared for, but significant gaps still exist concerning preparedness for a pandemic/serious cross-border biological threat. Consequently, as evidenced in PANDHUB deliverable 4.3 – *Multi-country investigations* - there is a real desire amongst transport hub operators to address these; for safety and security of staff and public, and also for resilience and business continuity.

PANDHUB Deliverable 4.3 considered the current state of communication between transport hub operators and found that there was no evidence of a Europe-wide cross-sector transport communications system, nor of any European-level cross-sector transport preparedness guidance to aid hub operators with development of operational pandemic or serious biological threat contingency plans. However, there is planned work along these themes, for example under the EC Joint Action JA-04-2017 on preparedness and action at points of entry (air, maritime and ground crossing).

2.1.1 Example of cross-border communication during an outbreak

During the 2009 H1N1 influenza pandemic, the Middle East Consortium on Infectious Disease Surveillance coordinated risk communication strategies, including harmonising messaging to the public and distribution of information in multiple languages [14]. It should be noted that the harmonisation of messages should be contained to areas affected by the infectious disease outbreak, and media should have a different fear-alleviating message for other non-affected parts of the world [15].

2.2 Considerations for improved cross-border communication

As described in Deliverable 4.3 – *Multi-country investigations* – "The first consideration is the development of a European-level preparedness planning framework for transport hub operators, that not only supports planning, but also formalises response networks ahead-of-time and provides operators with an evidence base for decision-making, helping ensure that the balance of business continuity and protecting health is achieved.

The second consideration is the development of European-level cross-transport sector communication plans, with best practice risk communication strategies and scenarios, for cross-border threat incidents. This could be developed within the preparedness planning framework. Article 4 of the European Union (EU) Decision 1082/2013 obliges Member States to share preparedness plans. EU 2017/1140 legislation on cross–border threats [16] concerns the exchange of personal data through an early warning response system between EC, the European Centre for Disease Prevention and Control, Member State ministries and national infectious disease expert institutions for contact tracing. These personal data include travel specifications with conveyance data.

The third consideration is the development of a cross-sector transport communications platform, potentially building upon existing platforms, to connect transport operators with each other and with public health.

Another key finding was the desire for stronger connections between transport operators and public health practitioners, to support both business continuity and incident response. These connections focus on clarity of the route into public health; the provision of public health information either before, and/or during, the acute stage of a serious biological incident; and best practice strategies for communicating risk to staff and stakeholders. The list of tools and guidance below was suggested by transport hub operators and other stakeholders to help address these points and may be useful for effective communications with both the media and the public and between countries.

Table 1: Suggested guidance and tools for transport operators to aid communications (source: PANDHUB Deliverable 4.3 – Multi-country investigations)

Guidance or tool	**To provide information on**
Tools ahead-of-time	
Infection control checklists and instructions	What scenarios should be prepared for
	Best infection control practices
Visual aide/reference cards (infection control)	Broad guidelines on what symptoms to look for in a case of infectious disease. What to do if an infectious disease case suspected
Guidance for action documents	
Flowchart or decision tree	When to contact public health
	Essential information to report to public health
	What to do in a suspicious incident e.g. hoax illness or potential chemical, biological, radiological, and nuclear-related incident, before official recognition.
Real-time tools	
Time-stamped public health information leaflets	The ‘science’ behind operational decisions. Risk communication to reassure staff and stakeholders and the travelling public.
Frequently Asked Questions leaflets Pre-written email *pro forma*	
Provision of real-time link to PH website or app	

3. Electronic tools for public risk communication

PANDHUB Deliverable 5.2 – *Communication tools* – reviewed the published literature to examine the current state of ICT-based communication in transport hubs in disaster and infectious disease settings. The review did not find any literature fulfilling the discussion of a real-time public communication tool used at transport hubs during pandemic disease outbreaks, indicating a gap in the published literature relating to the topic. However, based on the findings in the review considerations for a transport hub setting have been suggested in section 3.2. The search terms used in the review are listed below in Table 2.

The review considered social networking sites (SNS), mobile applications, ICT response strategies, and websites. For each of these topics, both disaster settings and infectious disease settings were considered. It should be noted that using mobile alert systems, such as that used in January 2018 in Hawaii [17], are not suitable for infectious disease settings as they are suited to large scale and high impact incidents.

