British Journal of Health Psychology (2014)

The British Psychological Society

www.wileyonlinelibrary.com

Intrusive memories of hallucinations and delusions in traumatized intensive care patients: An interview study

Dorothy M. Wade[1,2]*, Chris R. Brewin[2], David C. J. Howell[1], Emily White[1], Michael G. Mythen[3] and John A. Weinman[4]

[1]Critical Care Department, University College Hospital, London, UK
[2]Department of Psychology, University College London, UK
[3]Biomedical Research Unit, University College Hospital, London, UK
[4]Institute of Pharmaceutical Science, King's College London, UK

Objective. Psychological morbidity, including post-traumatic stress disorder (PTSD), is common in survivors of intensive care. Intrusive memories of trauma are important symptoms of PTSD. Research has not established which aspects of intensive care are most traumatizing; invasive medical procedures, fear of dying from life-threatening illness or injury, or effects of psychoactive drugs, including hallucinations and delusions. Our study aimed to investigate the roots of post-intensive care trauma by interviewing survivors with symptoms of PTSD. Were their intrusive memories primarily of real events or hallucinations and delusions from intensive care?

Design. Interview study as part of a mixed-methods investigation of psychological outcomes post-intensive care.

Methods. We used purposive sampling to identify patients with intrusive memories of intensive care unit. Detailed interviews were conducted to investigate the nature and content of post-intensive care memories. Intrusive memories were categorized as factual, hallucinatory/delusional, or uncertain.

Results. Thematic saturation was achieved after 17 interviews. Approximately 70% (12/17) of patients had hallucinatory/delusional intrusive memories of intensive care, while 12% (2/17) had factual but no hallucinatory/delusional memories; 18% (3) were uncertain whether memories were factual or hallucinatory/delusional. Further analysis suggested that 88% of all patients had hallucinatory/delusional intrusive memories. The content of intrusive memories commonly merged realistic events (involving intensive care staff, environment, medical procedures and unpleasant physical experiences) with delusions and frightening hallucinations.

Conclusions. We found that patients in this in-depth study were more traumatized by frightening hallucinations/delusions than real events, suggesting they may have post-psychosis PTSD, rather than classic PTSD. Interventions are needed to diagnose and treat intensive care hallucinations/delusions, or minimize effects, to prevent PTSD.

*Correspondence should be addressed to Dorothy M. Wade, Critical Care Department, T3, University College Hospital, 235 Euston Rd, London NW1 2BU, UK (emails: dorothy_wade@btinternet.com and dorothy.wade@uclh.nhs.uk).

DOI:10.1111/bjhp.12109

Statement of contribution

What is already known on this subject?

- It is known that there are elevated rates of post-traumatic stress disorder (PTSD) and other psychological morbidity after intensive care.
- It has been suggested that the intensive care experience has a troubling impact on patient memory that may be associated with PTSD, but the nature of the memory problems and their role in post-intensive care PTSD is not well defined or understood.
- It is not understood which are the most traumatizing aspects of intensive care that may lead to the development of PTSD.

What does this study add?

- This detailed interview study showed that patients suffered intrusive memories (emotionally arousing memories that repeatedly intrude into people's minds) related to intensive care up to 8 months after leaving the intensive care unit (ICU).
- The content of intrusive memories merged factual memories from the ICU, such as pain, bleeding and choking, with hallucinatory, delusional memories such as persecution, conspiracy, religious cults, zombies, aliens, trials and torture.
- In this study, intrusive memories were more commonly of hallucinations and delusions experienced in the ICU, rather than factual events from intensive care, suggesting a syndrome such as post-psychosis PTSD.
- Hallucinations and delusions, rather than factual events, were the most traumatizing aspects of intensive care among this group of patients and may have led to the development of PTSD.

It is known that patients experience both extreme stress (Samuelson, 2007) and altered states of consciousness (Ely, Siegel, & Inouye, 2001) in intensive care. Subsequently, many survivors suffer from psychological morbidity, with prevalence rates estimated at 9–27% for post-traumatic stress disorder (PTSD; Wade, Hardy, Howell, & Mythen, 2013) and median 28% for depression (Davydow, Gifford, Desai, Bienvenu, & Needham, 2009). Important symptoms of PTSD include intrusive memories (emotionally arousing memories that repeatedly intrude into patients' minds) and flashbacks (vivid reliving of trauma; Brewin, Gregory, Lipton, & Burgess, 2010).

However, it is not clear which aspects of intensive care are most traumatizing. Suggested factors include fear of dying from a life-threatening illness, multiple invasive medical procedures, potent psychoactive drugs, or hallucinations and delusions that are commonly experienced in intensive care. Clinical risk factors for PTSD following intensive care include the use of benzodiazepines, duration of sedation, and mechanical ventilation (Wade *et al.*, 2013). Identified 'psychological' risk factors for PTSD post-ICU include psychiatric history, stress, hallucinations or delusions in intensive care, and memory disturbance.

Early work by Schelling *et al.* (1998) showed that acute respiratory distress syndrome (ARDS) patients who reported a greater number of traumatic intensive care memories were more likely to have PTSD. Another seminal study by Jones, Griffiths, Humphris, and Skirrow (2001) found that having delusional memories without recall of factual events in the ICU at 2 weeks was associated with PTSD at 8 weeks. However, the nature and role of memory disturbance as a precursor of post-intensive care PTSD need further elucidation, as previous studies defined and measured memory in a number of different ways.

As they may be heavily sedated or unconscious, few patients remember being admitted to intensive care, and most are disorientated when they wake up (Capuzzo, 2001). Many patients recall little from the entire stay (Granja *et al.*, 2008). The use of benzodiazepines and other forms of sedation in intensive care may have profound effects on memory, including amnesia (Ghoneim, 2004), as well as potentially causing hallucinations or delusions. After leaving the ICU, patients may have frustrating gaps in memory (Griffiths & Jones, 2001) or conversely, persistent memories of intensive care (Rundshagen, Schnabel, Wegner, & Esch, 2002). These may be 'factual' memories such as tubes or masks (Rotondi *et al.*, 2002) or alternatively, memories of hallucinations and/or delusions (Jones *et al.*, 2007; Wake & Kitchiner, 2013). Previous studies did not investigate whether memories of intensive care were voluntary or more typical of the involuntary and intrusive memories that characterize psychological disorders (Brewin *et al.*, 2010).

