

Are radiologists able to manage serious anaphylactic reactions and cardiopulmonary arrest?

¹C R TAPPING, MB, ChB, BSc and ²A D CULVERWELL, MB, ChB, BSc

¹Department of Radiology, Hull Royal Infirmary, Hull, UK and ²Department of Radiology, Leeds General Infirmary, Leeds, UK

ABSTRACT. In this study, we aimed to assess the ability and confidence of radiologists in managing adult life support in cardiopulmonary arrest and acute anaphylaxis reactions. We used a questionnaire survey assessing the knowledge of how to manage and the confidence in managing an adult cardiorespiratory arrest scenario. This was sent to 165 radiology consultants and registrars in 6 NHS trusts in Yorkshire: 105 participated. The questionnaire elicited basic demographic details and included eight questions aimed at assessing recent training, knowledge and confidence in the management of adult resuscitation (Resuscitation Council (UK) 2005 guidelines) and acute anaphylaxis. Despite the fact that 90% of participants stated that they would feel confident to initiate life support, the average score from the questions assessing life support procedure was 2.3 out of 5, with only 13% of participants answering all questions correctly. There was no correlation between grade of radiologist and likelihood of a correct answer, nor was there a correlation between feeling confident and knowing the correct life support procedure. Flaws in training were highlighted, with only 61% of radiologists having attended a life support course in the last 4 years. Those who had attended a course more recently were more likely to perform cardiopulmonary resuscitation correctly ($p=0.02$). Individuals who were confident in initialising cardiopulmonary resuscitation were more likely to be confident that other members of staff could assist them ($p=0.028$). This study emphasises the need for regular life support training and the need to alter the attitude of radiologists, who must consider it their role to initiate effective life support in the radiology environment.

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Cardiopulmonary resuscitation (CPR) was introduced approximately 45 years ago and now has a firm evidence base. The most recent evidence-based guidance was published by the Resuscitation Council (UK) in 2005, and it has been clearly demonstrated that when adhered to these guidelines greatly improve resuscitation outcomes following cardiorespiratory arrest [1].

The Resuscitation Council (UK) defines a number of types of resuscitation: basic, intermediate and advanced adult life support. Basic life support (BLS) requires no equipment and involves simple airway manoeuvres, rescue breaths, chest compressions and calling for assistance. It is distinguished from intermediate life support (ILS) and advanced life support (ALS) as these apply to healthcare professionals trained in these techniques. They involve initial airway manoeuvres, calling for help, chest compressions (30:2), as in the BLS algorithm, but also involve administration of drugs (*i.e.* adrenaline), recognition of “shockable” heart rhythms and the use of defibrillators. ALS also includes further training in searching for causes and management of the critically ill patient, such as those with non-shockable arrhythmias (see Figure 1) [2].

Sudden cardiac arrest causes more than 60% of adult deaths in the world, and the crucial determinant for

successful resuscitation is rapid instigation of high-quality CPR and prompt defibrillation of ventricular fibrillation/ventricular tachycardia (VF/VT) [3, 4]. Any delay in commencing effective life support can result in a very poor outcome for the individual, with the highest chance of survival being if CPR is commenced by well-trained staff within 2 min of an arrest [4]. Radiology departments are frequently isolated with a limited number of staff well trained in resuscitation skills, the “crash” trolley might not be within the room and the medical “crash” team may take a long time to arrive. It has been shown that the likelihood of CPR being successful in such circumstances is reduced [5]. In these cases, the most experienced doctor present will carry out the first few minutes of CPR, and this is likely to be a radiologist, making their skills in life support pivotal to the survival of the patient. A recent audit in one of the authors’ institutions found that 3–4% of all crash calls requiring CPR in a year came from the radiology department (Table 1). Although many may not see it as an obvious part of their role, it is obviously essential that radiologists maintain their life support skills, not only to save lives, but as a requirement of the General Medical Council (GMC) “good practice”.

This study was performed to assess consultant and radiology registrar (SpR) theoretical knowledge of the most up-to-date resuscitation guidelines, which were revised and published in 2005 [2].

