

THE IMPACT OF COMMUNICATION MATERIALS ON PUBLIC RESPONSES TO A RADIOLOGICAL DISPERSAL DEVICE (RDD) ATTACK

M. Brooke Rogers, Richard Amlôt, and G. James Rubin

It is a common assumption that, in the event of a chemical, biological, radiological, or nuclear (CBRN) attack, a well-prepared and informed public is more likely to follow official recommendations regarding the appropriate safety measures to take. We present findings from a UK study investigating the ability of crisis communication to influence perceptions of risk and behavioral intentions in the general public in response to CBRN terrorism. We conducted a focus group study involving a scenario presented in mock news broadcasts to explore levels of public knowledge, information needs, and intended behavioral reactions to an attack involving an overt radiological dispersal device (RDD), or dirty bomb. We used the findings from these focus groups to design messages for the public that could be presented in a short leaflet. We then tested the effects of the leaflet on reactions to the same scenario in 8 further focus groups. The impact of the new messages on levels of knowledge, information needs, and intended compliance with official recommendations was assessed. The provision of information increased the perceived credibility of official messages and increased reported levels of intended compliance with advice to return to normal/stop sheltering, attend a facility for assessment and treatment, and return to a previously contaminated area after decontamination of the environment has taken place. Should a real attack with an RDD occur, having pretested messages available to address common concerns and information needs should facilitate the public health response to the attack.

PUBLIC REACTIONS CAN BE A MAJOR DETERMINANT of the overall economic, medical, and social impacts of an emergency or disaster.¹⁻⁵ Recently, there has been growing recognition that, “For many high impact risks we [governments] do not understand what the public actually expects in a situation, or how tolerant they may be of ‘abnormal’ risks during a crisis,”^{6(p24)} leading to an increased focus on the development of risk communication messages to improve community and individual resilience against a variety of risks, including chemical, biological, radiological, and nuclear (CBRN) terrorism.⁷⁻¹⁰ In general, these efforts entail the preparation of risk and crisis communication strategies developed to aid communicators in

their efforts to encourage members of the public to think about their actions and vulnerabilities during an emergency. As part of this effort, various projects have been undertaken, such as IMPACT,¹¹ Informed, Prepared, Together,¹² CIE Toolkit,¹³ PIRATE,¹⁴ and the CDC/ASPH Pre-Event Messaging Development Project,¹⁵ which informed the Centers for Disease Control and Prevention’s (CDC) First Hours program.⁵ These and others have sought to assess what members of the public know about given risks and what information they would like to receive in the event of a CBRN incident occurring. Messages to meet these information needs can then be designed in advance, tested, and refined.¹⁶⁻²¹

M. Brooke Rogers, PhD, is Senior Lecturer in Risk and Terror, Department of War Studies; and G. James Rubin, PhD, is Senior Lecturer in the Psychology of Emerging Health Risks, Department of Psychological Medicine; both at King’s College London, London, UK. Richard Amlôt, PhD, is Scientific Programme Leader, Emergency Response Department, Health Protection Agency, Porton Down, UK.

Such messages should take account of research into how people respond to emergencies. This literature has challenged the concept of a panic-prone public.^{13,22,23} Instead, goal-directed, rational behaviors in the face of difficult and potentially life-threatening circumstances are more common and have been termed “normative responses” to terrorism.²⁴ Normative responses can entail the seeking of information,^{25,26} attempts to contact family members and loved ones, undertaking protective steps for self and family, and locating food, water, and shelter during a terrorist incident.²⁰ This does not mean that individuals avoid changing their behavior, but rather that they find ways to cope with and adapt to the situation without incurring lasting psychological health effects.

This article presents the results of a 2-phase focus group study designed to gain a better understanding of normative responses to radiological terrorism and to assess the impact of terrorism-related messaging on levels of knowledge, understanding, and intended compliance with official advice on the part of the UK public. During this study, members of the public took part in focus groups relating to a hypothetical attack involving a radiological dispersal device (RDD), or dirty bomb. Radiological incidents are of particular interest because they typically score so high on psychometric risk measures of fear and dread, and thus, even without the context of terrorism, it is often assumed that there is the potential for mass flight or overwhelming demands on health services.^{1,27,28} We assessed participants’ knowledge about CBRN terrorism, explored what information participants believed should be included in government messages related to CBRN terrorism, identified intended behaviors in response to such an event, and identified the desired sources of official advice. We then developed and tested the impact of communication messages for an incident involving an RDD.

METHODS

Design

Two phases of focus groups were conducted 14 months apart. Phase 1 used 3 2-hour ($N=22$) focus group sessions during the summer of 2007 to explore the internal logic of public perceptions of risk and behaviors in response to a hypothetical RDD attack. Information gained from the Phase 1 focus groups was then used to develop a leaflet intervention designed to address participants’ information needs. The leaflet intervention was pilot-tested during a read-aloud study ($N=5$) before being introduced during the Phase 2 focus groups in order to explore its impact on levels of knowledge, understanding, and intended compliance with official recommendations.