We aimed to investigate the nature of the trauma that troubled patients most, by conducting interviews with ICU survivors with significant PTSD symptoms about the nature and content of intrusive memories of intensive care. Did intrusive memories reflect real events that took place in intensive care, as in traditional PTSD, or were memories about hallucinations and delusions, suggesting an unusual variant, known as post-psychosis PTSD (Morrison, Frame, & Larkin, 2003)?

Methods

Design

An in-depth interview study of patients with intrusive memories of intensive care was conducted as part of a mixed-methods investigation of psychological outcomes following intensive care.

Participants

Purposive sampling was used to identify survivors of intensive care who had significant PTSD symptoms including intrusive memories of intensive care, for the in-depth interview study. Interviewees were identified during a previously published cohort study of 157 intensive care patients (Wade *et al.*, 2012) and its associated pilot study of 10 patients. The cohort and pilot studies included level 3 (intensive care) patients who spent more than 24 hr in a 35-bedded critical care unit in London. All patients had completed the post-traumatic stress disorder diagnostic scale (PDS; 16) 3 months after being discharged from intensive care. Patients were asked to participate in interviews for this current study if they had received a high score (2 or 3) for an intrusive memory item from the PDS (Foa, Cashman, Jaycox, & Perry, 1997):

1. Have you had upsetting thoughts or images about your time in intensive care that came into your head when you didn't want them to? or
2. Have you had bad dreams or nightmares about your time in intensive care?

Sample size

Although it is not possible to predetermine how many interviews will be needed to obtain thematic saturation in qualitative research, we were aware that a maximum of 20 should be sufficient to generate enough themes in this study. This was based on expert opinion

that only a small sample (often 12–15 interviewees) is needed when studying a homogeneous population, with a tightly focused research question, as was the case in this study (Baker & Edwards, 2012; Smith, 2003).

Measure

The Intrusions Interview is a semi-structured interview designed to elicit the presence and detailed content of intrusive memories about a trauma (Patel *et al.*, 2007). It was adapted from its original use as a face-to-face interview with depressed patients for intensive care. The first author carried out interviews of 30–60 min by phone. Patients were asked about spontaneous memories of intensive care that came to mind repeatedly in the previous week. The most frequent, distressing memories were explored. Patients were asked to describe the content of memories in detail. The interview also included items to rate the frequency and duration of memories, vividness, associated emotions, sense of reliving or 'nowness', reliving physical sensations or emotions from intensive care, interference with daily activities, uncontrollability of, and distress caused by, memories. Items were scored 0–3 (except duration). Four questions about 'help' needed to manage intrusive memories were added to the interview schedule.

Ethics

The study was approved by a joint hospital–university ethics committee in the United Kingdom in 2008. All interviewees gave informed consent.

Thematic analysis

The content of memories was analysed using a rigorous process involving several stages of thematic analysis, resulting in all memories being assigned to themes. Themes were not pre-decided, as little has previously been established in a systematic way about the content of intensive care patients' intrusive memories. All interviews were transcribed, and initially, the first and last authors independently went through each interview line by line to identify the major themes. They compared their separate lists of themes and, after discussion, found that some themes were in fact variations of the same themes and agreed on a reduced number of main themes. This generated a coding scheme. The coding scheme was used by a third rater who independently analysed a sample of six interviews to determine the appropriateness of the scheme. The three raters were then able to tighten the definitions of main themes and agree on the subthemes found within each theme. Finally, the coding scheme and definitions of themes and subthemes were used independently by the first author and a fourth author to analyse the whole sample of interviews again to test for inter-rater reliability. Results of thematic analysis are presented in quotations and tables.

During this analysis process, agreement was also reached by the four raters on assigning the nature of memories to three categories: (1) hallucinatory/delusional, (2) factual, or (3) uncertain. In a separate process, the first and fourth authors assigned answers to the 'help needed' questions to three categories (1) need for help/therapy/counselling, (2) family help or self-help sufficient, and (3) no need for help.

Inter-rater reliability

Consistency was compared by dividing the number of matching classifications identified by two raters, by the total number of elements identified by both, and multiplying by 100. An 80% reliability rate is considered acceptable in thematic analysis (Marques & McCall, 2005).

Descriptive statistics

Socio-demographic and clinical data and psychological scores collected for the interviewees during the associated cohort study (Wade *et al.*, 2012) and pilot studies have been presented as means and standard deviations (if continuous variables), or numbers and percentages (if categorical). Results of ratings scales from the Intrusions Interview (Patel *et al.*, 2007) have been presented as means and standard deviations.

Results

Twenty-six patients from a previously published cohort study (Wade *et al.*, 2012) and three from an associated pilot study reported intrusive memories of intensive care on the PDS and therefore were eligible for the interview study. Of these 29, five patients declined to be interviewed, three did not reply, one did not turn up, one said memories had stopped, and two were not followed up as the interviewer determined that thematic saturation had already been achieved. This resulted in interviews being carried out with 17 patients. Average time between intensive care discharge and interview was 5 months (4–8 months).

Socio-demographic and clinical characteristics of interviewees

The mean age of interviewees was 53 years (range 29–89). There were eight men and nine women. They spent an average 11.4 days (range 2–31) in intensive care and were sedated for 3.9 days (range 0–24) on average. Approximately 27% were elective surgical, 27% emergency surgical, and 47% medical patients. Reasons for admission included respiratory failure (four patients), repair of enterocutaneous fistulas or anastomotic leaks (four), pancreatitis (two), and others (thrombotic thrombocytopenic purpura, thoracic surgery, vascular surgery, revision of Mitrofanoff, D&V following bariatric surgery, facial surgery). Benzodiazepines were administered to 73% of interviewees in the ICU, inotropes, or vasopressors to 53%.