Table 2: Search terms used in the literature review [19], source: Deliverable 5.2 – Communication tools

Transport	Disease/Incident	Communication tool	Victim
Airport	Pandemic	Real-time	Public
Railway	Emergency	Smartphone	Passengers
Station	Influenza	Social Media	Crowd

Section 3.1 provides an overview of the current evidence regarding electronic tools use in risk communication, and section 3.2 presents considerations for how to use electronic tools in communication based on the evidence.

3.1 Current evidence base

With regards to response strategies, the review in Deliverable 5.2 notes that one-to-one communication is resource intensive and might not feasibly be applied to large populations. Additionally, the entire population may not be reached; reliance on ICT tools during disaster responses can have negative, with sometimes life-threatening, effects on elderly populations who may not be as familiar with this form of communication. If the transport hub has a public health officer, they should be trained to use relevant communication methods in order to disseminate an appropriate message to the public.

3.1.1 Social networking sites

The review found that SNS was the most studied of the communication options considered. SNS have so called serial transmission, where messages can be further passed on by users (such as sharing on Facebook or retweeting on Twitter), which was emphasised as being crucial in terms of information reaching a large number of people, particularly as SNS have large public userbases. Studies show that the largest predictor of SNS use during a disaster is past experience of using SNS. Risks of rumour spreading are higher in SNS settings, which are effectively a public outlet, and if responders commit to engaging with the public

through social media platforms, they must dedicate resources to eliminating rumours. Data provided by SNS users through their engagement with the services can be used to identify users in a geographic area without needing users to provide Global Positioning System (GPS) data, such as has been seen in a Twitter triangulation system, using users' biographical metadata, posts, and retweets. This, combined with knowledge of users' use of language, can be used to create targeted content. However, as SNS change over time and may contain a lot of noise, appointed social media communicators would need to be employed to utilise such channels, which is more resource intensive than traditional one-way communication. Text mining live SNS feeds using content analysis can be used to provide responders with insights, though not in real time, and can thus be used to evaluate a previous response. Surveillance systems for influenza using Twitter can be used to supplement traditional surveillance initiatives to explore disease outbreaks. This may be a replacement for the former Google Flu Trends resource. Surveillance through internet searches would need to identify the most commonly used services in the countries considered, *e.g.* Liu *et al.* used Chinese web searches when examining Chinese reactions to Ebola [20].

3.1.2 Mobile applications

Uses of mobile application tools can be advantageous in a disaster response. The review found that their limited success in the past was due to a lack of consistency in the strategic use of mobile tools by different responders and a standard approach could be used as a blueprint for the future use of mobile tools. Besides this, the main issue with mobile applications is that participants have to actively sign-up with and install the application on their devices. The application may furthermore have competitors. The applications can be configured such that they are able to gather data while in use, thus enabling them to be useful to both the public and responders. Mapping outbreaks through smartphones has already been seen during the 2014-2016 Ebola virus disease outbreak [21]. Smartphones have been used for infectious disease surveillance during the 2014 Hajj pilgrimage [22] and may be useful for diagnostic purposes [23]. In terms of user preferences, a mobile application should include paging, as this was preferred to scrolling, and a combination of closed and open answer questions. Self-triaging algorithms and online tool algorithms could be prepared and evaluated prior to an incident. Potential disadvantages of mobile applications are that users have to actively sign up to the system, and potential questionnaires they may include could be time consuming which will lead to reaching a smaller audience than that of more established and integrated communication systems.

A mobile health (mHealth) app, Mo-Buzz, containing elements for surveillance, disease mapping, and educational resources has been developed in collaboration with Sri Lankan public health inspectors to address shortcomings identified in their current dengue monitoring and management practices [24]. A different mHealth method of data collection has been used to determine travellers' behaviour through a daily questionnaire surveyed through an app which also gathered GPS data [25]. Such initiatives could be used to determine at risk passengers prior to return and potential future outbreak source sites.

3.1.3 Websites

For communication through websites, the review found using organisational reputation builds trust in the information and encourages a larger audience to use it. Government agencies and non-governmental organisations' websites were found to have high quality information while those of news outlets did not. In designing websites for these types of communications,

it is important to take into account readability of the website whilst still maintaining a high quality of information. Such websites are also considered a good information source when a disaster is not occurring and following a disaster. Combinations of SNS and websites have been examined to determine public digital interest in an infectious disease during an outbreak, such as the 2016 Zika virus outbreak, which was measured via examining web activity such as tweets and access to Wikipedia information, thus providing health authorities with information on which of the public's concerns they should address [26]. Editors of voluntarily updated information resources, such as Wikipedia, may use different emotional expressions and linguistic styles depending on their gender [27] which could affect the information's credibility and readability.