Address correspondence to: Dr CR Tapping, Department of Radiology, Hull Royal Infirmary, Anlaby Road, Hull, HU3 2JZ. E-mail: Charles.Tapping@hey.nhs.uk

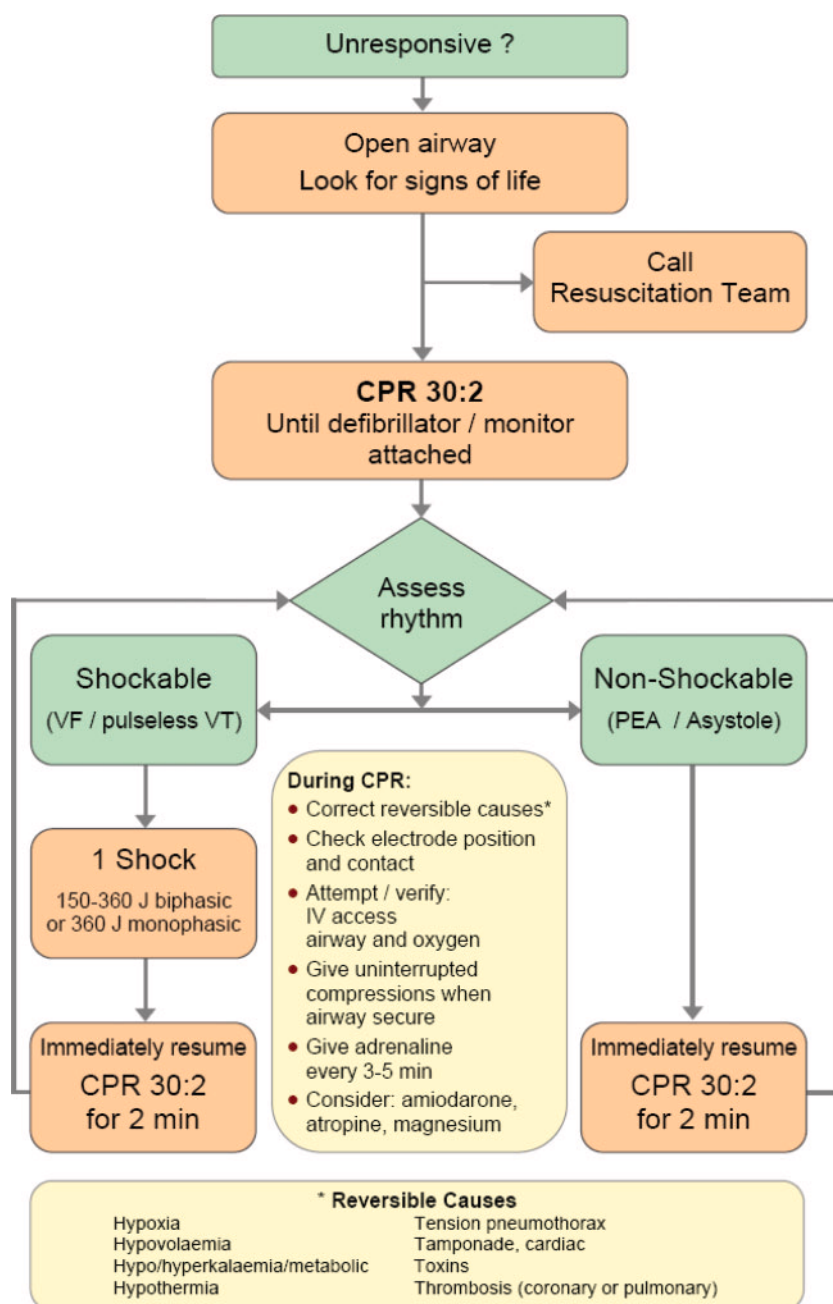


Figure 1. Current advanced adult resuscitation algorithm. Note: In ventricular fibrillation (VF)/ventricular tachycardia (VT), give adrenaline 1 mg iv if VF/VT persists after a second shock, and this should be repeated every 3–5 min thereafter if VF/VT persists; or, if in pulseless electrical activity/asystole, give adrenaline 1 mg iv as soon as intravenous access is achieved and repeat every 3–5 min. (With kind permission of the Resuscitation Council UK. From, Advanced Adult Life Support Guidelines, 2005.) CPR, cardiopulmonary resuscitation.