Psychological scores during intensive care admission and 3 months later

Table 1 shows that interviewees had scored highly for mood, stress, and delirious symptoms (including hallucinations) while in the ICU. Half had amnesia for the intensive care stay, while 73% had early intrusive memories of intensive care (40% factual and 33% hallucinatory/delusional memories) while still in the ICU. Their mean scores for PTSD, depression, and anxiety 3 months after leaving the ICU were clinically significant.

Table 1. Psychological attributes of interviewees, assessed before discharge from the intensive care unit[a], and 3 months later

Patients' psychological attributes, measured in the intensive care unit (ICU)						Symptom severity 3 months post-ICU		
Mood in ICU (0–60) Mean (*SD*)	Stress in ICU (0–72) Mean (*SD*)	Delirious symptoms in ICU (0–20) Mean (*SD*)	Extent of memory of ICU while in ICU *N* (%)	Early intrusive memories of ICU while in ICU *N* (%)	Distress from early intrusive memories of ICU in ICU (1–7) Mean (*SD*)	PTSD at 3 m (0–51) Mean (*SD*)	Depression at 3 m (0–60) Mean (*SD*)	Anxiety at 3 m (0–80) Mean (*SD*)
32.1 (10.3)	36.6 (12.7)	8.5 (3.8)	Very little 7 (47%) Some/most 8 (53%)	None 4 (27%) 'Factual' 6 (40%) 'Hallucinatory 5 (33%)/delusional'	4.2 (1.8)	23.1 (10.7)	25.7 (16.4)	48.4 (15)

PTSD, post-traumatic stress disorder.

[a]In-ICU psychological attributes were not available for two of the 17 interviewees. Mood was measured with Profile of Mood State items (McNair, Lorr, & Droppelman, 1971); stress with the intensive care stress scale (ICUSS; Wade *et al.*, 2012); delirious symptoms with an ICUSS subscale; distress from early intrusive memories was measured on a Likert scale of 1–7; PTSD with the Post-traumatic Stress Diagnostic Scale (Foa *et al.*, 1997) using a cutpoint of 18; depression with the Center for Epidemiologic Studies Depression scale (Radloff, 1977) with cutpoint 16; anxiety with the State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) with cutpoint 44.

Characteristics of intrusive memories at time of interview (4–8 months after intensive care)

Table 2 shows that patients' intrusive memories of intensive care when they were interviewed 4–8 months later were very vivid and clear and associated with helplessness and anxiety. Sadness, anger, and shame were present. Intrusive memories were distressing, frequent, and long; they occurred nearly every day and lasted 6 min. Sense of 'nowness' (re-living) was mild. Six had a strong sense of 'nowness' the week of the interview (scoring either 2 or 3 of 3), and seven reported that a sense of 'nowness' was previously strong. Therefore, 13 of 17 (76%) had a strong sense of reliving memories, the week of or shortly before the interview.

Content analysis: Types of memory

Content analysis of interviews (see Tables 3 and 4) distinguished between two categories: hallucinatory/delusional intrusive memories (of hallucinations and delusions from intensive care) and factual intrusive memories (probable real events in intensive care). There was also the third category of uncertain memories (patients not sure whether memories were real or not), and all raters concluded that these memories had hallucinatory/delusional elements. The number and types of intrusive memories recorded were 20+ (one patient reported uncountable multiple memories) hallucinatory/delusional memories from 12 patients; 16+ factual memories from nine patients; and six uncertain memories from four patients. Some patients had more than one type of intrusive memory. In summary, 15 of 17 patients (88%) had either hallucinatory/delusional or uncertain intrusive memories. Two patients (12%) had no hallucinatory/delusional memories but factual intrusive memories only.

Table 2. Characteristics of 17 patients' intrusive memories 4–8 months after leaving the ICU[a]

Characteristics of intrusive memory	Mean	*SD*	Possible range of scores	Interpretation of mean score
Vividness	2.1	0.8	0–3	Very clear vivid memory
Sense of 'nowness'	1.0	1.2	0–3	Mild effect
Duration	5.9	6.2	No limit	6 min
Frequency	1.75	0.9	0–3	Nearly every day
Reliving emotions from critical care	1.1	1.1	0–3	Mild impact
Reliving physical sensations from critical care	0.5	0.9	0–3	Mild impact
Associated helplessness	1.9	1.1	0–3	Moderate impact
Associated anxiety	1.65	1.0	0–3	Moderate impact
Associated anger	1.2	1.1	0–3	Mild impact
Associated shame	1.1	1.3	0–3	Mild impact
Interference with daily life	0.6	0.9	0–3	Mild impact
Uncontrollability of memory	1.25	1.2	0–3	Mild impact
Distress caused by memory	1.75	1.2	0–3	Moderate impact

[a]Characteristics rated with items from the Intrusions Interview (Patel *et al.*, 2007).

Table 3. Types, themes, and subthemes of 17 patients' intrusive memories 4–8 months post-ICU[a]

Type of intrusive memory	Number of patients with memory type
Hallucinatory	12
Factual	9
Uncertain	4
Factual memories alone	2
Probable hallucinatory/delusional memories	15