The review was not able to take into consideration that SNS may have both mobile and website versions and how this might affect strategy for use in a disease outbreak. Furthermore the review does not consider strategies for crowdsourced ICT services such as Facebook Safety Check or Google Person Finder. Organisations having a so-called human voice in online communication via SNS can be received more favourably by users [28]. SNS can also be used to recruit research participants in emergency settings [29; 30]. Public health organisations' posts on SNS that feature positive emotional appeal or provide factual information have higher levels of user engagement [31]. This should be taken into account by appointed social media communicators, who may also need to deliberate over the use of hashtags [32].

3.2 Considerations for using ICT tools for improved communication with the public

Transport hub operators should

- Consider using SNS to disseminate and obtain information from members of the public during an infectious disease outbreak; and
- be aware that communication via SNS or mobile applications may not reach all groups and must include contingencies for such situations in their preparedness plan;
- Use social media early warning systems developed for use in the hubs ensuring those at risk are reached; and
- Seek collaborations with large public health information sources which provide tracking of disease epidemiology such as the Program for Monitoring Emerging Diseases or the World Health Organization.

This may require a standard operating procedure for social media use during outbreaks and novel applications of social media should be invested in to target those at risk. Furthermore, whilst mobile applications for use in transport hubs could be developed, it will require further efforts to ensure uptake.

Transport hubs' communication via SNS and mobile application communication will not be successful in getting the messages across to all members of the public in the hub during an outbreak and there must be a plan for how to communicate with members of hard to reach and vulnerable groups. When using SNS and ICT tools, transport hub operators should be aware that information will be shared from members of the public in addition to from official hub sources. This may speed up information dissemination but also leads to loss of authority,

and increases the potential for rumour-spreading, including the potential impact of increased speed of information dissemination on public responses during pandemics. To ensure information is reliable, transport hubs should appoint a communication expert who will maintain and monitor communications for inaccurate information.

Responder organisations should consider:

- Using evidence-based message development and user interface design; and
- Ensuring websites are used as information sources for transport users in periods of low-risk but which can also be directed to during high-risk periods so that they are always maintained and familiar which may help with time critical communication efforts.

A stakeholder workshop held following the review as part of PANDHUB Deliverable 6.3 – *Workshops* – corroborated the findings of the review, indicating that senders, as well as receivers, perceive the same benefits in these forms of communication. This may influence the uptake of considerations.

4. Traditional methods for public risk communication during a pandemic

During infectious disease outbreaks the need for effective communication with the public is paramount. Without proper risk communication, efforts to increase disease resilience and implement mitigation are considerably weakened [33]. Several recent reports into influenza outbreaks by the Centers for Disease Control and Prevention in the United States have highlighted the effects of poor communication between health responders and the public [34]; and calls for improved public communications during outbreaks have been made [35]. Research suggests that trust and credibility are key components in creating effective communication and that this is best engendered through: empathy and caring, competence and expertise, honesty and openness, and dedication and commitment [36-38].

The field of risk communication for infectious disease outbreaks is highly related to that in general disaster settings, *i.e.* man-made disasters or natural disasters. This field has received a great deal of attention and has formed its own specific discipline of ‘crisis communication’ [39]. Psychological and behavioural science fields have often been used to inform such crisis communication, with well-established psychological theory being used to develop guiding principles for effective implementation [40; 41]. Several recent reviews, *e.g.* [36; 38], have examined effective communication strategies for incidents involving chemical, biological (including pandemics), and radiological incidents specifically. There is therefore a wealth of research that can be used to form the basis of a strategy for communicating with members of the public at transport hubs during a serious infectious disease incident. Drawing together the findings of this research and applying it to the context of a transport hub we present several key considerations for effective public risk communication in Section 4.1.

4.1 Key points for an effective communication strategy

4.1.1 Provide facts, not reassurance

Members of the public will want information about the nature of the incident, and the actions that emergency responders and the authorities are taking. Avoid providing generic reassurance, without providing facts. Reassurance that is not supported by evidence, or is not in line with official actions, can reduce public trust in authorities. Avoid 'myth-busting', which can have the effect of perpetuating the myths that it is attempting to address.