Methods and materials

A quantitative questionnaire was designed to investigate consultant and SpR radiologists' knowledge of adult life support theory. Questions were based upon the most recent adult life support guidelines published by the

Table 1. Adult "crash" calls requiring CPR over a 12-month period in 2007/2008 ($n=550$)

Area	Number	Percentage of total (%)
CT scan room	9	1.6
Ultrasound department	2	0.35
Interventional suite	7	1.3
Nuclear medicine	1	0.18
Total	19	3.5

Data kindly supplied by Resuscitation Department, Hull Royal Infirmary, UK.

Resuscitation Council (UK) 2005. The questionnaire (Appendix 1) elicited basic demographic details and included eight questions aimed at assessing recent training, knowledge and confidence in adult resuscitation. All of the questions had numerous potential responses and required the responder to place a tick in the most appropriate box. The questionnaire was piloted in a small study in January 2008, in which the questionnaire was sent to 10 doctors of differing grades (from foundation year 2 (FY2) to consultant), to assess its clarity and ease of completion. Feedback provided from participants resulted in only minor changes to terminology for the final questionnaire.

A list of all the consultant and trainee radiologists in the Yorkshire region was obtained. A copy of the questionnaire along with a covering letter was sent to each individual email address during March 2008. No exclusion criteria were applied. All of the correspon-

dences were sent from a dedicated email address set up by the authors for this study. The covering letter explained the aim of the study and invited participation (Appendix 2). It was made clear that responses would remain anonymous and that there was no obligation to participate. Willing responders were asked to return the questionnaire by email. To improve the response a reminder was sent out to the same address after 2 weeks, with an adapted covering letter (Appendix 3) allowing responders to return paper copies of the questionnaire to an internal hospital contact addresses.

Data were analysed using the statistical software package for social sciences version 12.0.0 for Windows (SPSS Inc., Chicago, IL) and χ^2 tests or Spearman's rank correlation coefficient performed to determine whether results were significant ($p < 0.05$).

Results

In total, 165 individuals (97 consultants and 68 SpRs) were invited to participate from 6 NHS trusts, including tertiary teaching hospitals and district general hospitals. 105 (65%) of these individuals completed the questionnaire: 60 consultants (63% of total contacted) and 45 SpRs from years 1 to 5 of their training (66% of the total contacted). 32 participants (25 consultants and 7 SpRs) opted to respond via paper copies and the remaining 73 responded via electronic mail (35 consultants and 38 SpRs). There were no differences in the results obtained by those responding electronically or by paper (χ^2 test, $p = 0.183$).

Of the 60 individuals who did not respond, only 2 provided explanations; 1 felt it was not relevant to them as it was not based on paediatric life support and the other was concerned that the data would not be kept anonymous.

From the five questions assessing knowledge of the adult resuscitation algorithm, the average score was 2.33 out of 5 (range 0–5). Table 2 shows the percentage of individuals answering correctly for each question. The average score for consultants was 2.31 out of 5, and the average score for SpRs was 2.4 out of 5. Table 3 provides a further breakdown of the scores attained. There was no significant difference between the likelihood of a correct answer and the radiologist's grade (χ^2 test, $p = 1$).

65 (61%) responders had attended a life support course since 2004, with 6 (6%) responders not having attended a course for over 10 years (Table 4). Unsurprisingly, those who attended a life support course more recently were more likely to get the answers correct (Spearman's correlation 0.226, $p = 0.02$). The average length of time since a resuscitation course was 4 years for the group as a whole (range between 1995 and 2008), 4.5 years for consultants (range between 1995 and 2008) and 3.5 years for SpRs (range 1998–2008).