The Phase 2 groups were conducted during September and October 2008 and included 8 3-hour sessions ($N=64$). Phase 2 participants were shown the same hypothetical

RDD terrorist attack used in Phase 1. Two Phase 2 groups were designated as baseline groups in order to provide an indication of any general changes in participant responses that could be attributed to the passage of time between Phases 1 and 2. The remaining 6 groups acted as leaflet intervention groups. Intervention group participants were issued the information leaflet during the scenario; Phase 2 baseline group participants were issued the information leaflet after they completed the scenario and were asked to consider how they felt the leaflet might have affected their responses had they received it earlier.

Participants

The 22 participants for the Phase 1 focus groups and 64 participants for the Phase 2 groups were recruited from outer London and the surrounding counties in the UK. Participants were recruited by a market research organization, Research Quorum (RQ). RQ uses a network of professional consumer group recruiters who draw from a comprehensive database of contacts representing a wide range of the public across all demographic categories in order to ensure that respondents fit any quota criteria. The participants were selected and assigned to each focus group in order to obtain a small but representative sample of participants. The sample included a mix of gender, age, ethnicity, and education and included some parents (Table 1).

In line with the King’s College London research ethics procedures (ethics approval code: RESC/06/07-12), the anonymity of each individual participant was maintained. Participants were provided with consent forms describing their right to withdraw from the study and, after the study, with information sheets including additional websites providing useful CBRN-related information and the contact details of the researchers if they had further questions after participating in the focus groups. Participants were provided with small cash stipends to cover the cost of transportation and other related expenses incurred by focus group attendance.

Scenario

The scenario was presented to participants in 4 stages:

Stage 1: A time prior to the incident (morning). Participants were presented with a mock newspaper article describing a series of incidents involving the discovery of radiological materials during a dawn raid by police in a location near their hometown.

Stage 2: A mock television news announcement shortly after the start of the incident (later that morning/early afternoon) included a police announcement informing respondents that an explosion had occurred, that radiation had been detected in the area, and that members of the public were being advised to shelter indoors with doors and windows closed. Additional media reporting described bodies at the

Table 1. Demographic Details of Participants for Phase 1 ($n=22$) and Phase 2 ($n=64$) Focus Groups

<i>Characteristic</i>	<i>Phase 1 No. %</i>	<i>Phase 2</i>	
		<i>Baseline No. %</i>	<i>Intervention No. %</i>
Sex:			
Female	11 (50)	9 (56.25)	24 (50)
Male	10 (46)	7 (43.75)	21 (43.5)
Not answered	1 (4)	—	3 (6.5)
Age:			
18-24	6 (27)	4 (25)	13 (27)
25-44	11 (50)	8 (50)	20 (42)
45-64	5 (23)	4 (25)	14 (29)
Not answered	—	—	1 (2)
Marital Status:			
Single	9 (41)	3 (18.75)	13 (27)
Married	10 (45)	12 (75)	27 (56.5)
Separated	—	1 (6.25)	4 (8)
Widowed	—	—	1 (2)
Not answered	3 (14)	—	3 (6.5)
Income:			
£10-£20K	1 (4)	—	5 (10)
£20-£30K	4 (18)	1 (6.25)	3 (6.5)
£30-£40K	5 (23)	2 (12.5)	8 (17)
£40-£50K	5 (23)	5 (31.25)	3 (6.5)
£50-£75K	4 (18)	6 (37.5)	4 (8)
> £75K	1 (4)	2 (12.5)	1 (2)
Refused	2 (10)	—	21 (43.5)
Not answered	—	—	3 (6.5)
Religion:			
Church of England	4 (18)	10 (62.5)	25 (52)
Catholic	2 (10)	4 (25)	8 (17)
Hindu	1 (4)	—	1 (2)
Muslim	1 (4)	—	2 (4)
Other	1 (4)	2 (12.5)	2 (4)
None	9 (42)	—	4 (8)
Don't know/missing	4 (18)	—	6 (13)
Ethnicity:			
White	19 (86)	15 (93.75)	37 (78)
Asian	3 (14)	—	4 (8)
Mixed	—	1 (6.25)	1 (2)
Black	—	—	4 (8)
Chinese	—	—	—
Other	—	—	1 (2)
Not answered	—	—	1 (2)
Parent:			
Yes—male	5 (24)	5 (31.25)	12 (25)
Yes—female	8 (38)	5 (31.25)	16 (33)
Yes—total	13 (62)	10 (62.5)	28 (58)
No—male	5 (24)	2 (12.5)	9 (18.5)
No—female	3 (14)	4 (25)	8 (17)
No—total	8 (38)	6 (37.5)	17 (35.5)
Not answered	—	—	3 (6.5)
Mean no. of children (SD)	2.42 (0.79)	1.73	2.51
Age finished education:			
Up to 18	8 (37)	8 (50)	18 (37.5)
19-22	7 (32)	8 (50)	22 (46)
23+	6 (27)	—	5 (10)
Not answered	1 (4)	—	3 (6.5)
Working mother? (% of Yes—female parents)			
Full-time	—	2 (40)	—
Part-time	2 (25)	—	1 (6.25)
Not working	5 (63)	3 (60)	12 (75)
Not answered	1 (13)	—	3 (18.75)

scene of the explosion, police in protective clothing and respirators, and a rising plume of smoke from the area.

