

Jury questionnaires

The response to the Disaster

Introduction

The general questionnaire

1. Although there have been some minor issues of drafting, all Interested Persons (IPs) are content that questions 13 and 14 should be asked of the jury in the general questionnaire. Question 13 (headed, "Emergency Response and the Role of the South Yorkshire Police") is in the following terms. "After the crush in the west terrace had begun to develop, was there any error or omission by the police which caused or contributed to the loss of lives in the Disaster? Answer "Yes" or "No." If your answer to the question above is "no," please answer the following question. After the crush in the west terrace had begun to develop, was there any error or omission by the police which may have caused or contributed to the loss of lives in the Disaster? Answer "yes" or "no." The questionnaire then invites the jury to explain the answer in its own words and sets out a number of matters it may take into consideration.
2. Question 14 is headed, "Emergency response and the Role of the South Yorkshire Metropolitan Ambulance Service ("SYMAS"). The substance of the questions is similar to question 13, with SYMAS substituted for the police.
3. In short therefore, questions 13 and 14 of the general questionnaire concern the adequacy of the response by the police and the ambulance service to the unfolding Disaster and its probable or possible contribution to the deaths of those who died.

The individual questionnaires

4. It is agreed there should be an individual questionnaire for each of those who died. All IPs are broadly content with two aspects of its contents. Question 1 concerns the medical cause of death of the person. On the basis of what is now agreed pathology evidence, the cause of death in each case but one will be compression asphyxia, with, in very few cases, other contributory causes. Question 1 of the individual questionnaires should be straightforward for the jury.
5. Question 2, under the heading, "Time of death," asks, "Please state the time of death for each person. This should be stated as a bracket between (i) the last point in time when it can be established that the person was probably alive and (ii) the point in time when it can be established that the person probably died."

6. The jury is told to avoid speculation or guesswork, to take account of the “broad bracket” given by the pathologists for time of death and only to adjust that broad bracket on the basis of reliable evidence. I anticipate it should be possible to give the jury more detailed guidance as to the cases in which on the evidence the pathologists’ time bracket may safely be adjusted. Given the massive task the jury already faces, it is incumbent on me to give them as much help as I properly can.

7. The families submitted that two further questions should be asked in the individual questionnaires. First, the jury should be asked whether or not the person would *probably* have survived had the collective response of the emergency services been quicker or more effective (the ‘probably question’). Second, they submitted the jury should be asked whether or not the person *may possibly* have survived had the collective response of the emergency services been quicker or more effective (the ‘possibly question’). Mr Hough QC, Counsel to the Inquests, submitted neither question should be asked. Miss Richards QC on behalf of SYMAS and Miss Barton QC on behalf of the present Chief Constable of South Yorkshire Police agreed with him. It is that issue I now have to resolve.

8. For present purposes I can adopt the summary helpfully set out by Mr Hough in his written submissions, adding to it where appropriate. The summary was based on the detailed medical evidence of the pathologists and intensivists. It provides the context for my decisions. As Mr Hough put it, the following propositions seem uncontroversial:
 - a. Each of the 96 people died as a result of injuries sustained in the crowd crush that developed in pens 3 and 4 of the Leppings Lane terrace on 15 April 1989. Crushing such as this can subject a person to different pathological processes which may lead to death, including principally –
 - i. a hypoxic mechanism whereby pressure prevents the chest expanding and breathing is compromised, with the result (if pressure is maintained) that oxygen levels in the brain fall and the person successively loses consciousness and loses respiratory drive; and
 - ii. an ischaemic mechanism whereby very severe crushing pressure restricts venous return to the heart, with the result that circulation is compromised.

The experts have described these respectively as “mechanism 1” and “mechanism 2”. In addition, a person in a crush may be suffocated by their mouth and nose being smothered and their being unable to breathe. These processes may operate together and

may interact with each other. The pathologists have in general terms agreed to use the term “*compression asphyxia*” to denote the medical cause of death of those dying as a result of these processes in the crowd crush.