94 participants (90%) felt they were confident in initiating BLS (Table 5); however, those who felt confident were no more likely to know the correct adult life support algorithm (χ^2 test, $p = 0.317$). Responders were more likely to provide correct answers to questions related to BLS interventions, e.g. chest compression ratio (54% correct responses), than to questions about the ILS or ALS algorithm, such as administration of adrenaline or defibrillation (44.5% correct responses). More SpRs ($n = 43$, 96%) than consultants ($n = 51$, 85%) felt confident initialising adult resuscitation. However, consultants more frequently responded "yes" when asked if their colleagues would be able to assist in BLS (consultants ($n = 32$) 53%; SpRs ($n = 21$) 47%); SpRs were more likely to state "don't know" (consultants ($n = 17$) 28%; SpRs ($n = 19$) 42%) (Table 6). If an individual felt confident in initiating BLS he or she was more likely to have confidence in the ability of other members of staff to assist in adult resuscitation (χ^2 test, $p = 0.028$).

All but two of the participants use intravenous contrast ($n = 103$), and, of those who do, 100% ($n = 103$) claimed to be able to recognise the signs and symptoms of an adverse reaction. 88% ($n = 92$) of participants stated they knew the correct procedure for managing adverse contrast reactions: 90% ($n = 54$) of consultants compared with 84% SpRs ($n = 38$). This confidence was unrelated to ability to correctly recognise correct adult life support procedures.

Discussion

Despite the vital importance of quick and effective resuscitation in patients with cardiopulmonary arrest, the current study showed that radiologists are unlikely to be able to initiate the correct CPR procedure as dictated by the Resuscitation Council (2005). Within the two main hospital trusts involved in this study, 3–4% of all "crash" calls requiring CPR originate from within a radiology department (Table 1). This figure is only likely to rise as the demand for radiology in the acute setting increases. This is further emphasised by the recent recommendation that CT and interventional radiology are considered pivotal for diagnosing and managing the multitrauma patient [6, 7].

Although these results are potentially alarming, they are perhaps understandable. Radiologists are very infrequently involved in CPR, and as a result skills, knowledge and even motivation to remain up to date are likely to fade with time. However, the fact that only 17% of in-hospital cardiac arrest patients are discharged alive and frequent observations that CPR and resuscitation skills are substandard suggest that this problem is not isolated to radiologists [3]. It would perhaps have been interesting to compare the current study with medical consultants and SpRs as a gold standard for the levels realistically attainable.

Table 2. Number and percentage of responders identifying the correct answer ($n = 105$)

Question	Percentage of responders providing correct answer
CPR compression to breath ratio	54 ($n = 57$)
Number of defibrillation shocks to administer	41 ($n = 43$)
Energy of second defibrillation shock	50 ($n = 53$)
Correct procedure following defibrillation	33 ($n = 35$)
Correct dose of adrenaline to administer	54 ($n = 57$)

CPR, cardiopulmonary resuscitation.

Table 3. Number of individuals getting correct answers from the group as a whole and from consultants and SpRs separately

Number of correct answers	Total (n=105)	Consultants (n=60)	SpRs (n=45)
5 out of 5	14 (13%)	10 (16%)	4 (9%)
4 out of 5	9 (9%)	3 (5%)	6 (13%)
3 out of 5	14 (13%)	9 (15%)	5 (11%)
2 out of 5	35 (33%)	16 (27%)	19 (42%)
1 out of 5	27 (26%)	18 (30%)	9 (20%)
0 out of 5	6 (6%)	4 (7%)	2 (4%)

10% of the participants did not feel confident to initiate CPR, which seems to be an alarming statement for doctors to make. Although the study did not ask responders to elaborate, this response suggests that a few radiologists may not be prepared to perform even BLS manoeuvres. Responders were able to correctly identify the most appropriate intervention more frequently when the question related to the BLS algorithm, for example chest compressions ratio, than when it related to the ILS algorithm, such as adrenaline doses (54% and 44.5%, respectively). Although life support courses for healthcare professionals include training on both basic and intermediate life support procedures, this may reflect the increased complexity of the ILS/ALS specific procedures.

Interestingly, those who felt confident to initiate life support during an arrest situation were no more likely to know the correct procedure to follow. 90% of participants felt confident in initiating adult life support, yet only 54% knew even simple aspects, such as the correct cardiac compression to breath ratio. It is possible to speculate that those claiming to be competent to manage an anaphylactic reaction may in a similar way be overconfident in their abilities to manage this life-threatening condition. It is worth noting that conforming to the most up-to-date anaphylaxis guidelines (Figure 2) [8] would have required a review of guidance more recently than the resuscitation guidelines of 2005.