Memory themes (definitions)	Number of patients with theme	Most common subthemes within themes
Interactions with intensive care staff (memories involving role of/perceptions of members of health care team)	15	1. Persecutory/critical (within hallucinatory/delusional or factual memories) (10) 2. Pleasant encounters (6)
Environment of intensive care (memory relates to a specific aspect of the physical environment or equipment)	14	1. Breathing or gastric tubes (6) 2. Masks (4) 3. Noises (bleeps, alarms) (3)
Narrative or delusional hallucinations (hallucinations with story may involve being harmed, be like movies, or multisensory)	12	1. Persecutory (9) 2. Exotic/bizarre (3) 3. Self causing others' death (2)
Medical/clinical procedures (memory relates to things that are done to critical care patients)	12	1. Cannulae or 'lines' put in or taken out (6) 2. Masks being put on or off (3) 3. Cleaning of sacral area (2)
Unpleasant or frightening physical experiences/sensations (e.g., excessive bleeding, extreme pain, suffocating, panic attack, pulling out tubes)	10	1. Pain (7) 2. Breathlessness/panic/choking (5) 3. Blood (3)
Death and afterlife: (memories or images concerning own or others' death or the afterlife)	9	1. Own or others' death (as delusions) (6) 2. Real perceived threat of own death (3)
Interactions with family (memories involving role of/perceptions of family and friends)	9	1. As confidants against 'persecutions' (6) 2. Loving/supportive presence (5)
Simple hallucinations (memories of simple hallucinations, e.g., lights, colours, geometric patterns,face shapes, animal shapes, voices)	6	1. Visual (faces, animals shapes, colours, seaside poster, lights, logo) (4) 2. Auditory (voices, sobbing, calling for help) (3)
Perceived need for help to deal with memories		1. Perceived need for help/therapy/ counselling (10) 2. Help from family or self-help sufficient (3) 3. No need perceived (4)

[a]From analysis of Intrusions Interviews (Patel *et al.*, 2007).

Table 4. Type, number and themes of intrusive memories 4–8 months post-ICU, and perceived need for help with memories

Name (order in which interviews were done)	Type/ number of memories	Theme: interactions with intensive care staff (n = 15)	Theme: intensive care environment/ equipment (n = 14)	Theme: narrative or delusional hallucinations (n = 12)	Theme: medical/ clinical procedures (n = 12)	Theme: unpleasant physical experience (n = 10)	Theme: death and afterlife (n = 9)	Theme: interactions with family or friends (n = 9)	Theme: simple hallucinations (visual/auditory) (n = 6)	Perceived need for help with memories
Anna (1)	H3	Conspiring doctors; nurses in man's bed	Air conditioning; ICU ward	Money for organs; poisoning; enormous man in bed	Operations; anaesthetics			Told family water was contaminated		Might want help in future
Franco (2)	F2 U1			People working, living, facing problems	Daily events of intensive care		Ready to die, to meet God (hallucination?)	Hoped to meet souls of family and friends (hallucination?)		No
Sally (3)	U1	Heard staff say 'she's dying, can't let her'	Lights, beeps alarms, smell of ICU				Hearing that she was dying (hallucination?)		Lights going off and on (hallucination?) Voices (hallucination?)	No (she talks to her family)
Colin (4)	F2 H1	Shocked nurse. NG tube stuck in paramedic's tunic	NG tube		Suctioning lungs	Choking, bringing up blood, panic, sharp pain in neck			Coloured lights like universal globe logo	No
Karen (5)	H2	Staff holding trials, killing patients	The bed bay. Tubes	Imprisoned, warning others to escape. On trial in mock courtroom		Pulling out tubes	Staff going to kill her. Dead in purgatory			Got help from follow-up clinic and GP

Continued

Table 4. (*Continued*)

Name (order in which interviews were done)	Type/ number of memories	Theme: interactions with intensive care staff (*n* = 15)	Theme: intensive care environment/ equipment (*n* = 14)	Theme: narrative or delusional hallucinations (*n* = 12)	Theme: medical/ clinical procedures (*n* = 12)	Theme: unpleasant physical experience (*n* = 10)	Theme: death and afterlife (*n* = 9)	Theme: interactions with family or friends (*n* = 9)	Theme: simple hallucinations (visual/auditory) (*n* = 6)	Perceived need for help with memories
John (6)	H1	'Evil' nurses; doctor's face bringing him back to reality	Bed, needle, heart 'metre', hospital	Zombies; cloaked abbots taking souls	Injections	Unbearable heat; heart attack starting	Patients killed; dead man; in coffin	Family not believing his story. Wife asks him to stay and not to die		Needed to talk about hallucination at the time
Paul (7)	H2	Nurse shaving boy		Nurse shaving Indian boy in post office. Was assassin			Shot three people on roof in Brazil			Would like to see psychiatrist about memories
Dora (8)	H – many F – many	Dependency; fought doctors; nurse comments	Bedpans, masks, NG and ETT tubes	WW2 train at Checkpoint Charlie. Beach bar. American diner	Prodding; lines taken out; masks put on	Pulled tube; hot, cold; choking; sleepless; breathless	News of people who died			Counselling with hospital focus
Aysha (9)	F1	Conflict with nurse. Doctor helped her	Nasal breathing tube		Removal of breathing tube; oxygen test	Pain from nasal tube				No
Raj (10)	F3 H1	Joking with doctor. Bossy nurse. Staff 'after him'	Stoma bags; oxygen mask; drugs patches	Staff in Bahai cult, selling NHS stuff to fund religion	Putting tubes in veins	Pain, taking mask off, unable to breathe		Told wife to get car or they were finished		Counselling on the wards and in first 2/ 3 months

Continued

Table 4. (*Continued*)

Name (order in which interviews were done)	Type/ number of memories	Theme: interactions with intensive care staff ($n = 15$)	Theme: intensive care environment/ equipment ($n = 14$)	Theme: narrative or delusional hallucinations ($n = 12$)	Theme: medical/ clinical procedures ($n = 12$)	Theme: unpleasant physical experience ($n = 10$)	Theme: death and afterlife ($n = 9$)	Theme: interactions with family or friends ($n = 9$)	Theme: simple hallucinations (visual/auditory) ($n = 6$)	Perceived need for help with memories
Laura (11)	F1 U3	Nurses: not caring, disapproving	Stand, meds, drip, tubes, window. Controlled environment	Nurse took call bell and hung it out of reach. Cannulated over and over (hallucinations?)	Prodding, tests, physio, cannulation Ward transfer	Cannulae; all over, pain, leaking. Felt removed from body. Pulled tube out		Dad helping her walk. Family said nurses did not remove call bell and leave her helpless	Calling for help, nobody came. (hallucination?)	Counselling on the ward from ICU staff. Booklet helped. Would like a timeline
Isaac (12)	F1 H1	Liked nurses and their banter	Lights, noise, machines, bleeps, mask		Oxygen mask put on	Mask being forced on; breathlessness; panic			Shapes, colours, seaside poster	None identified (likes self-help)
Owen (13)	H2			Threatening scenes in 1920s USA and a Danish village			Faced with violence; fighting for his life	Thinking about his brother.		No
Kate (14)	H2 U1	Nurses chatting	Curtains; beds	Crazy puffins firing blood from guns			Nurse saying she'd died	Mother outside, refusing to come in	Voices from the past; mother sobbing	No. Chatty nurses helped
Nora (15)	F3	In trouble with nurses. Guilt about nurses' time	CPAP mask, needle, tube. Alarm		CPAP. Tube put in for blood gases. Being cleaned after bowels open	Unable to breathe. Pain, panic, heart racing Double incontinence				Yes, but no time to access it now
Magda (16)	H2 F2	Screaming at nurses	Bed, ITU, catheter		Given drugs Sacral area	Unbearable Pain; nappy rash;				Needed help in the early days at home