- b. The effect of the processes described above is highly dependent on the pressure to which a person is subject, including its force, direction and consistency. Furthermore, their effect will vary considerably from person to person. The variable and dynamic nature of forces operating in crowd crushes is a major reason for the wide spectrum of outcomes of those involved in the crush at Hillsborough (some persons uninjured; some losing consciousness but recovering well; some suffering hypoxic brain injury; 96 people dying).
- c. Despite their best efforts, the experts have generally found it impossible to look at the pathological and other objective evidence and say from that that a given person must have survived for a long period after initially being subjected to crushing forces. In the great majority of cases the pathologists have been unable from the evidence to state with any degree of confidence (i) when a person would have gone into cardiac arrest; or (ii) for how long each person survived after first being subjected to crushing forces. The experts have comprehensively rejected the theory propounded at the inquests in 1990/91 that every one of those who died was necessarily in a condition from which they could not recover by a set point in time (e.g. 3.15pm). However, they have also found it very difficult to deduce prolonged survival periods from (i) apparently elevated brain weights and/or (ii) references in the initial autopsy reports of cerebral oedema / coning and (iii) descriptions in the initial autopsy reports to features suggestive of significant brain swelling.
- d. Accordingly, it has often been necessary for the experts (particularly the intensivists) to give interpretive evidence concerning AV footage of each person who died and the observations of witnesses. By reference to this material, the experts have in a number of cases attempted to say whether the person was at a given stage in one of three states: (i) unconscious but breathing; (ii) in respiratory arrest but with a pulse; or (iii) in cardio-respiratory arrest. For example, in some cases they have been able to say that video / photographic evidence of high quality CPR being performed at a given time without any response throughout would suggest that the person had probably (or very probably) been in cardiac arrest at the start of the CPR. However, they have often found it very difficult to give firm or clear answers because the available evidence is ambiguous or there is no,

or no sufficient evidence upon which they are able to form an opinion as to the condition of an individual at a particular time.

- e. In general, the medical experts have for each person given evidence of a broad bracket of time within which the person died, between (i) the last time at which there is clear evidence of the person being alive (e.g. the person being seen obviously alive on timed footage); and (ii) the time by which the person had been clearly identified as deceased (e.g. confirmation of death in the gymnasium). In some cases, they have also pointed to evidence which might lead the jury to say that the person had survived to a time later than the start of the bracket (e.g. a picture which might or might not show the person alive, or a witness's observations). In some cases, they have pointed to evidence which might lead the jury to say that the person had gone into cardiac arrest before the time at which death was formally confirmed (e.g. evidence of a failure to respond to competently performed CPR).
9. Attached as annexe 1 to this ruling is an agreed summary of the overview medical evidence given on 5 May and 22 October 2015.
 10. The jury has heard a great deal of evidence concerning the emergency response to the Disaster. For the purposes of the present issue, the following is relevant:
 - a. At 2.59pm, gates were being opened to let fans out of the central pens. This was seen in the control box and CI McRobbie was sent down to the pitch. A photograph taken by a supporter in the north stand at 2.59pm shows people in the Leppings Lane terrace coming over the fence. A number of witnesses, including Mr Page (CAO of SYMAS) and PS Goddard (the control box radio operator) have agreed by reference to that photograph that it was possible to see that the situation was an emergency.
 - b. Shortly after 3pm, SO Eason and QAP Chippendale of SYMAS who were on duty at the match walked to the west end of the ground, having seen fans coming out of the pens. They arrived there at 3.04pm. They did not go through the crowd to see what was happening in the pens and they apparently did not appreciate the seriousness of the situation. Mr Eason collected his medical kit and (from 3.12pm) gave treatment to a person with a relatively minor injury.
 - c. Supt Greenwood ran forward to speak to the referee and stopped the match at 3.05 to 3.06pm. Over the following minutes, he and other officers began the process of extracting people from the gates in the perimeter fencing. Meanwhile, at 3.06 to 3.08pm,

SYP made a request by radio for SYMAS to send a “fleet of ambulances”. Although the request for a fleet to be despatched was refused, a number of ambulances were sent to the ground over the following minutes.