It is not surprising that those who attended an adult resuscitation course more recently are likely to follow correct procedures during an arrest situation, further highlighting the vital importance of undergoing regular refresher courses. The fact that 38% of radiologists have not undergone a refresher course for over 5 years, despite guidelines produced by the Resuscitation Council (UK) that suggest that "clinical staff should update their skills annually", is of concern [9]. The stressful and chaotic conditions involved in resuscitation emphasise the need to be clear on the correct procedure to follow. The adult life support algorithm is constantly evolving, reflecting the constant advances in the evidence base, with significant changes being made for the 2005 Resuscitation Council (UK) guidelines (Figure 1) [2]. Only 13% of participants would be conforming to the correct algorithm and current evidence. The variation in participant's knowledge frequently reflected out-of-date resuscitation training; for

example, those who attended courses prior to 2005 frequently indicated that the CPR ratio was 15 compressions to 2 breaths, as was recommended in the 2000 Resuscitation Council guidelines. However, only three participants who had attended a resuscitation course since 2000 provided the correct answers as per the 2000 guidelines. Although the previous guidelines would result in effective resuscitation, it is not hard to imagine that the confusion caused by different members of the resuscitation team following different protocols is likely to significantly reduce the effectiveness of CPR. It is for these reasons that the new guidelines were widely publicised. The Resuscitation Council (UK) guidelines state that clinicians should update their skills annually [9]. However, many NHS trusts, including those involved in the current study, have adopted 3-yearly training for senior clinicians and annual training for junior doctors, unless they hold a valid Adult Life Support certificate (which needs to be updated every 4 years). In either case radiologists are falling short of this. In addition to Resuscitation Council guidance, the GMC, as an aspect of maintaining good medical practice, requires that doctors "keep knowledge and skills up to date throughout your working life ... [and] be familiar with relevant guidelines" [5, 8]. With the imminent arrival of GMC re-validation strategies and the required "licence to practice", the lack of recent life support training may well lead to problems with revalidation.

Life support courses, either intermediate or advanced, are compulsory; it is not, however, a requirement for people to undergo regular training on the management of anaphylaxis, despite the fact that anaphylaxis is a day-to-day risk for many of our patients as a result of our intervention. These guidelines have also recently been updated, adopting advances in evidence-based practice. If radiologists score so poorly on life support skills, for which they are offered regular training, the importance of providing training on other acute medical scenarios that as a profession they are likely to face is clear. One solution may be for the Royal College of Radiologists to run a resuscitation course specific to radiologists' needs, for example including contrast reaction management in life support training.

Although a response rate of 105 out 165 is good, one potential bias facing the results of this study is that those who did not know the answers may have been less likely to

Table 4. Last adult resuscitation course attended by year

Last resuscitation course attended	Total (n=105)	Consultants (n=60)	SpRs (n=45)
1995–1997	6 (6%)	6 (10%)	0 (0%)
1998–2000	11 (10%)	7 (12%)	4 (9%)
2001–2003	23 (22%)	12 (20%)	11 (24%)
2004–2006	28 (27%)	14 (23%)	14 (32%)
2007–2008	37 (35%)	21 (35%)	16 (35%)

Table 5. Participant confidence in initialising adult resuscitation

Response	Total (n=105)	Consultants (n=60)	SpRs (n=45)
Yes	94 (90%)	51 (85%)	43 (96%)
No	8 (7%)	7 (12%)	1 (2%)
Don't know	3 (3%)	2 (3%)	1 (2%)

participate. However, there is no method to know for sure whether radiologists who chose not to respond had poorer knowledge of arrest management. A further limitation of this study was its restriction to a single geographical region in the UK, although this area did include six NHS trusts. All of the trusts in the study area advised us that they recommend a refresher course for doctors in resuscitation at least every 2–3 years. Although this is not dissimilar to the policy of other NHS trusts within the UK, other trusts in

Table 6. Participant confidence in gaining adequate support from other members of staff

Response	Total (n=105)	Consultants (n=60)	SpRs (n=45)
Yes	53 (51%)	32 (53%)	21 (47%)
No	16 (15%)	11 (18%)	5 (11%)
Don't know	36 (34%)	17 (28%)	19 (42%)

other regions may be more proactive in advertising, arranging or enforcing attendance at resuscitation courses.