Continued

Table 4. (*Continued*)

Name (order in which interviews were done)	Type/ number of memories	Theme: interactions with intensive care staff (n = 15)	Theme: intensive care environment/ equipment (n = 14)	Theme: narrative or delusional hallucinations (n = 12)	Theme: medical/ clinical procedures (n = 12)	Theme: unpleasant physical experience (n = 10)	Theme: death and afterlife (n = 9)	Theme: interactions with family or friends (n = 9)	Theme: simple hallucinations (visual/auditory) (n = 6)	Perceived need for help with memories
		'torturing' her		Torture Alien nurse pecking	cleaned; cannulae changed	blood; toileted in bed		Told family of terror at alien nurse		
Terry (17)	H2	Staff in conspiracy; fighting with porters	Curtains, floor, hospital	Killing Amy Winehouse; people after body parts	Scan		Gas chambers; drowning	Warns family to leave – staff are after them	Faces in curtains; animals on floor	Needed help on ward; by phone from home

H, hallucinatory/delusional; F, factual; U, uncertain; NG, nasogastric; ETT, endotracheal tube.
From analysis of Intrusions Interviews (Patel *et al.*, 2007). All names of participants have been changed.

Thematic analysis: Content of memories

Content of memories was analysed according to themes and subthemes that emerged from thematic analysis and was agreed on during a rigorous process involving four raters. After several stages of analysis, eight main themes were agreed. The list that follows begins with the most commonly occurring theme and ends with the least common: interactions with staff; the ICU environment; narrative or delusional hallucinations; medical procedures; unpleasant physical experiences; death and afterlife; interaction with family; and simple hallucinations (see Tables 3 and 4). Between one and three subthemes were also agreed for each theme (Table 3).

Saturation of themes

We defined saturation as occurring when new themes no longer emerged from the interviews, and two or three main subthemes were clearly established within each theme. Saturation of themes was achieved somewhere between interview 14 and 17. The amount of variation within each theme was minimal, with patient memories forming a typical and readily discernible pattern (see Tables 3 and 4).

Inter-rater reliability

Inter-rater reliability for classifying types of memory was 79%; inter-rater reliability for classifying themes and subthemes of memories was 91%.

Summary of content and thematic analysis of memories, with illustrative quotations

Intrusive memories of hallucinations or delusions were predominant. The following quotation from John's interview (all names have been changed) was typical of an intrusive memory of an extended persecutory delusion:

> They [the nurses] had to prepare so many patients for death. . . They turned you into a zombie. . . put you into a shopping trolley and wheeled you into a basement. They got paid according to how many patients they brought down. People were lying round at various stages of dying. . .. . . I ended up in a trolley with an old boy called George, who was dead. . ..He was leaning on me and there was unbearable heat. . .Before I knew it, a nurse came upon me. She gave me the injection. There were people there with cloaks like an abbot, I couldn't see their faces. They were . . . families who would take your soul. . . They would envelop you . . .suck you up and move on. . .I jumped out and got away but ended up in a coffin in a chapel of rest.

Other hallucinations were bizarre, but with persecutory elements, as in this quotation from Kate:

> There were puffin birds jumping out of the curtains with toy guns, firing blood at me. I kept wiping my face. . . There were loads of birds jumping on the next bed..laughing at each other. Completely crazy. I was really scared. I didn't say anything to anyone.

In some hallucinatory and delusional experiences, the patient was persecutor not victim, as in Terry's memory:

> I had the feeling. . .I caused Amy Winehouse to have a car accident. She had a baby, and the car they were in was going down a slope into water. I watched them drowning. I knew that I had done it. I was trying to keep away from people, but they were all looking for me – the police and her relatives. . .This hallucination kept recurring when I was in ICU, it was very vivid. When I came out of hospital I still had them vividly. [*This predated the death of Winehouse*.]

'Factual' intrusive memories concerned unpleasant physical experiences from intensive care including pain, bleeding, breathlessness, feelings of choking, or medical procedures involving tight-fitting oxygen masks, cannulae, catheters, breathing, or gastric tubes (see Table 3). Magda's memory of extreme pain also touched on interactions with staff characterized by indignity, fear, and distrust:

> I had terrible nappy rash and they had to clean me every 5 or 10 min. I thought they were torturing me, putting knives in my bum. I was screaming that the nurses were torturing me. The pain was awful and there was a total lack of dignity, having to go to the toilet in bed. . .One night I was struck down with unbearable pain, the worst of my whole life. . .. I was inconsolable, screaming, crying. . ... I had. . . paracetemol, codeine, morphine. Eventually it was a huge cocktail of drugs. They made me go mad and I still had pain.

Nora had another common 'factual' memory – breathlessness or suffocation during intensive care treatment:

> It was like putting your head outside the train with your mouth open. It was painful because you have poppers. Keeping the mask airtight. . .It was the feeling of panic that I wasn't able to breathe properly with all this air being pushed in so fast. . .Like sucking in an empty crisp packet. . .the anxiety, the fear of having the mask on, made my heart go like the clappers. . .I would try to get my thumb underneath it to let some air out; every time I did that the alarm would go off and I would get into trouble. . . Now I have nightmares as if it's happening then and there. My daughter says I'm sweating like anything, really panicking. It takes ages to get my bearings, that I'm not in hospital, there's no mask, I'm safe at home.