Stage 3: A mock television news announcement in the hours/days following the incident encouraged individuals to return to normal and to attend an assessment and treatment center if they believed they had been exposed. Messages were provided by a medical doctor.

Stage 4: A mock television news announcement several weeks after the incident suggested that the government had encouraged evacuated individuals to return to live and work in their newly decontaminated area. However, the news footage also discussed ongoing bans on food and milk within a certain radius of the location of the attack and noted that several tons of topsoil had been removed. Messages were provided by an “independent scientist” who challenged the official advice to return to normal.

The data generated by the Phase 1 focus groups were used to inform the information included in a leaflet intervention designed for the second phase of this study. The Phase 2 focus groups followed the same 4 stages listed above. However, participants were also provided with the leaflet prior to the presentation of Stage 3.

Leaflet Design

The leaflets contained information intended to help members of the public make informed decisions about appropriate protective behaviors for themselves and their families. Some examples of broad issues identified for inclusion in the leaflets included background information concerning the threat (eg, “What Is Radiation?”), how exposure can occur, a description of symptoms of radiation sickness, how to tell if you have been exposed, and whether there is any treatment for exposure. Additionally, information concerning likely emergency responses and the likely actions of the authorities in the event of an RDD was included, along with sources for further information. The leaflets were designed to be generic, as if they had been prepared in advance of our scenario occurring and distributed immediately afterwards. As such, they did not discuss specific events relating to our scenario but gave broader advice about RDDs in general.

The text of the leaflets was reviewed by experts from the Health Protection Agency (HPA) and compared with information from the HPA and CDC websites in order to ensure accuracy of the scientific information. The leaflet intervention was pilot-tested with a read-aloud study ($N=5$) to test legibility and comprehensibility of the information before being implemented in Phase 2. The leaflet can be viewed at www.liebertpub.com.

Procedure

The focus groups were conducted, recorded, and transcribed by professional moderators from Research Quorum. Moderators were instructed to focus on identifying

participants’ existing levels of knowledge about RDDs, what information they wanted to know, and their likely reactions and intended behaviors on hearing news of a deliberate terrorist attack involving radiation.

In addition to the free-flowing conversations, participants were asked to write down, without conferring, the first thing they would think and how they would feel after exposure to the mock newspaper article and DVD scenario at each stage. They were also asked to rate their likelihood of following the official advice contained in the messages: (1) carry on as normal (Stage 2); (2) attend a treatment center if you were at the station 2 hours either side of 5:00 PM (Stage 3); (3) carry on as normal (Stage 3); (4) contact your family doctor or a health-related telephone helpline for advice if concerned (Stage 3); (5) return to your normal daily routine (Stage 4); and (6) travel through the affected area if you needed to (Stage 4). Participants were also asked to write down a percentage score for how credible (ie, believable and trustworthy) the advice given by the authorities was throughout the scenario. Finally, participants were asked to provide a score for the credibility of the “independent scientist.”

Analysis

Using coded, anonymized versions of the transcripts, we used interpretative phenomenological analysis (IPA)²⁹ to identify key themes related to participants’ understandings of a terrorist attack involving an RDD and their behavioral intentions and information needs. We conducted a subjective assessment of themes attributable to the presence of the leaflet in the Phase 2 focus groups to identify the impact of the leaflets on levels of knowledge, understanding, and intended behaviors in response to an RDD attack. In addition, we analyzed individual responses to the quantitative rating questions to identify any differences between self-rated responses across the baseline and intervention groups.

RESULTS

The leaflet intervention increased the perceived credibility of official messages and tended to increase reported levels of intended compliance with advice to (1) return to normal and stop sheltering, (2) attend a facility for assessment and treatment, and (3) return to a previously contaminated area after decontamination had taken place.

Baseline Knowledge, Perceptions, and Intended Behaviors

The 2 Phase 2 baseline groups that did not receive the leaflet until after the scenario had been completed showed similar responses to the scenario as the Phase 1 groups. This suggested that the passage of time between Phase 1 and Phase 2 had not affected the participants’ reactions to the

scenario. Data from the 2 relevant Phase 2 groups were therefore included with the Phase 1 data for our qualitative analysis.