Conclusions

The varied and frequently incorrect responses stated by radiologists in this study have the potential to cause confusion and difficulty when initiating and performing

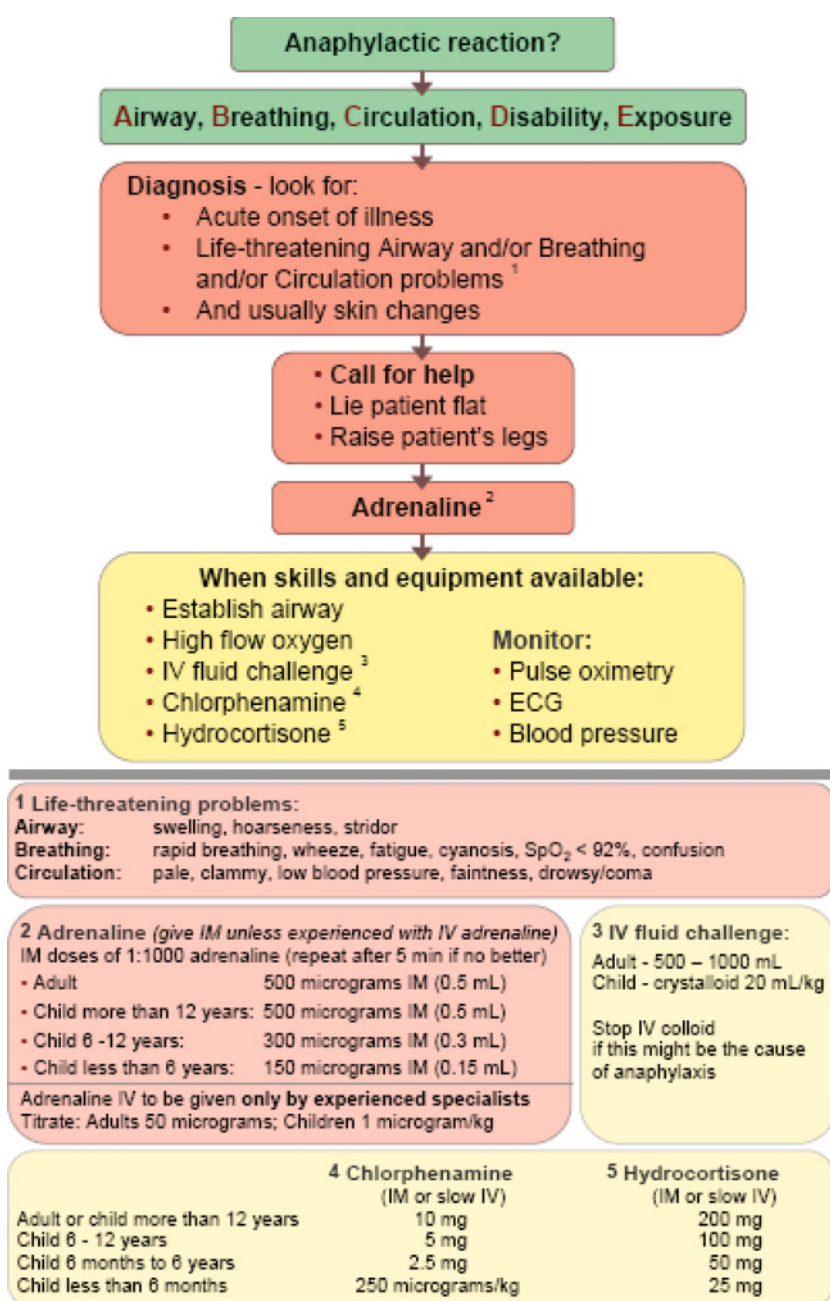


Figure 2. Emergency treatment of anaphylactic reactions. (With kind permission of the Resuscitation Council UK. From Emergency treatment of anaphylactic reactions, Guidelines for healthcare providers, Working Group of the Resuscitation Council (UK) 2008 [8].) ECG, electrocardiogram.