Hallucinatory/delusional and factual elements were sometimes combined, making it difficult for patients such as Laura to recognize what was real and what was not:

> There was a nurse. . .I felt she was disapproving because I was a bariatric patient, I wasn't a real Intensive care patient, I wasn't really "ill". . . I was clicking the buzzer and the nurse took it off me and told me to be quiet. She hung it on a hook out of my reach. . . She said the other patients were sick and I was disturbing everyone. . . It really made me feel like a child. . .My memory is of lying there with tubes in me. I thought I called for help many times and nobody came. But my family said that none of this happened. They knew I wasn't myself.

Help

Ten patients (60%) wanted professional help to manage their intrusive memories now, had sought help already, or thought they should have had help or might want it in future (see Tables 3 and 4).

Discussion

These detailed interviews with intensive care survivors with significant PTSD symptoms showed that they suffered from vivid, frequent, long-lived, distressing intrusive memories

or 'flashbacks' in which they relived the trauma of intensive care. This in-depth study found that most patients' intrusive memories were hallucinatory or delusional, and often persecutory, while some had 'factual' memories of interaction with staff, the intensive care environment, invasive medical procedures and equipment, and unpleasant physical experiences. Others had 'uncertain' intrusive memories in which patients were unsure whether frightening, horrifying events had really happened or not.

To our knowledge, this is the first study to demonstrate and analyse the presence of frightening intrusive memories and flashbacks experienced by patients following intensive care, by conducting in-depth interviews about their nature and content. The study was designed to provide rich, detailed data about patients' experience, using a methodology that has been widely used to investigate intrusive memories in the trauma literature (Brewin *et al.*, 2010; Patel *et al.*, 2007).

Limitations of the study are that the sample size was small, as is usual in many qualitative studies. However, it was an acceptable sample size for a qualitative study designed to elicit common experiences among a homogeneous sample of people (Baker & Edwards, 2012). It was also not possible to verify objectively whether remembered events were real or hallucinatory/delusional; this categorization was based on patients' opinions and raters' assessments (based on clinical experience) of the likelihood of events being real or hallucinated/delusional.

In a previous study, delusional memories 1–2 weeks after intensive care were found to be associated with later PTSD (Jones *et al.*, 2007). Our study suggests that hallucinatory or delusional memories may keep recurring as *intrusive* memories or flashbacks for many months. Other studies asked current intensive care patients which stressors bothered them most (Novaes, Aronovich, Ferraz, & Knobel, 1997). Our study suggests that months later, patients may suffer *intrusive* memories involving similar stressors (tight masks, endotracheal tubes, bleeding, feelings of suffocation, pain, or panic).

The content of hallucinatory/delusional memories in our study included delusions such as being poisoned (by air conditioning or contaminated water), assaulted, tortured, kidnapped, threatened with death, or put on trial. Patients believed staff were conspiring to harvest their organs, steal their money, or sell their drugs to fund sinister cults. They merged elements of hospital care such as injections, blood tests, and endotracheal tubes, with terrifying delusional narratives reminiscent of gothic horror films.

It is not clear how to account for the hallucinations and delusions that haunted these intensive care patients as intrusive memories. Were they manifestations of a psychotic disorder, a mental condition characterized by abnormalities in one or more of five domains including delusions and hallucinations (APA, 2013)? Hallucinations are perception-like experiences that occur without an external stimulus (APA, 2013). Some patients' memories were of simple visual hallucinations, psychedelic film logos, faces, spiders, or the ward as a seaside poster. However, other hallucinations were complex and delusional. Delusions are fixed beliefs that are not amenable to change in the light of conflicting evidence (APA, 2013). Subtypes include persecutory, somatic, religious, or grandiose delusions. Persecutory delusions are about others causing the individual physical, social, or psychological harm (Freeman & Garety, 2000).

Current taxonomies may throw some light on intensive care hallucinations (Ffytche, 2004). Visual hallucinations belong to two main phenomenological syndromes; 'syndrome one' ranging from simple lines and colours, through to distorted faces to unfamiliar figures in bizarre costumes. These hallucinations, usually silent and brief, are associated with primary pathology in visual pathways. Some hallucinations in our study belonged to 'syndrome one' but most corresponded with 'syndrome two'. 'Syndrome

two' hallucinations may be extracampine (felt rather than seen) and multimodal (affecting several senses), involve complex delusional explanations, and last several days. The primary pathology for these hallucinations lies in the brainstem, involving cholinergic and other brainstem neurotransmitter systems.

Intensive care hallucinations/delusions are thought to arise during delirium, which may be due to illness factors such as sepsis or hypoxia; drugs such as benzodiazepines, anticholinergics, or opioids; and sleep or sensory deprivation. These factors may trigger an imbalance of neurotransmitters, such as depletion of acetylcholine and excess of dopamine (Trzepacz, 1999). Dopamine is known to give salience to neutral stimuli and create meaningful connections between coincident events (Hemsley, 1993). Dopamine also modulates emotional memory via the amygdala, a brain centre involved in fear responses (Greba, Gifkins, & Kokkinidis, 2001).

The risk of developing intrusive memories of intensive care hallucinations/delusions may be increased in patients who have amnesia for much of their intensive care admission, along with enhanced memory of the most traumatic aspects (Jones, Griffiths, & Humphris, 2000). Their amnesia may be seen as a common side effect of benzodiazepines or other sedatives used in intensive care (Ghoneim, 2004) or attributed to delirium (in which sedative drugs may also be a contributory factor) that results in memory loss for the period of confusion. Traumatic emotional memories may be heightened by intravenous glucose infusions (Korol & Gold, 1998) and exogenous or endogenous stress hormones released in intensive care (Roozendaal, Okuda, de Quervain, & McGaugh, 2006).