- d. There is no clear evidence that either SYP or SYMAS made a formal declaration of a major incident before 3.21pm, although a number of the radio communications began to describe the events as a serious or major emergency. SYP contacted SYFRS at 3.13pm to request cutting equipment, with a view to having the perimeter fencing cut down.
- e. From about 3.16pm, the police formed up a human chain of officers to carry people out of pen 3. Fans, police and others were engaged in efforts to remove people from the pens in both directions. By around 3.30pm, the pens had been evacuated of casualties. Cutting equipment had not arrived in time for it to be put to use, although parts of the fencing had been torn down in the rescue efforts.
- f. Treatment of casualties on the pitch varied considerably. Some received high-quality resuscitative care from doctors, some received first aid and some were unattended for periods of time. Many were carried to the gymnasium on hoardings or stretchers. Casualties were transported by ambulance to hospitals from both the west and east ends of the ground.
- g. Mr Whitmore, the expert in pre-hospital care, was critical of a number of aspects of the emergency response. Focussing on the early period, he criticised Mr Eason for having not (i) ascertained what was happening in the pens, (ii) declared a major incident and (iii) established a clear area on the pitch and a system of triage for casualties being brought from the pens. He expressed the view that an effective triage system could have saved more lives. Those criticisms were accepted by Mr Page and by Mr Eason himself. Mr Whitmore described a proper triage system which would have involved an initial brief assessment of each casualty, followed by treatment in order of priority. Under that system, a person found to be without a pulse would initially be classed as dead and would receive no treatment. As Mr Weatherby QC on behalf of the 22 families pointed out, the approach to someone not breathing and without a pulse would depend upon available resources. As more resources became available, cardio-pulmonary resuscitation might be attempted. Unfortunately, the chances of successfully resuscitating someone in cardiac arrest in these, out of hospital circumstances were in any event very low (only in the order of two per cent), even if resuscitation were commenced at the time of, or within a minute or so of, cardiac arrest, and diminished as time passed.

- h. Mr Hopkins, the policing expert, was also critical of various aspects of the emergency response. He said that those in the control box should have made an unambiguous declaration of a major incident; should have established a command post on the pitch; and should have made better use of the tannoy system.

Legal Principles

11. Again, I adopt Mr Hough's summary of the legal principles. It is not in dispute. The following principles are particularly relevant for present purposes:
 - a. In an Article 2 inquest held with a jury, the coroner's responsibility is to elicit the jury's answers to the four statutory questions, including the key question by what means and in what circumstances each person came by his/her death. A means should be found for the jury to resolve the key issues raised by that question. In complex cases, this may involve the use of a questionnaire.
 - b. In devising the appropriate means, a coroner has very considerable discretion: *R (Middleton) v West Somerset Coroner* [2004] 2 AC 182 at 202E. Each inquest raises its own particular facts, circumstances and central issues. The coroner's task involves finding a practical means for the jury to address the issues in a focussed way, without overburdening them.
 - c. A jury may express conclusions about how a person died which have a critical or judgmental charge. They may not, however, appear to determine any issue of criminal liability of a named person, or any issue of civil liability at all.
 - d. The coroner has a general power (but no duty) to elicit the jury's conclusions on events and circumstances which may possibly have contributed to the death(s) under investigation but cannot be shown probably to have made a contribution. See: *R (Lewis) v HM Coroner for Mid and North Shropshire* [2010] 1 WLR 1836 (confirmed in *R (Le Page) v HM Asst. Deputy Coroner for Inner South London* [2012] EWHC 1485 (Admin) and in *R (Wiggins) v HM Asst. Coroner for Nottinghamshire* [2015] EWHC 2841 (Admin)). This was a topic I considered in some detail in my ruling of 2 September 2015 (see paragraph 41 and following).

- e. In putting questions to the jury, a coroner should not invite a jury to make a finding which could not properly be made on the evidence. See *R (Chief Constable of Devon and Cornwall Police) v HM Coroner for Plymouth* [2013] EWHC 3729 (Admin.) at para. 16(iii):

“Procedure in Coroner's courts should be evidence based and there can be no justification for asking a Jury to make a finding for which there is no evidence. The harm that could ensue if juries are asked to speculate without any evidence to support their speculation is obvious. This is not in any way a criticism of the diligence with which a jury approaches its task: it is simply that, if there is no material upon the basis of which a jury can answer a question, asking them to do so presents them with an impossible task.”

The general questionnaire

Why it is appropriate to ask both a probably and a possibly question

12. Before turning to the area of dispute, it is necessary to set out why both a ‘probably question’ and a ‘possibly question’ should be asked in the general questionnaire. Again, because this was not an area of dispute, I shall adopt Mr Hough’s summary of the position. As did he, I shall start with the ‘possibly question.’