CPR on an adult patient within the radiology department. Furthermore, performing resuscitation in a way that is not in accordance with the current evidence-based guidelines drastically reduces the patient's chance of survival. This study emphasises the need for regular life support training and the need to alter the attitude of radiologists, who must consider it their role to keep up to date with resuscitation guidelines and anaphylactic management protocols so that they are able to initiate effective life support in the radiology environment.

Acknowledgments

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Appendix 1

ADULT RESUS QUESTIONNAIRE – Adult Life Support

Please indicate only one response with a "X". Only consider this questionnaire in the context of adult resuscitation.

Level: Cons ☐

SpR 1 ☐ SpR 2 ☐ SpR 3 ☐ SpR 4 ☐ SpR 5 ☐

Last adult Resus course attended (Intermediate Life Support, Advanced Life Support):

1995–1997 ☐ 1998–2000 ☐ 2001–2003 ☐

2004–2006 ☐ 2007–2008 ☐

1. The most appropriate rate of CPR for an adult (chest compressions: breaths):

5:2 ☐ 10:2 ☐ 15:2 ☐ 30:2 ☐ Don't know ☐

2. Number of shocks delivered in each cycle of CPR (if "shockable" rhythm):

1 ☐ 2 ☐ 3 ☐ Don't Know ☐

3. The second shock level/energy given using a monophasic defibrillator (if rhythm is "shockable"):

200 J ☐

260 J ☐

300 J ☐

360 J ☐

Don't know ☐

4. Immediately following a defibrillator shock the next thing to do is:

Check rhythm ☐

Shock again ☐

Resume CPR for 2 minutes ☐

Resume CPR for 3 minutes ☐

Don't know ☐

5. The correct administration of adrenaline given during cardiac arrest;

1 mg adrenaline given every 3–5 minutes ☐

10 mg adrenaline given every 3–5 minutes ☐

1 mg adrenaline given every 2–3 minutes ☐

10 mg adrenaline given every 2–3 minutes ☐

Don't know ☐

6. Do you use i.v. contrast?

Yes ☐ continue below*.

No ☐ please go to question 7.

*If YES, do you know the signs/symptoms of an adverse reaction?

Yes ☐

No ☐

Do you know the procedure to treat patients suffering from an adverse reaction?

Yes ☐ continue to question 7.

No ☐ continue below **.

7. Would you feel confident initiating BLS?

Yes ☐

No ☐

Don't know ☐

8. Do you feel the members of staff around you (radiographers, assistants etc) would be able to assist you in BLS

Yes ☐

No ☐

Don't know ☐

Thank you for taking the time to fill in this questionnaire

Appendix 2

Dear Colleague

We are STR (year 1) radiologists in the xxxxxxxx Deanery (xxxx and xxxxx). As Radiologists are involved with the care of very unwell people they are often in the situation that they are the only/first doctor dealing with patients who "crash". Their immediate life support skills and knowledge may make the difference to patients

while they await the arrival of the medical team. As a result we thought it would be both interesting and important to audit both trainee and consultant Radiologists' knowledge of resuscitation guidelines.

We hope you will time to fill in the simple electronic form attached.

Please click 'reply to sender', fill in the questionnaire marking an 'X' in the appropriate box and then click 'send'. It will then be returned to us. All responses will be anonymised.

Kind Regards

Appendix 3

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We are STR (year 1) radiologists in the XXXXXXXX Deanery (Xxxx and Xxxxx). As Radiologists are involved with the care of very unwell people they are often in the

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We hope you will time to fill in the simple anonymous form below.

Please print out the page and fill an 'X' in the appropriate box and return in the internal post/post to either:

XXXXXXXXXX

XXXXXXXXXX

Or alternatively click 'reply to sender', fill in the questionnaire marking an 'X' in the appropriate box and then click 'send'. It will then be returned to us. All responses will be anonymised.

Kind Regards