4.1.2 Provide sufficient practical information

Members of the public should be provided with sufficient practical information to enable them to effectively take recommended actions. Providing sufficient practical information ensures that people are able to take protective actions, generates a sense of agency and control, and therefore helps to reduce public anxiety.

4.1.3 Communicate in a timely way

Communication with the public about the nature of the incident and actions that are being taken should begin as soon as possible following an incident, and regular updates on the incident and the actions that people should take should be provided. The public should be told when the next update will be provided, and an update should be provided at this time, even if no new information is known. Be clear on when information is not communicated because it is not yet known, and when information is not being shared for security reasons.

4.1.4 Communicate honestly

Authorities should communicate openly and honestly with members of the public about the nature of the incident and the actions that are being taken. This includes communicating where information is uncertain or unknown; members of the public understand that incidents are continually evolving, and that there is often a delay before all information becomes available. This is acceptable, as long as this uncertainty is communicated.

4.1.5 Ensure consistency, between different sources of information, and betweenactions and deeds (*e.g.* the use of personal protective equipment)

Information provided should be consistent between organisations, and over time. Information should also be consistent with actions that are being taken; where advice given is perceived to contradict actions being taken, this results in reduced public trust. An example of potentially contradictory actions and information would be seeing emergency responders dressed in personal protective equipment, at a time when the public are being reassured that there is no risk to their health. This apparent contradiction should be clearly explained in communications.

4.1.6 Provide health-focused explanations about why certain actions are necessary

It's important to explain not only what actions people should take, but also why such actions will be effective. Responders and authorities should therefore provide health-focused explanations about why recommended protective actions are necessary. This will help people to understand why it is important to take action, enhancing perceived efficacy of the actions, and potentially increasing public compliance.

Effective communication at transport hubs is important for ensuring that members of the public take appropriate protective actions. Research suggests that an effective communication strategy is one which contains both practical information about protective actions that people can take and health-focused explanations about why such actions are necessary, and that provides this information in an honest and timely manner. The communication principles described here can be used when communicating using traditional methods (*e.g.* leaflets, posters, traditional media) and newer methods (*e.g.* digital technology, social media). Those in charge of communicating with the public at transport hubs should therefore take these principles into account when designing an effective communication strategy.

4.1.7 Models for risk communication include [45; 46]:

- Decide, announce, defend model
- Risk perception model
- Mental noise model
- Negative dominance model
- Trust determination model

The 'decide, announce, defend' model is not seen to be a useful method of communicating risk [45]. The remaining models have the following foci:

Table 3: An overview of risk communication models

Model	Focus
Risk perception	An individual's perception of risk, which is based on outrage factors (measuring the risk perception) and hazard factors [45]. When there is high hazard and low outrage, risk will be perceived lower than it is [46].
Mental noise	Stress impacts how people process information. In this model, stress can impede the line of communication [45; 46].
Negative dominance	In the negative dominance model, negative and positive information is processed simultaneously, with negative information bearing more weight [45]. As such, the audience may pay more attention to negative information and this information may be retained longer [46].
Trust determination	This model emphasises the essentialness of establishing trust in risk communication and how trusted groups may be able to communicate when the public are having trouble accepting information [46]. Once trust is formed, other goals can be achieved [45].

4.1.8 Example of use of models in a bioterrorist attack

Covello *et al.* [45] consider how these models could be used in response to a bioterrorist attack, mentioning that due to the nature of such an event it is crucial to consider risk communication. They state that emergency response communications must have built trust prior to the event, to enable effective communication after the event, they must have clear communication to reduce mental noise, and avoid unnecessary negative wording.

Furthermore use of technical jargon may be a hindrance as seen in the risk communication surrounding the 2007 San Diego fires [47].

5. Mental health first aid

During an infectious disease outbreak, pathophysiological effects of the disease should not be the only causes of morbidity and mortality considered, effects on mental health and behaviour should also be considered as mental health problems may arise as a result of an infectious disease outbreak [48]. Such effects have been examined in studies of pandemic influenza [49; 50], SARS [51], and Ebola virus disease [52-54]. Awareness of mental health issues in both the public and responders following a serious infectious disease outbreak is an important consideration when communicating risk to these stakeholder groups. Section 5.1 gives focus to the recognition and impact of mental health issues following known incidents and section 5.2 provides case study scenarios within transport hubs. Section 1.1 outlines key points to bear in mind when formulating risk communication messages.