With respect to *level of knowledge and understanding* about an RDD incident, the baseline responses were characterized by low levels of knowledge and elevated levels of confusion, concern, and fear. Participants reported vague or inaccurate knowledge of the threat, with particular concerns about the long-term health effects of radiation including cancer, organ damage, and possible adverse effects to future generations, a theme that ran throughout the study. Comments included references to the explosion “going out in the wind” (GP6, R4) and the belief that exposure to an RDD would result in a systems failure in the body:

It's like close down the system, isn't it? You know ... the organs start packing up. I don't know how it acts on the body, but it can't feel good, can it? (GP1, R1)

An exploration of baseline *information needs* indicated that our participants held unexpected and occasionally highly idiosyncratic views about RDDs and the ways in which dirty bombs and radiation exert their negative effects. Participants initially focused on a need to understand the basic properties of radiation. They requested information explaining how the radiation was likely to travel or spread, whether or not drinking water would be contaminated, the length of time any contamination was likely to last, and detailed information about the short-term and, especially, long-term effects and symptoms of exposure to radiation. Respondents expressed concern that the symptoms of exposure are difficult to differentiate from common flulike symptoms.

A strong desire existed for information that was factual and linked to practical suggestions or advice:

I don't know what the threat is. I don't understand the chemistry behind it. I'm not sure what the logical response to it is; therefore, I need advice. Shall I go out to work, shall I stay in, shall I close the windows? (GP4, R4)

Participants also suggested that official recommendations must go beyond the simple provision of fact by offering an explanation for the underlying rationale informing public health recommendations:

I've put down that we still do it, remove clothes, take shower, etc., but I don't see what that is going to do against the fumes of smoke given off by a radioactive explosion. You breathe in bad smoke, and what good is taking off your clothes and having a shower going to do? (GP4, R4)

This also applied to the official advice encouraging members of the public to return to normal after following advice to shelter (eg, “Why is it safe to leave the shelter a few hours after a plume has passed?”), as well as the official advice encouraging members of the public in the exposure zone to

attend an assessment and treatment center even if they were asymptomatic. In short, official advice had the potential to cause confusion if the underlying rationale for the health advice was not communicated.

The baseline findings for behavioral intentions confirmed the presence of a number of normative responses such as seeking information, contacting family members and loved ones, taking protective steps for self and family, and locating food, water, and shelter. A number of additional behavioral responses were also identified including: collecting children from school in spite of official warnings to shelter in place or continue with normal routines; fleeing the area even if located outside of the affected zone; unwillingness to attend an assessment or treatment center because of fear of contamination from others; and unwillingness to return home or resume normal routines after receiving information that it was safe to do so.

Impact of the Leaflet

Phase 2 respondents reported that the leaflet improved their knowledge and understanding of a dirty bomb and addressed their immediate, short-term concerns about radiation and the impact of an RDD incident:

I think it helps in a certain ... where it kind of paraphrases what a dirty bomb is, because I had in my head ... I imagined huge, big mushroom clouds and, y'know, the worst case thing. And, y'know, it kinda just says, basically, it'll just take out a street. So, I think if I'm not in that street, quids in, y'know. (GP14 Leaflet, R6)

Other comments included:

Very informative leaflet—lots of facts and helpful advice. This would help to prevent rumours and myths. (GP8 Leaflet written response, R6)

I thought it was good. It was very informative. It tells you what a dirty bomb is; it tells you what you should do and it tells you why you should do it. (GP8 Leaflet written response, R3)

Overall, the provision of information lowered levels of anxiety and helped create a sense of control over the situation:

Having read this, I'm not in control, as I said, but I feel more in control. If this happens and I've read this, I will remember these bullet-points. They're in my mind and I will think, “yes,” y'know. And I think that's helpful. It stops panic. (GP16 Leaflet, R4).

The leaflet intervention also addressed a number of the *information needs* identified during the baseline focus groups. Table 2 presents the results of the individual written responses to the questions asked immediately after each mock newspaper or DVD inject in the baseline (Phase 1) and intervention (Phase 2) focus groups.

Table 2. “First Reaction” Quantitative Questions Asked in Phase 1 and Phase 2, RDD Baseline, and Intervention (leaflet) Focus Groups. Participants responded individually to the questions prior to the start of discussions at each scenario stage. Scores ranged from 0 (not likely/not credible) to 100 (very likely/very credible) for each question (standard deviation in parentheses).

<i>RDD Scenario</i>	<i>Phase 1</i>	<i>Phase 2</i>	
		<i>Baseline</i>	<i>Intervention</i>
<i>Stage 2:</i>	(<i>n</i> = 22)	(<i>n</i> = 16)	(<i>n</i> = 44)
How likely are you to “Go in, stay in, tune in”?	86.0 (17.6)	80.0 (21.7)	73.6 (30.9)
How likely are you to remove and seal clothes and take a shower, assuming you had been in contact with the smoke given off in the explosion?	94.1 (22.0)	99.3 (2.6)	93.5 (18.0)
<i>Stage 3:</i>			
How likely are you to follow the advice that “sheltering is no longer necessary”?	47.0 (28.9)	43.7 (32.6)	68.4 (26.1)*
How likely are you to “avoid the cordoned area”?	98.2 (5.0)	100 (0)	99.6 (3.0)
How likely are you to “attend sports facility for monitoring if exposed”?	82.5 (23.3)	89.7 (23.8)	91.8 (17.4)
<i>Stage 4:</i>			
How likely are you to return home, because levels are safe?	17.1 (26.9)	38.7 (28.3)	54.3 (31.6)
<i>Final scenario questions:</i>			
How credible (ie, believable and trustworthy) were the advice messages given by the authorities?	33.2 (20.7)	38.7 (22.2)	65.8 (21.5)**
How likely are you to return home, because levels are safe?	17.1 (26.9)	38.7 (28.3)	54.3 (31.6)
For the credibility of the “independent scientist”?	72.5 (24.1)	61.0 (24.2)	51.9 (26.6)
<i>Leaflet discussion questions:</i>			
To what extent do you think the leaflet [would have] helped you in making decisions about the scenario?		78.7 (20.2)	81.8 (16.3)
To what extent do you think the leaflet [would have] helped you understand the <i>advice from the authorities</i> presented in the scenario?		83.3 (11.4)	83.4 (15.8)
How credible (ie, believable and trustworthy) do you think the advice messages in the leaflet are?		80.7 (16.5)	88.1 (12.6)