The ‘possibly question’ in the general questionnaire

13. In my view the jury could properly find that lives *may* have been lost as a result of failures in the emergency response of SYP and/or SYMAS. It could properly conclude:
- a. Senior police officers ought to have declared a major incident at or shortly after 2.59pm and given directions for the terrace to be evacuated (including by using the tannoy system). This would have relieved the pressure in the crush from a relatively early stage. It would have led to earlier extraction and treatment of an indeterminate number of the casualties.
 - b. SYMAS officers at the ground, notably Mr Eason and Mr Higgins, should have established the nature of the emergency by around 3.06pm, declared a major incident and begun to establish a triage area on the pitch in the following minutes. This would have led to earlier and/or improved treatment of some of the casualties (although it would also likely have led to those found to be without a pulse being quickly assessed as beyond saving).

14. Earlier and/or improved treatment may have saved some of the lives of those who died. In the great majority of cases, the person was only confirmed to be dead at a relatively late stage (often around 4pm). The jury may be unable to say by reference to any evidence that the person had probably died by an earlier stage. The possibility of lives having been saved by improved emergency response cannot in the circumstances be denied. In other words, the situation for many individuals is analogous to that of the inmate in the *Lewis* case.
15. Given that the jury could properly say that there were failings in the emergency response which may have cost lives, they should be asked to express their views as to the adequacy of that response. It is a topic of great importance in these inquests. The failure properly to address it was the primary reason for the High Court quashing the earlier inquests. If the jury can lawfully answer questions about it, they should be asked to do so.

The 'probably question' in the general questionnaire

16. I agree with Mr Hough that the jury could properly find that errors/omissions in the emergency response of SYP and/or SYMAS *probably* contributed to the loss of lives in the Disaster.
 - a. The jury could properly find that, but for failings in the emergency response of SYP, some of those who died would have (i) had crushing forces relieved at an earlier stage; (ii) been extracted from the pens sooner; (iii) had their airways protected sooner; and/or (iv) received competent treatment sooner. Equally, the jury could properly find that, but for failings in the emergency response of SYMAS, some of those who died would have been assessed and received competent treatment at an earlier stage.
 - b. It is very difficult to say of a specific individual whether or not he/she would have been extracted earlier, treated earlier or survived if the emergency services had acted differently (see below). This is, in summary, because (i) it is usually impossible due to limitations in the evidence to say that a person survived to a point in time when a better emergency response could have made a difference and (ii) it is conceptually very difficult to say what effects an improved response would have had for a specific individual caught up in the crush.
 - c. However, it is possible for the jury to have regard to the situation as a whole and conclude that some more lives probably would have been saved by an improved emergency response on the part of SYP and/or SYMAS. The following considerations are relevant:

- (i) Given the evidence as a whole (including the footage of the situation on the pitch and the evidence as to when individuals received treatment), the jury could safely find that failings in the emergency response significantly delayed the release and effective treatment of many individuals.
 - (ii) The expert evidence is that an earlier release of pressure could prevent a person losing consciousness; that earlier attention to a person could protect the airway and thus prevent respiratory arrest; and that earlier treatment could prevent a person descending into respiratory and then cardiac arrest. In other words, improvement in the emergency response had the capacity to prevent death in various ways.
 - (iii) There is positive evidence of some people being extracted from the crush and surviving as a result of quick and effective treatment. The three particular cases of Ian McDermott, Gary Currie and Andrew Devine provide good examples. Other witnesses have described losing consciousness, being removed from the pens and surviving with very few ill effects. The jury could conclude that the delivery of earlier and improved treatment to many people would have led to some reduction in the overall number of those who died.
17. Mr Hough accepted this approach involves the jury in standing back and making a somewhat impressionistic assessment. It would not be the sort of assessment a jury might be asked to make in a criminal case or a judge in a civil case. However, it is not, I agree, inappropriate where the jury is being asked to express a general view about the loss of lives as a whole in the group and in the context of an inquisitorial process.