5.1 Importance of mental health first aid in incident response

In particular during the 2014-2016 Ebola virus disease outbreak, symptoms of post-traumatic stress disorder (PTSD) and anxiety-depression were still prevalent after a year of response when examined in July 2015 [55]. PTSD in particular is a well-known post-disaster psychological burden [56; 57]. In an outbreak, the health care workers involved may experience mental health issues during the response [54; 58; 59]. Especially first responders have job-related exposures that may put them at higher risk of mental health morbidities [60], including suicide, and this must be investigated in order to reduce such a risk [59; 61; 62]. The level of risk may be influenced by workers' perception of their response efforts [63]. Mental health issues may persist for years following a disaster [64]. Repeated exposure to disasters is also a concern [65]. Decisions made including moral complexity and related uncertainties also have an impact on responders' mental health [67]. Responders may experience transpersonal experiences during disasters, including near death experiences, being around those dying, and grieving [68]. Furthermore, they may experience backlash as a result of others' grieving [69]. Strong links between law enforcement and emergency mental health providers must be encouraged [70].

Emergency responders must have received mental health preparedness training as part of an emergency preparedness plan to enable them to provide appropriate response in the psychological area [59; 71]. Besides negative mental health impacts, there may also be positive mental health impacts of experiencing an infectious disease outbreak. Following the SARS epidemic, increased support among friends and family and self-care has been observed through survey [72]. A sense of purpose among responders may also be fostered as a result of participation in the response [59]. Pietrantoni and Prati found self-efficacy, collective efficacy, and a sense of community to be resilience factors preserving first responders' work-related mental health [62]. Efficacy is useful for building responder willingness [73]. Additionally, mental health professionals, including psychologists and psychiatrists, were important responders to HIV/acquired immune deficiency syndrome [74] and could thus play a similar role in other epidemics. Such health workers may not be trained in emergency mental health [75] but even those without mental health training could step in if required to [76]. In particular, there may be a lack of training for bioterrorist disasters [77],

which can have grave mental health consequences and risk communication should be prepared [45; 78].

Shultz *et al.* recommend using trauma signature analysis to assess exposure to the trauma event to estimate the severity of exposure and related psychological risk factors. This analysis should be followed by a mental health intervention fulfilling Inter-Agency Standing Committee guidelines on mental health and psychosocial support in emergency settings at the site of the outbreak. This intervention should be combined with development of a science-based risk communication strategy to alleviate fears among those not at the site of the outbreak [53]. Public health agencies must be aware that media might not broadcast risks in the manner intended [79]. Indeed media in other parts of the world may provoke fear [15; 53; 80]. Indirect exposure to extreme events could in itself cause distress and a higher risk of mental health problems as a result of the exposure [80]. Fear behaviours during an infectious disease outbreak may lead to further spread of the disease [53]. Following an outbreak, fears might be heightened as seen following terrorist attacks [81].

The main aeroplane-related emergencies where mental health has been provided are accidents, such as [60; 82], where the emergency mental health personnel need to consider the mental health needs of many different groups of people including flight crew, passengers, and responders. Following train bombings in 2004, increases in peri-event panic disorders among passengers due to panic attacks following the mass trauma event have been observed in a longitudinal study [83]. Again, responders may also experience increased mental anguish from being in such a situation [68].

5.2 Mental health impacts of biological events

Public reactions to a biological threat will vary based on the nature of the incident. Factors that affect public response include: the level of ‘dread’ risk associated with the incident [84]; perceived severity of and likelihood of contracting the disease [85]; and level of self- and response-efficacy [36]. These factors may affect public intentions to take protective actions during a biological incident, and also levels of public anxiety. More information about each of these factors is described below.

5.2.1 Dread risk/ unknown risk

Along with unknown risk, dread risk is one of the two main drivers for risk perception [84]. There are various different factors that increase the level of dread risk associated with different incidents, and these include threats that: are invisible or not observable; have potentially catastrophic consequences; are perceived to be uncontrollable; have unknown consequences; and have the potential to create delayed effects. Along with chemical and radiological incidents, incidents involving biological agents are associated with particularly high dread risk and unknown risk, because they score highly on many of these factors [86].

5.2.2 Perceived likelihood and perceived severity

In order for people to be willing to take recommended protective actions during a biological incident, they must believe that there is a likelihood that they have been affected [36; 85]. Perceived likelihood of having been affected is related to a number of different factors, including proximity to the threat, the number of people affected by the incident, and how widespread the effects are. Perceived likelihood may also be affected by other factors, such as the amount and type of media coverage of the incident [87].