Note. Bold text indicates significant difference between Baseline and Intervention group scores (* $p < 0.01$; ** $p < 0.001$) using Mann-Whitney U tests.

The majority of Phase 2 participants believed that the leaflet would help them make decisions about the scenario ($M = 81.8$) and that the leaflet would help them understand the advice from the authorities ($M = 83.4$). Overall, participants rated the leaflet as “credible” ($M = 80.7$), and participants reported:

It made you do things that you probably wouldn't have, wouldn't have otherwise done.... Having a shower, bagging up your clothes, not rubbing your eyes, and that sort of thing. (GP15 Leaflet, R7)

The information in the leaflet concerning pathways to contamination and symptoms was seen as effective. However, once the basic information needs had been addressed, Phase 2 participants generated unique, additional information needs. These included requests for additional in-

formation on water and food contamination; the ease with which radiation is spread from person to person and from pets; and the way in which the experts or authorities are checking, measuring, and monitoring radiation. Others requested information and checklists to help them seal up their houses. This illustrates the changing nature of information needs over the life cycle of an incident once the initial health concerns have been addressed.

Phase 2 participants were clear about the level and type of proof they would require in order to feel convinced that their compliance with the official advice was worthwhile. In the short term, participants requested contamination zone maps that offered specific advice and behavioral recommendations for individuals living in each zone. These detailed area maps were expected to indicate different levels of contamination, as well as safe zones:

They should show a map on there, say, "Right, this is where the explosion happened in all this circle, and within that circle down" and then it's your judgment if you're just behind it, or whatever, and then everyone else don't have to worry. (GP10 Leaflet, R4)

These area maps should be linked to detailed, practical information about the steps one should follow if one is in a specific area (eg, if you are in the red zone, please report to the assessment center; if you are in the yellow zone, please shelter; if you are in the green zone, carry on as normal and avoid the cordoned-off area).

In the long term, the Phase 2 participants requested repeated checks on health and levels of contamination in the area, including scales and comparisons that would enable them to put the contamination into a context relative to their everyday lives. Many participants suggested that simple tools, such as radiation badges (if available), would give them a greater sense of control.

In spite of the leaflet's ability to address a number of information needs, a lack of consistency in messages across the various messengers (eg, police, medical, independent scientist, leaflet) served to increase confusion and anxiety in both the baseline and intervention groups. For example, Phase 1 and Phase 2 participants reported that the Stage 4 discussions about levels of contamination in the surrounding areas (ie, in meat and vegetables) and the description of several tons of top-soil being removed from the immediate area generated high levels of concern and confusion because the official advice in Stage 3 indicated that the radiation levels had decreased to the point that sheltering was no longer necessary.

In spite of increases in confusion and anxiety during Stage 4, Table 2 illustrates that the perceived credibility of the advice and messages given by the authorities almost doubled between the baseline and intervention studies when participants were asked, "How credible (ie, believable and trustworthy) were the advice and messages given by the authorities?" (Phase 1: $M=33.2$, $SD=20.7$; Phase 2: $M=65.8$, $SD=21.5$).

The provision of appropriate messages increased intended compliance with official advice to engage in a number of protective behaviors. Table 2 also shows the change in behavioral intentions between the baseline and intervention focus groups. However, it should be noted that compliance rates with suggested protective behaviors, such as sheltering, attending a sports center for monitoring if exposed, and showering, were high across both groups. While the leaflet intervention did not change the likelihood of avoiding the cordoned area (Question 4), as compliance rates were already high (Phase 1: $M=98.2$, $SD=5.0$; Phase 2: $M=99.6$, $SD=17.4$), the leaflet intervention appeared to increase the likelihood of following the advice that "sheltering is no longer necessary." However, some respondents indicated that, in spite of their belief that sheltering was no longer necessary, they would take a "better safe than sorry" approach and remain in their homes (shelter) for another day, if not 48 hours.