The families' submissions on the individual questionnaires

18. Mr Weatherby submitted each individual questionnaire should have a 'probably question' on survivability. It is a topic of great importance to the families. It has been a key issue in the present inquests, not least in response to the artificial cut-off point of 3.15pm at the previous inquests. Considerable time has been spent on it during the present inquests. In the case of each of those who died, there was sufficient evidence for the jury safely to conclude he/she would probably have survived had the response of the police and/or the ambulance service been adequate. As I understood Mr Weatherby's position, were I to conclude that in some cases the jury could safely answer a question on an individual's survivability, in other cases it could not, he would not wish that to be reflected by different questions in one individual

questionnaire. That certainly was Mr Roche's position on behalf of 77 families. Of course, the essential submission was that that problem did not arise.

19. Mr Weatherby took as an example a particular case (Michael Kelly), where he submitted the 'probably question' could properly be answered on the evidence. He submitted moreover, that in each case the jury could approach the matter on the basis there was a failure by the police to take any, or any sufficient action to alleviate the crush from the time exit Gate C was opened at 2.52pm. That alone would justify a 'probably question' in each questionnaire. It would give each family a determination to which it is entitled. It would go further than the answer to the general questionnaire.
20. Mr Weatherby submitted that it followed there should in each case be a 'possibly question.' That would take account of a possible jury view that some cases were stronger than others on survivability. He did not accept the answer to a 'possibly question' would add nothing to the answer to the general questionnaire. A determination of a realistic possibility of survival would have meaning for the family and be of public interest.
21. Mr Weatherby further submitted that the jury having determined the time bracket for death, it would possible for it consistently to approach each case and decide whether the person might have survived.
22. Mr Roche on behalf of 77 families agreed with Mr Weatherby, as did the other family advocates. He emphasised the importance of the issue to the families. He agreed it was a matter for my discretion. He submitted the reasons not to exercise it in favour of individual survivability questions would need to be compelling. To do so would not place an intolerable burden on the jury.

My view

The 'probably question' in the individual questionnaires: some general observations

23. In these inquests, in stark contrast to the previous ones, and in part, due to the meticulous work of Operation Resolve, we have sought to look at the individual experiences of each of those who died. Eyewitnesses, doing their best after 26 years, have sought to help. Specialists in intensive care, forensic pathologists (necessarily commenting on autopsy reports of the pathologists who carried out the post-mortems) and neuro-pathologists have sought to help about the cause and time of death of each of those who died. Not surprisingly however, there are general areas of difficulty and uncertainty. For example, witnesses' recollections so long

after the events are open to question. There are doubtful or disputed or inconsistent identifications. Witness statements from 1989 often did not deal with the sort of topic and detail we have been considering in this phase of the inquests. Timings were often uncertain unless confirmed by the AV footage. Pulse checks (which indicate whether a person has a heartbeat), are notoriously unreliable: particularly so if carried out by someone who is not a medical professional, as was often the case. In many cases it is difficult to draw any safe inference from a person's failure to respond to cardio-pulmonary resuscitation (CPR). The effect of high quality CPR given by a medical professional may be very different from that given an untrained or less well trained member of the public or police officer. Answers may depend on the interpretation of blurred or unclear photographs or audio-visual evidence. In some cases the pathologists could not say whether an injury was sustained before or after death.

24. Moreover, in each case we do not have a full picture of what happened to an individual. There are very often substantial gaps in the evidence. Those gaps normally cover the immediate aftermath of the crush, a most important period in determining prospects of survival.
25. All these are aspects which, in general terms, render the task of the jury in safely answering the 'probably question,' very difficult. There are other, overwhelming difficulties.
26. Except in a few cases where there is clear evidence of an early death, it is generally impossible to establish with any precision when the person died. In most cases the available evidence does not prove the person probably survived beyond 3.05pm; in many cases beyond 3.00pm. As Mr Hough emphatically underlined, that does not mean the evidence established that everyone died early. If that were so, there could not be the 'probably question' in the general questionnaire. The difficulty is the proof of probable survival in an individual case. The mechanism of circulatory collapse could have been very rapid indeed. Some individuals may have been more susceptible to the pressure than others. Compressive forces on individuals varied. When an individual went into cardiac arrest is mostly unclear. If survival in an individual case cannot be proved beyond 3.00pm or 3.05pm, it cannot be said that an emergency response at 2.59pm or 3.04pm (see paragraph 10 above) would have relieved the pressure or have led to effective treatment of the individual. I cannot accept Mr Weatherby's submission that the jury could approach the improved emergency response on the basis of an earlier time. This earlier time seems to me to relate to what Mr Duckenfield should have done after he ordered the opening of the gates. Of course, the point may be made against Mr Duckenfield that he should at that time have ordered the tunnel closed and thereby prevented

the fatal crush developing in the first place. That point, which does not really concern the response to the Disaster, is very fully covered by questions in the general questionnaire.