As with perceived likelihood, for people to be willing to take protective actions during a biological incident, they must perceive that the incident has a reasonable degree of severity [36; 85]. Perceived severity may be related to actual severity, with increased mortality rate resulting in increased perceptions of severity. Perceived severity may also be linked to the amount and type of media coverage of the incident [87].

5.2.3 Self- and response-efficacy

In order for members of the public to be willing to take recommended protective actions, they must believe that the actions are effective (response-efficacy), and that they will be able to successfully take recommended actions (self-efficacy) [88]. Applied specifically to the context of chemical, biological, radiological, and nuclear incidents, high levels of response-efficacy and self-efficacy result in an increased willingness to take recommended protective actions [89]. A belief that one is able to take protective actions may also create a sense of control, and therefore reduce public anxiety [90].

5.2.4 Basic principles of Psychological First Aid

A commonly used emergency mental health approach is Psychological First Aid (PFA). As noted above, people may experience a variety of reactions in response to a biological threat. As described above, incidents that are deliberate, involve unfamiliar agents, and have unknown consequences, are most likely to be anxiety-provoking [36; 84]. Another factor that increases the anxiety associated with an incident is witnessing death or serious injury to others; this has also been shown to be a key risk factor for developing longer term psychological conditions (*e.g.* PTSD) following an incident [91]. If people are distressed, it may be beneficial to carry out PFA [92]. PFA has ten aims:

1) To provide comfort and consolation
2) To protect people from further threat and stress
3) To provide immediate physical care
4) To encourage goal oriented and purposeful behaviour
5) To help people reunite with loved ones
6) To enable voluntary sharing of experiences
7) To link survivors with sources of support
8) To facilitate a sense of being in control
9) To identify people who need further help (*e.g.* through triage)
10) To provide accurate information

PFA involves a meeting between a professional and the person who has been affected by the incident, in which the professional aims to meet the affected person's immediate needs, and listen to their concerns. During this conversation, it is important to learn the facts about the person's experience, so that they can be provided with accurate information. However, a person should not be made to talk about their experiences if they do not wish to do so, and it should not be assumed that everyone who has been affected by the incident will be traumatised as a result of it.

5.2.5 Use of Psychological First Aid in three case studies involving biological threats at transport hubs

In Table 4 below we present three specific case studies that deal with different aspects of a biological incident. Each of these case studies is likely to result in different levels of public concern, and thus potentially different public responses. For each one, we outline the nature

of the incident, the potential psychosocial effects of such an incident (based on the level of dread risk, perceived likelihood and severity, and perceived self- and response-efficacy), and the requirements for psychological first aid during the incident. The case studies consider increasingly serious scenarios, starting with a disease case, followed by a deliberate attack, and finally a death in the transport hub. While potentially causing concern to members of the public, the first case study considering the presence of a person suffering from a pandemic disease within the transport hub is likely to be the least concerning of the three case studies presented here.

Table 4: Mental health first aid case studies considered

Case study 1: An alert that a natural pandemic disease case has been present within the transport hub	
Factors involved	PFA requirements
This case does have some factors that may increase dread risk (for example, the invisible nature of the disease). However, it is naturally-occurring, and consequences and treatment are (likely to be) well-known and effective. While still resulting in high perceived likelihood of being affected (due to the immediate presence of a person suffering from the disease), perceived severity is likely to be low to moderate, as is fatality risk. If an effective treatment is available, and if members of the public are aware of this (for example, if communication around the nature of the pandemic and available treatments has been successful), then perceived self and response efficacy are also likely to be fairly high, thus reducing public concern.	• Information on preventative actions that can be performed for themselves and others; • Information on treatment options; • Information on sources of further information; • Information on who to contact if they or someone they know may have contracted the disease; and • Information on how to obtain a one-to-one interview for individuals that are particularly concerned.
Case study 2: A deliberate biological attack on the hub users/staff	
Factors involved	PFA requirements
A deliberate biological attack on hub users and staff is likely to create a large amount of public anxiety, as it has several factors that result in high perceived dread risk. Not least of these is the fact that this scenario includes the presence of an invisible and unknown agent (rendering the situation extremely ambiguous), that has been released deliberately with intent to harm those present (man-made threats provoke more anxiety than natural threats). In addition to this, as the agent is unknown, the consequences of exposure will also be unknown, as will any potential treatment options. The unknown nature of the agent will result in increased perceptions of severity, and the close proximity to the release will increase perceptions of likelihood of exposure. Given the unknown nature of the agent and the available treatments, self- and response-efficacy are likely to be low. High perceived severity and likelihood, combined with low self- and response-efficacy, may result in public denial of the threat, and lack of willingness to take protective actions.	Requirements for case study 2 will be more resource intensive than case study one due to the deliberate nature of the outbreak. • Each affected person should have an interview with a professional, who can listen to their concerns following the incident, and can provide them with accurate information; and • Ensure PFA is tailored to suit each of these individual affected persons' needs and deliver advice on a case-by-case basis. As in **case study 1**, while each person should feel able to talk about their experiences if they wish, they should not be made to do this if it makes them uncomfortable or distressed.