The leaflet intervention also had a strong influence on reluctance or refusal to return to an area after decontami-

nation had taken place. This behavior had the lowest intended compliance rate during the Phase 1 focus group and appeared to be the most difficult behavior to overcome. Concerns included "... that they don't know enough and are rushing families back to a possible unsafe area which could have long-term effects on them" (GP4 written response, R1). In spite of this, after receiving the information about radiation and contamination/decontamination in the leaflet, the "timing" of advice to return to normal became less of an issue as long as there was proof of the level of safety:

If everything has been done that's humanly possible to do to ensure that that area is returned to normal, then ... if it takes two weeks then so be it; if it took a month, but if they would say to me, everything has returned to normal, then so be it. (GP10 Leaflet, R8)

Many of the discussions centered on the long-term checks and repeated measurements that were needed in order to certify that an area and homes were safe. Overall, participants in Phase 2 were less likely to leave the area but appeared to be more demanding of the type and levels of ongoing proof they desired to feel certain that the area was safe. The majority of Phase 2 participants expressed an increased willingness to wait for additional information before making their choices.

Several methodological limitations should be kept in mind when reviewing our results. For instance, while the small number of participants in our focus group studies allowed us greater depth of engagement than larger-scale survey studies and enabled us to recognize clear trends and patterns across the qualitative responses, we are unable to comment on the wider significance of the differences in intended behaviors and levels of trust reported in Table 2. It is also possible that the desire to please the experimenter informed some of the responses of our participants when presented with our leaflet, although justifications for the written responses were explored in detail and subject to change through group discussion, and outlying trends were weeded out through the in-depth process of IPA. Additionally, while issues of conformity and group polarization are always a concern in this type of study, the use of experienced facilitators and the format used for capturing participants' initial responses through writing prior to discussion with the group go some way toward addressing these issues. Finally, although the hypothetical nature of our scenario inevitably prevents us from drawing definitive conclusions about how the public would behave during a real incident, the correspondence between our results and the behaviors seen in genuine incidents involving radiation provides some reassurance.^{30,31}

DISCUSSION

Our Phase 1 focus groups identified several behavioral intentions that might have negative impacts for response

organizations following an RDD. These included intended compliance with advice to return to normal (eg, sheltering is no longer necessary), attendance at a facility for treatment and assessment, and the intention to return to a previously contaminated area after decontamination of the environment has taken place. In general, findings from the Phase 1 focus groups were broadly consistent with those of previous studies in this area.^{4,32} For example, several previous studies have noted that members of the public lack knowledge about radiation and tend to show heightened levels of anxiety about radiological terrorism.^{1,23,33} The behavioral responses identified in this phase also correspond well with the results of previous studies, which have identified a tendency for members of the public to collect children in the immediate aftermath of a terrorist attack,³⁴ self-evacuate from areas perceived to be at risk from radiation,³⁵ express unwillingness to attend an assessment center for fear of coming to harm,²¹ and be wary about the potential for long-lasting contamination despite attempts to communicate a low level of risk.^{36,37}

The outcomes of the Phase 2 focus groups demonstrated that the provision of appropriate messages increased the perceived credibility of official advice and that such behaviors are amenable to change by the provision of clear, consistent, and trustworthy information. Overall, responses to the information leaflet were positive, and the contents addressed a variety of information needs, including improved knowledge and understanding of the scale, impact, and response to the RDD scenario. Participants who received the leaflet were more likely to believe that the incident was contained to a small area, less likely to leave the area altogether, and more willing to return to a previously decontaminated area. As a result, participants appeared to be more receptive to official advice and rated messages coming from the authorities as more credible. These findings correspond well with previous research suggesting that a key aspect of people's concerns regarding radiation incidents relates to the inherent difficulty in understanding where risk exists and where it is safe;^{23,30,38} by providing more information on this issue, our leaflet appeared to effectively reduce levels of worry among our participants.

The leaflet also improved intended compliance with advice to attend an assessment center if exposed, to follow advice that sheltering is no longer necessary, and to follow advice to return home once levels are declared safe. Nevertheless, not all of the participants believed that they would shelter during an incident or remain in a previously contaminated area, especially if they had young children. It is likely that this will be a key communication issue in a CBRN incident, and focus group participants indicated that they would likely comply with the recommendations as long as they could ensure the safety of their immediate family, especially children. In order to address this, response organizations must offer advice and guidance on the emergency plans and procedures schools have in place and openly communicate these plans to parents before, during, and after an incident. To date, the role of in-

formation about, and from, schools in guiding behavior during a disaster has been neglected in the literature.

Participants acknowledged that the leaflet intervention successfully addressed the majority of their immediate short-term concerns. However, the leaflet did little to address their long-term health concerns around exposure, contamination, and treatment or management. It is likely that information on long-term consequences will need to be provided separately to the information in the existing leaflets.³⁹ Participants made a number of useful suggestions regarding how the leaflet could be refined and improved. For example, providing members of the public with a detailed insight into what will occur at an assessment and treatment center when they arrive should be a key feature of any communication targeted at encouraging individuals to report to assessment centers. Emphasizing the expertise of the center's staff may also be desirable.