27. Even if it could be said that the individual did probably survive for a longer period, it would generally be impossible for the jury to say what the effect on that individual of an improved emergency response would probably have been. There are too many uncertainties. Mr Hough set out some questions which reflect the difficulties. When would the pressure on that particular person have been relieved? What would the effect of the relief of that pressure in his/her particular case have been? When would the person extracted from the pen have been given the notional better emergency response? What would his/her condition have been? If in cardiac arrest, would he/she have been triaged as dead?
28. As Mr Hough submitted, the 'probably question' would raise a problem of consistency. Even if it were possible to identify a few individuals in respect of whom the jury could safely reach a conclusion, that could not justify asking a question in the great majority of cases which could not safely be answered.
29. In the result it is clear to me that the 'probably question' cannot be asked in the individual questionnaires. It would in short amount to asking a question which the jury could not safely answer. It would amount to setting the jury a massive and time-consuming task which it could not fulfil without guesswork and speculation.

The 'possibly question' in the individual questionnaires

30. It is agreed that whether the 'possibly question' should be asked in the individual questionnaires is very much a matter for my discretion. For reasons which I shall shortly set out, I have come to the clear view it should not be.
31. For the reasons I have already explained when dealing with the 'probably question,' the jury could not on the basis of the evidence come to any safe conclusion about the realistic prospects of survival in any individual case. On proper analysis therefore the answer to the 'possibly question' could have no real meaning in the case of any individual. It would amount to no more than saying, that an improved emergency response might have saved some lives, of which that individual's life might have been one; also, that it cannot be proved that that individual died too early to be saved. It would not say anything positive to the effect that the individual could have been saved in a particular way. It would merely reflect the absence of evidence about the exact time of death and the chances of that individual being saved. It would not, in other words, amount to a finding that the particular individual had a measurable

chance of survival which was due to an inadequate response by the police and/or SYMAS. It could add nothing to the answers to questions 13 and 14.

32. Questions 13 and 14 of the general questionnaire provide a better means for the jury to address the core issues regarding the emergency response. As Mr Hough said, in a case where it is extremely difficult to make positive findings about the effect of delayed treatment on each individual, it makes sense to address the failings of the emergency response on those who died as a group. They will be meaningful and clear.
33. To add to the jury's already massive burden by asking a further question which could not produce a meaningful answer and would not be anchored to specific evidence would not be justified.

Drafting points in respect of questions 13 and 14 of the general questionnaire

33. In their submissions IPs raised a number of points regarding the drafting of the "considerations" for the jury in respect of questions 13 and 14. I now need only express my views in respect of two.
34. First, in my view the present bullet point under question 13 regarding the initial mistaken belief by some police officers that what was happening was crowd disorder, not an unfolding Disaster, should remain. A number of officers gave evidence to that effect. It is something the jury is entitled to take into account when assessing the police reaction to events.
35. Second, in my view there should be a specific bullet point under questions 13 and 14 going to the topic of cutting equipment. It is an important issue. The draft prepared by Mr George satisfactorily sets out the consideration.
36. Otherwise I approve the approach taken by Mr Hough. I anticipate a final version of the general questionnaire will now be produced.

Some final observations on the individual questionnaires

37. I of course understand the importance of these topics to the families. As I have said, we have heard a great deal of evidence on the topic of survivability in respect of each person who died. We have sought to examine the issue as thoroughly as possible. Even if, as is the case, the evidence does not permit definitive answers to be given in individual cases, I hope that by

going through the evidence the families have a better understanding about what happened to their loved ones. It is not uncommon in inquests to deal with evidence which cannot ultimately be reflected entirely in the questions posed for the jury. Moreover, and importantly, questions 13 and 14 in the general questionnaire mean that for the first time any inadequacy in the response to the Disaster by the police and/or SYMAS will be clear both to the families and the public.