According to an influential theory of PTSD, there is an imbalance between two memory systems that work in parallel in the brain (Brewin *et al.*, 2010). In one system, normal episodic memories are supported by the ventral visual stream and medial temporal lobe structures such as the hippocampus; in the other, intrusive images arising from briefly perceived sensory input are supported by the dorsal visual stream, insula, and amygdala. Under normal conditions, episodic memories contextualize experience and inhibit the unwanted intrusion of sensory images. During trauma, however, extreme stress and reduced hippocampal function create a narrowing of attention, resulting in less information about the traumatic event being stored in the form of an episodic memory, and increasing the prominence of emotion-laden images. It can be hypothesized that this model is applicable to the extreme fear and helplessness experienced by many intensive care patients. An alternative but not necessarily contradictory perspective is that hallucinatory/delusional intrusive memories of intensive care are drug 'flashbacks' (Ashton, 2002). Drug flashbacks may be triggered by fatigue or stress and are more common after taking multiple hallucinogenic drugs (which many patients are administered during an intensive care stay) (Halpern & Pope, 2003). The mechanisms underlying drug flashbacks are not well understood (Abraham, Aldridge, & Gogia, 1996), but it has been suggested that drug flashbacks are a form of PTSD (Ashton, 2002).

Another possible parallel is with patients with psychotic illnesses who develop PTSD. A review found that prevalence of PTSD following psychotic episodes ranged from 11% to 67% (Morrison *et al.*, 2003). It is argued that hallucinatory or delusional disturbances can shatter a person's experience of themselves, the world, and others in a similar way to non-psychotic trauma. A study of transplant patients who experienced hallucinations also found that patients had intrusive memories of hallucinations and met criteria for PTSD (DiMartini, Dew, Kormos, McCurry, & Fontes, 2007). The authors argued that PTSD criteria should be extended to include psychically induced experiences from a medical event.

Our study suggests that patients may be traumatized by hallucinatory or delusional intrusive memories following intensive care. To date, the traumatic nature of intensive care hallucinations has not been fully appreciated by all intensive care staff. However, positive work has been carried out in some UK ICUs that have established ICUsteps patient support groups or used ICUsteps booklets to inform patients about these memories (http://www.icusteps.org/). Furthermore, a number of ICUs throughout Europe use patient diaries, an intervention that was shown to reduce the incidence of new cases of PTSD in a randomized controlled trial (Jones *et al.*, 2010).

More studies to investigate hypothesized relationships between medications, delirium, hallucinations and delusions, intrusive memories, and psychological morbidity following intensive care are needed. Additionally, further trials of interventions to modify pharmacology or help patients process traumatic hallucinatory or delusional memories should be carried out to reduce the incidence of PTSD, including distressing intrusive memories, after intensive care.

Acknowledgement

DW received funding from the Medical Research Council and the UCLH/UCL NIHR Biomedical Research Unit to carry out this study.

References

Abraham, H. D., Aldridge, A. M., & Gogia, P. (1996). The psychopharmacology of hallucinogens. *Neuropsychopharmacology*, *14*, 285–298. doi:10.1016/0893133X(95)00136-2

American Psychiatric Association (APA) (2013). *Diagnostic and statistical manual of mental disorders*. (5th ed.) Arlington, VA: Author.

Ashton, H. (2002). Delirium and hallucinations. In E. K. Perry, H. Ashton & A. H. Young (Eds.), *Neurochemistry of consciousness: Neurotransmitters in mind* (pp. 181–203). Amsterdam, the Netherlands: John Benjamin Publishing Co.

Baker, S. E., & Edwards, R. (2012). *How many qualitative interviews is enough?* Southampton, UK: National Centre for Research Methods.

Brewin, C. R., Gregory, J. D., Lipton, M., & Burgess, N. (2010). Intrusive images in psychological disorders: Characteristics, neural mechanisms, and treatment implications. *Psychological Review*, *117*, 210–232. doi: 10.1037/a0018113

Capuzzo, M. (2001). Analgesia, sedation, and memory of intensive care. *Journal of Critical Care*, *16*, 83–89. doi:10.1053/jcrc.2001.28789

Davydow, D. S., Gifford, J. M., Desai, S. V., Bienvenu, O. J., & Needham, D. M. (2009). Depression in general intensive care Unit survivors: A systematic review. *Intensive Care Medicine*, *35*, 796–809. doi:10.1007/s00134-009-1396-5

DiMartini, A., Dew, M. A., Kormos, R., McCurry, K., & Fontes, P. (2007). Posttraumatic stress disorder caused by hallucinations and delusions experienced in delirium. *Psychosomatics*, *48*, 436–439. doi:10.1176/appi.psy.48.5.436

Ely, E. W., Siegel, M. D., & Inouye, S. K. (2001). Delirium in the intensive care unit: An under-recognized syndrome of organ dysfunction. *Seminars in Respiratory and Critical Care Medicine*, *22*, 115–126. doi:10.1055/s-2001-13826

Ffytche, D. H. (2004). Visual hallucination and illusion disorders: A clinical guide. *Advances in Critical Neuroscience and Rehabilitation*, *4*, 16–18.

Foa, E. B., Cashman, L., Jaycox, L., & Perry, K. (1997). The validation of a self-report measure of posttraumatic stress disorder: The Posttraumatic Diagnostic Scale. *Psychological Assessment*, *9*, 445–451. doi:10.1037/1040-3590.9.4.445

Freeman, D., & Garety, P. A. (2000). Comments on the content of persecutory delusions: Does the definition need clarification? *British Journal of Clinical Psychology*, *39*, 407–414. doi:10.1348/0144665001634 00

Ghoneim, M. M. (2004). Drugs and human memory (part 1): Clinical, theoretical, and methodologic issues. *Anesthesiology*, *100*, 987–1002.