Finally, it is important to note that leaflet interventions are designed to accompany, not replace, messaging that addresses the need for real-time information about an ongoing incident. Our study has shown that compliance with recommended behaviors could be improved through effective communication about a CBRN incident, as long as the information presented is consistent and clear, addresses the knowledge gaps and information needs of the intended audience, and is delivered through a variety of sources (eg, leaflet, TV, radio, newspaper, internet).

A word of caution is needed, however, as a few participants believed that the leaflet played down the threat of radiation, which could cause some individuals to hesitate when it came to seeking treatment:

Yeah, it reassures me, but I don't know if that's necessarily always a good thing, 'cause if I was a little bit more panicked I'd be more inclined to follow the step by step. I mean I would anyway, but I imagine someone might get a bit blasé about it and think, "Oh, I'll be fine." (GP16 Leaflet, R1)

This led to the suggestion that:

... they should emphasize the point that you don't have to have cuts and bruises to be contaminated because it's what you can't see that's the problem, rather than what you can see. (GP16 Leaflet, R2)

In either case, simple reassurance may not be an effective way to increase compliance with behavioral recommendations.

In conclusion, in spite of the concerns about how and when the leaflets would be received, the current study illustrates that effective communication about CBRN threats could improve compliance with preferred behaviors through increasing knowledge, reducing anxiety, managing expectations, building trust, and creating familiarity with organizations and emergency response procedures. Explaining the nature of the threat in practical detail has the potential to decrease some of the anxiety surrounding the agent and provide reassurance, as well as decreasing some of the

resistance to returning to a previously contaminated area or home. Furthermore, for communication to be effective, decisions must be made about the point (ie, preevent, incident, postevent) at which the information is delivered.

ACKNOWLEDGMENTS

We would like to thank Simon Wessely, Ian Hall, Steve Leach, John Simpson, Bob Spencer, Jill Meara, Tim Brooks, John Croft, Steve Doel, Mike Barker, Liz Morgan-Lewis, Michael Collie, Kate Bunting, and Research Quorum for their help in developing the scenarios, questions, and discussion guides for the focus groups described in this report. The authors gratefully acknowledge funding provided by the Home Office during the period 2005 to 2009.