Sir John Goldring
30 December 2015

**SUMMARY OF THE OVERVIEW EVIDENCE ON MEDICAL MATTERS GIVEN ON 5
MAY AND 22 OCTOBER 2015**

The “A-B-C” – airways, breathing and circulation

1. The cells in the body require oxygen to function normally. The oxygen is obtained by breathing in the air around us. The air passes through the airways, from the mouth/nose, through the windpipe (trachea) and into the lungs. In the lungs, oxygen passes into the bloodstream. It is then circulated around the body by the heart, which acts as a pump.
2. Blood that is rich in oxygen (oxygenated blood) is carried around the body in arteries and is bright red in colour. De-oxygenated blood is returned to the heart via the veins, and is dark blue or even black.
3. The brain in particular needs a large amount of oxygen to function normally.
4. There are three ways in which the supply of oxygen to the brain can be reduced. These are the A-B-C problems:
 - a. Airways – if there is a problem getting oxygen into the blood stream, such as may happen when someone is unconscious and the airway becomes blocked, or if someone is smothered against something
 - b. Breathing – the chest is unable to expand to draw air into the lungs
 - c. Circulation – there is a problem with circulating oxygen around the body because the heart is not functioning effectively.

The effect of a crowd crush

5. There are two main mechanisms that can affect people caught in a crowd crush. These are set out in diagrams contained in the jury bundle.

Mechanism 1 – hypoxia – where breathing is compromised

6. The first is the **hypoxic mechanism**. This occurs where the chest cannot expand. This means that – although the heart is still pumping and the airways are clear – the person cannot breathe in and so the body is receiving no oxygen, or reduced oxygen. This is called **hypoxia**.

7. After some time, the person will **lose consciousness** and as the oxygen level in the brain continues to fall the brain will lose the reflex to breathe (**respiratory drive**). The person will go into **respiratory arrest** (i.e. they stop breathing) and then **cardiac arrest** (i.e. the heart stops pumping effectively).

Mechanism 2 – ischaemia – where circulation is compromised

8. The second mechanism is the **ischaemic mechanism**. This occurs when very severe pressure from the crush restricts the flow of blood returning to the heart through the veins (i.e. the **circulation**).
9. This can lead to three problems: (i) if insufficient blood returns to the heart, then the heart cannot work effectively as there is nothing to pump out; (ii) the pump effect of the heart itself may be restricted by being compressed in the crush; (iii) the heart's own blood supply may be affected by the **arteries** supplying it being squashed. The first of these problems – the lack of sufficient blood to pump out – was described as the main problem in this mechanism.

Suffocation

10. People in a crowd crush may also be at risk of **suffocation**. This occurs when a person's mouth and nose are smothered so that they are unable to breathe. An example may be where someone's face is pushed into contact with the body or clothing of the person next to them. If the smothering is not relieved then, as with the first mechanism, oxygen levels within the blood will diminish, potentially leading to unconsciousness, loss of respiratory drive, respiratory arrest and then cardiac arrest.

The interaction of the different mechanisms

11. All of these different processes can affect a person at the same time. Mechanism 1 (hypoxia, where breathing is compromised) will tend to occur before Mechanism 2 (ischaemia, where circulation is compromised), as less pressure is required to restrict breathing than to restrict the operation of the heart. In the same way, were the pressure to ease within a crowd crush, the effect of Mechanism 2 would subside first, with Mechanism 1 reducing if the pressure continued to be released.
12. Suffocation could occur at the same time as either or both of the other mechanisms, but is unlikely to happen in isolation.