Granja, C., Gomes, E., Amaro, A., Ribeiro, O., Jones, C., Carneiro Costa-Pereira, A., & JMIP Study Group. (2008). Understanding posttraumatic stress disorder-related symptoms after Intensive care: The early illness amnesia hypothesis. *Critical Care Medicine*, *36*, 2801–2809. doi:10.1097/CCM.0b013e318186a3e7

Greba, Q., Gifkins, A., & Kokkinidis, L. (2001). Inhibition of amygdaloid dopamine D2 receptors impairs emotional learning measured with fear-potentiated startle. *Brain Research*, *899*, 218–226. doi:10.1016/0005-7967(93)90116-C

Griffiths, R. D., & Jones, C. (2001). Filling the intensive care memory gap? *Intensive Care Medicine*, *27*, 344–346. doi:10.1007/s001340000752

Halpern, J. H., & Pope, H. G. (2003). Hallucinogen persisting perception disorder: What do we know after 50 years? *Drug and Alcohol Dependance*, *69*, 109–119. doi:10.1016/S0376- 8716(02)00306-X

Hemsley, D. R. (1993). A simple (or simplistic?) cognitive model for schizophrenia. *Behaviour Research and Therapy*, *31*, 633–645. doi: 10.1016/0005-7967(93)90116-C

ICU Steps. Retrieved from http://www.icusteps.org

Jones, C., Backman, C., Capuzzo, M., Egerod, I., Flaatten, H., Granja, C., ... the RACHEL group. (2010). Intensive care diaries reduce new onset post traumatic stress disorder following critical illness: A randomised, controlled trial. *Critical Care*, *14*, R168. doi:10.1186/cc9260

Jones, C., Backman, C., Capuzzo, M., Flaatten, H., Rylander, C., & Griffiths, R. D. (2007). Precipitants of post-traumatic stress disorder following intensive care: A hypothesis generating study of diversity in care. *Intensive Care Medicine*, *33*, 978–985. doi:10.1007/s00134007-0600-8

Jones, C., Griffiths, R. D., & Humphris, G. (2000). Disturbed memory and amnesia related to intensive care. *Memory*, *8*, 79–94. doi:10.1080/096582100387632

Jones, C., Griffiths, R. D., Humphris, G. H., & Skirrow, P. M. (2001). Memory, delusions, and the development of acute posttraumatic stress disorder-related symptoms after intensive care. *Critical Care Medicine*, *29*, 573–580.

Korol, D. L., & Gold, P. E. (1998). Glucose, memory, and aging. *American Journal of Clinical Nutrition*, *67*, 764S–771S.

Marques, J. F., & McCall, C. (2005). The application of interrater reliability as a solidification instrument in a phenomenological study. *The Qualitative Report*, *10*, 439–462.

McNair, D. M., Lorr, M., & Droppelman, L. F. (1971). *Manual for the profile of mood states*. San Diego, CA: Educational and Industrial Testing Service.

Morrison, A. P., Frame, L., & Larkin, W. (2003). Relationships between trauma and psychosis: A review and integration. *British Journal of Clinical Psychology*, *42*, 331–353. doi:10.1348/014466503322528892

Novaes, M. A., Aronovich, A., Ferraz, M. B., & Knobel, E. (1997). Stressors in ICU: Patients' evaluation. *Intensive Care Medicine*, *23*, 1282–1285. doi:10.1007/s001340050500

Patel, T., Brewin, C. R., Wheatley, J., Wells, A., Fisher, P., & Myers, S. (2007). Intrusive images and memories in major depression. *Behaviour Research Therapy*, *45*, 2573–2580. doi:10.1016/j.brat.2007.06.004

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*, 385–401. doi:10.1177/014662167700100306

Roozendaal, B., Okuda, S., de Quervain, D. J., & McGaugh, J. L. (2006). Glucocorticoids interact with emotion-induced noradrenergic activation in influencing different memory functions. *Neuroscience*, *138*, 901–910. doi:10.1016/j.neuroscience.2005.07.049

Rotondi, A. J., Chelluri, L., Sirio, C., Mendelsohn, A., Schulz, R., Belle, S., . . . Pinsky, M. R. (2002). Patients' recollections of stressful experiences while receiving prolonged mechanical ventilation in an intensive care unit. *Critical Care Medicine*, *30*, 46–752.

Rundshagen, I., Schnabel, K., Wegner, C., & Esch, J. S. A. (2002). Incidence of recall, nightmares, and hallucinations during analgosedation in intensive care. *Intensive Care Medicine*, *28*, 38–43. doi:10.1007/s00134-001-1168-3

Samuelson, K. A. (2007). Stressful memories and psychological distress in adult mechanically ventilated intensive care patients – a 2-month follow-up study. *Acta Anaesthesiologica Scandinavica*, *51*, 671–678. doi:10.1111/j.1399-6576.2007.01292.x

Schelling, G., Stoll, C., Haller, M., Briegel, J., Manert, W., Hummel, T., & Peter, K. (1998). Health related quality of life and posttraumatic stress disorder in survivors of adult respiratory distress syndrome. *Critical Care Medicine*, *26*, 651–659.

Smith, J. (2003). *Qualitative psychology, a practical guide to research methods*. London, UK: Sage.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press.

Trzepacz, P. T. (1999). Update on the neuropathogenesis of delirium. *Dementia and Geriatric Cognitive Disorders*, *10*, 330–334. doi:10.1159/000017164

Wade, D., Hardy, R., Howell, D., & Mythen, M. (2013). Identifying clinical and acute psychological risk factors for PTSD after Intensive care: A systematic review. *Minerva Anestesiologica*, *79*, 1–20.

Wade, D. M., Howell, D. C., Weinman, J. A., Hardy, R. J., Mythen, M. G., Brewin, C. R., . . . Raine, R. A. (2012). Investigating risk factors for psychological morbidity three months after intensive care: A prospective cohort study. *Critical Care*, *16*, R192. doi:10.1186/cc11677

Wake, S., & Kitchiner, D. (2013). Post-traumatic stress disorder after intensive care. *British Medical Journal*, *346*, f3232. doi:10.1136/bmj.f3232

Received 23 January 2014; revised version received 17 April 2014