Case study 3: A case collapsing and dying in the transport hub	
Factors involved	PFA requirements
Witnessing death or serious injury to others has been shown to be a key risk factor for developing longer term psychological conditions (*e.g.* PTSD) following an incident. In addition, the presence of an unknown disease with obviously high fatality, in the immediate vicinity of the individual, will result in high levels of dread risk. Perceived likelihood and severity will also be high, contributing to high levels of public anxiety. Given the unknown nature of the disease, information about treatment options will also be unavailable. This will reduce self- and response-efficacy, which will again contribute to increased levels of public anxiety.	As with **Case study 2**, this scenario is also likely to be particularly concerning for those involved. Witnessing another person die from a disease not only increases perceived likelihood and severity, it also substantially increases the level of trauma experienced as a result of the incident. • All individuals who witness the incident should be offered a one-to-one interview with a professional, who will listen to their concerns; • The professional will try to identify the facts of the incident so that they are able to provide appropriate and accurate support and information; and • Information needs in this case are likely to include information about likelihood of developing the disease, preventative measures that can be taken (both to prevent a person from contracting the disease, and to prevent them passing the disease on to their loved ones), and the treatment options (as and when information about this becomes available). Again, it will be important that PFA is tailored to meet the needs of each individual, to ensure that support provided is as helpful as possible.

5.3 Mental health first aid considerations for public risk communication

An infectious disease outbreak will affect many different groups' mental wellbeing, including those infected, response personnel, and others, including susceptible individuals, bereaved persons, and relatives of those who are ill.

- Mental health and behavioural science expertise and considerations should be included in a comprehensive public health response to an infectious disease outbreak
- Such a response should include PFA taking into account the fact that different severities of disease outbreak will require different levels of response
- Messages should avoid creating unnecessary fear and
- Information must be shared in a structured manner

6. Discussion and conclusion

In this report we have considered four types of communication during incidents of serious public health concern: cross-border, electronic methods (social media, websites, and apps); traditional methods and mental health first aid. From the available evidence bases of these communication methods, we have determined considerations for those involved with conducting communication during an infectious disease outbreak involving a transport hub.

Communicators must consider different groupings of people, including based on age, and communication inequalities leading to knowledge gaps [93]; and different communication strategies and approaches when communicating, in order for the message to reach as many people as possible. The message itself must be constructed in such a way that the evidence provided in communications comes from a sound knowledge base (which could be an already well-established source from a global health agency) and is provided via the widest, most efficient dissemination method. It must also be remembered that the transport hub is not a closed space – people in the hub are able to communication with those outside the hub.

For all this to occur there must be an effective communication strategy which has been created according to relevant risk communication principles. In particular for electronic communication it is important to curate knowledge and guidance on use of SNS such that necessary employees are trained in the use and norms prior to initiating emergency communications [94]. Further such employees must have awareness of the reciprocal communication flows SNS permit and mitigate risk communication challenges arising from those flows [95].

In this deliverable we have considered communication surrounding the 2009 H1N1 influenza pandemic, the 2014-2016 Ebola virus disease outbreak, and the 2016 Zika virus outbreak. It is crucial that previous risk communication attempts are evaluated upon completion to lead to improvement of future ones through lessons learned, as China did between SARS and H7N9 influenza [96]. One method of testing a communication strategy prior to its use could be to run an exercise, such as that from PANDHUB Deliverable 6.4 – *Live exercise* – which also considered communications surrounding a disease outbreak in a transport hub, allowing for the improvements to strategy to be implemented before an outbreak occurs.

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