REFERENCES

1. Becker SM. Emergency communication and information issues in terrorist events involving radioactive materials. *Biosecur Bioterror* 2004;2(3):195-207.
2. Gigerenzer G. Out of the frying pan into the fire: behavioral reactions to terrorist attacks. *Risk Anal* 2006;26:347-351.
3. Gray GM, Ropeik DP. Dealing with the dangers of fear: the role of risk communication. *Health Aff (Millwood)* 2002;21(6):106-116.
4. Rogers MB, Amlôt R, Rubin GJ, Wessely S, Krieger K. Mediating the social and psychological impacts of terrorist attacks: the role of risk perception and risk communication. *Int Rev Psychiatry* 2007;19(3):279-288.
5. Vanderford ML. Breaking new ground in WMD risk communication: the pre-event message development project. *Biosecur Bioterror* 2004;2(3):193-194.
6. Government Office for Science. *Blackett Review of High Impact Low Probability Risks*. London: Department for Business, Innovation and Skills; 2011. <http://www.bis.gov.uk/assets/goscience/docs/b/12-519-blackett-review-high-impact-low-probability-risks>. Accessed February 3, 2013.
7. Cabinet Office. *Preparing for Emergencies: What You Need to Know*. 2004.
8. Cabinet Office. *National Risk Register*. 2007. http://webarchive.nationalarchives.gov.uk/+http://www.cabinetoffice.gov.uk/~media/assets/www.cabinetoffice.gov.uk/publications/reports/national_risk_register/national_risk_register%20pdf.ashx. Accessed August 18, 2010.
9. Communicating in the first hours. Terrorism emergencies. Centers for Disease Control and Prevention website. Updated May 14, 2007. <http://www.bt.cdc.gov/firsthours/terrorist.asp>. Accessed August 18, 2010.
10. Cabinet Office. *The National Security Strategy of the United Kingdom: Security in an Interdependent World*. March 2008. <http://www.statewatch.org/news/2009/jul/uk-national-security-strategy.pdf>. Accessed January 17, 2013.
11. te Brake JHM, van der Post MJTP, de Ruijter AM. Resilience from concept to practice: citizens and resilience. 2008. http://www.impact-kenniscentrum.nl/doc/file_1221486858.pdf. Accessed January 17, 2013.
12. Wood-Heath M, Pinder S, Mullen A. Informed. Prepared. Together. 2009. <http://www.informedprepared.eu>. Accessed August 18, 2010.
13. Pearce JM, Rubin GJ, Amlôt R, Wessely S, Rogers MB. Communicating public health advice after a chemical spill: results from national surveys in the United Kingdom and Poland. *Disaster Med Public Health Prep* 2012 Dec; in press.
14. Public Information Responses After Terrorist Events (The PIRATE Project). Public intentions and information needs after biological and radiological terrorism. 2011. <http://www.pirateproject.eu/>. Accessed January 17, 2013.
15. Wray R, Becker SM, Henderson N, et al. Communicating with the public about emerging health threats: lessons from the pre-event message development project. *Am J Public Health* 2008;98(12):2214-2222.
16. Becker SM. Communicating risk to the public after radiological incidents. *BMJ* 2007 Dec 1;335(7630):1106-1107.
17. Glik D, Harrison K, Davoudi M, Ruelle D. Public perceptions and risk communications for botulism. *Biosecur Bioterror* 2004;2(3):216-223.
18. Henderson JN, Henderson LC, Raskob GE, Boatright DT. Chemical (VX) terrorist threat: public knowledge, attitudes, and responses. *Biosecur Bioterror* 2004;2(3):224-228.
19. Wray RJ, Kreuter MW, Jacobsen H, Clements B, Evans RG. Theoretical perspectives on public communication preparedness for terrorist attacks. *Fam Community Health* 2004;27:232-241.
20. Wray R, Jupka K. What does the public want to know in the event of a terrorist attack using plague? *Biosecur Bioterror* 2004;2(3):208-215.
21. Rubin GJ, Amlôt R, Rogers MB, et al. Public perceptions of and reactions to pneumonic plague. *Emerg Infect Dis* 2010;16:120-122.
22. Sheppard B, Rubin GJ, Wardman JK, Wessely S. Terrorism and dispelling the myth of a panic prone public. *J Public Health Policy* 2006;27:219-245.
23. Pearce JM, Rubin GJ, Selke P, Amlôt R, Mowbray F, Rogers MB. Communicating with the public following radiological terrorism: results from a series of focus groups and national surveys in Britain and Germany. *Prehospital Disaster Med* 2012 Dec 21; epub ahead of print.
24. Maguen S, Papa A, Litz BT. Coping with the threat of terrorism: a review. *Anxiety Stress Coping* 2008;21(1):15-35.
25. Meredith LS, Eisenman DP, Rhodes H, Ryan G, Long A. Trust influences response to public health messages during a bioterrorist event. *J Health Commun* 2007;12(3):217-232.
26. Lemyre L, Turner MC, Lee JEC, Krewski D. Public perception of terrorism threats and related information sources in Canada: implications for the management of terrorism risks. *J Risk Res* 2006;9(7):755-774.
27. International Atomic Energy Association. *The Radiological Accident in Goiania*. Vienna: IAEA; 1998.
28. Acton JM, Rogers MB, Zimmerman PD. Beyond the dirty bomb: re-thinking radiological terror. *Survival* 2007;49(3):151-168.
29. Smith JA, Flowers P, Larkin M. *Interpretative Phenomenological Analysis: Theory, Method and Research*. London: Sage; 2009.
30. Rubin GJ, Page LA, Morgan O, et al. Public information needs after the poisoning of Alexander Litvinenko with polonium-210 in London: cross sectional telephone survey and qualitative analysis. *BMJ* 2007;335:1143-1146.

31. Rubin GJ, Amlôt R, Wessely S, Greenberg N. Anxiety, distress and anger among British nationals following the Fukushima nuclear accident. *Br J Psychiatry* 2012;201: 400-407.
32. Rubin GJ, Chowdhury A, Amlôt R. How to communicate with the public following a chemical, biological, radiological or nuclear attack: a systematic review. *Biosecur Bioterror* 2012;10:383-395.
33. Vyner HM. The psychological dimensions of health care for patients exposed to radiation and the other invisible environmental contaminants. *Soc Sci Med* 1988;27:1097-1103.
34. Rubin GJ, Brewin CR, Greenberg N, Simpson J, Wessely S. Psychological and behavioural reactions to the bombings in London on 7 July 2005: cross sectional survey of a representative sample of Londoners. *BMJ* 2005 Sep 17; 331:606.
35. Ziegler DJ, Brunn SD, Johnson JH. Evacuation from a nuclear technological disaster. *Geographical Review* 1981;71:1-16.
36. Boin A, van Duin M, Heyse L. Toxic fear: the management of uncertainty in the wake of the Amsterdam air crash. *J Hazard Mater* 2001;88(2-3):213-234.
37. McCarron P, Harvey I, Brogan R, Peters TJ. Self-reported health of people in an area contaminated by chromium waste: interview study. *BMJ* 2000;320:11-15.
38. Slovic P. Perception of risk. *Science* 1987;236:280-285.
39. Hyams KC, Murphy FM, Wessely S. Responding to chemical, biological or nuclear terrorism: the indirect and long-term health effects may present the greatest challenge. *J Health Polit Policy Law* 2002;27:273-291.

*Manuscript received November 4, 2012;
accepted for publication December 28, 2012.*

Address correspondence to:
M. Brooke Rogers, PhD
Senior Lecturer in Risk and Terror
King's College London
Department of War Studies
Strand
London WC2R 2LS
E-mail: Brooke.Rogers@kcl.ac.uk