The effect on different individuals of the mechanisms

13. The effect of the different mechanisms on an individual will vary considerably from person to person. People's physical size and strength, or their age, may be relevant. Other relevant factors include an individual's own genetic makeup, any underlying diseases or injuries, and whether the person has depleted oxygen stores as a result of activity.
14. In short, each person will be affected by the mechanisms in a different way as a result of their individual physiological features.
15. Further, in crowd crushes pressure can wax and wane so that someone who is crushed at one moment may find that the pressure eases temporarily, only to return at a later stage. At points when the pressure eases blood may return quickly to the heart, allowing respite from Mechanism 2; or the person may be able to breathe, thereby slowing or reversing the loss of oxygen levels in the blood cause by Mechanism 1.
16. Another characteristic of crowd crushes is that even people standing next to one another can be subjected to very different levels of pressure at any given time. The direction of the force will also vary. Someone who is standing so that the force of the crowd passes from one side of his body to another will be better protected than someone who experiences the pressure passing from the back of the body to the front.
17. There are, therefore, a very large number of factors that govern how each person will be affected by the mechanisms described above in a crowd crush, such as the one at Hillsborough. There is little scientific research in this area and the experts who gave evidence stressed that it was important to keep a very open mind when considering how the crush affected each of those who died in the disaster.
18. The experts agreed that the variable, dynamic nature of crowd crushes is reflected in the wide spectrum of outcomes for those who were caught in the crush at Hillsborough. Some were uninjured; others lost consciousness but recovered; and others died. Even those standing next to one another during the crush had very different outcomes.

Timescales

19. Because of the variation in how crowd crushes affect individuals, and the lack of scientific data specifically considering the impact of crowd crushes on individuals, it is only possible to give general estimates about the timescales involved. These estimates are based on data from animal experiments, rather than humans, and educated judgments about how the mechanisms progress beyond the loss of consciousness.
20. It is important to appreciate that these timescales are based on an assumption of a static, unremitting crush. As explained above, if the pressure was relieved so that a person could breathe or have his circulation restored, then Mechanism 1 and Mechanism 2 could be reversed.
21. In terms of Mechanism 1 (where breathing is compromised), Professor Nolan and Dr Soar said that **assuming breathing was completely prevented**, the person might lose consciousness within 1-2 minutes, and cardiac arrest might follow at some point between about 3 to 11 minutes afterwards. Professors Hardman and Deakin had suggested a shorter period, of about 5 minutes before cardiac arrest, in the same circumstances.
22. In terms of Mechanism 2 (where circulation is compromised) all of the experts agreed that, in circumstances where the pressure was maintained, loss of consciousness and cardiac arrest would occur more quickly than in Mechanism 1. **If the heart is prevented completely from pumping out blood** then loss of consciousness would follow rapidly and cardiac arrest could potentially occur in less than a minute.
23. All of the experts agreed however that the timescales given above were of limited assistance in the context of the crowd crush at Hillsborough and had to be used with care. They provided useful guidance in indicating that both mechanisms could lead to unconsciousness and cardiac arrest within a relatively short period. They were also useful in demonstrating that Mechanism 1, in which oxygen levels were reduced gradually, operated more slowly than Mechanism 2, at least in circumstances where breathing or circulation were completely prevented.
24. However because of the dynamic nature of crowd crushes, because both mechanisms could apply at the same time, and because of the individual

variabilities described above, the timescales should not be applied mathematically. They should not be used to try to fill gaps in the evidence.

25. It was very important therefore to keep an open mind and consider the evidence we have in respect of each individual.

Unconsciousness, respiratory arrest and cardiac arrest

Unconsciousness

26. Where someone is **unconscious** as a result of low oxygen levels, but is **still breathing and has an open airway**, then it is entirely possible for him to return to consciousness without any further intervention, provided that the airway does not become blocked.
27. There are several ways in which an unconscious person is vulnerable to an airway blockage. The tongue may loll back and cover the airway, flexion of the neck downwards or the presence of large pieces of regurgitated stomach contents may also cause the airway to become blocked. An unconscious person is less able than a conscious person to prevent themselves becoming smothered, and hence is more at risk of suffocation (as described above).
28. Where an airway has become blocked either by the tongue or the flexion of the head, it can be re-opened by changing the position of the casualty, for example by tilting his head or placing him in the recovery position. An OP airway or similar device may also be used. In cases where stomach contents block the airway, these can be cleared by someone using their finger.

Respiratory arrest

29. Where someone is **unconscious** as a result of low oxygen levels and is **not breathing** (i.e. in respiratory arrest, but not cardiac arrest), he is extremely unlikely to recover without resuscitation efforts being made. The casualty requires oxygen from, in rising order of effectiveness, rescue breaths ("mouth-to-mouth" resuscitation), bag-and-mask ventilation, or the provision of oxygen from a cylinder.

Cardiac arrest

30. Someone who is in cardiac arrest will be unconscious, not breathing and will have no effective heart activity. In 1989, the chances of survival for someone who

was outside hospital and in cardiac arrest as a result of Mechanisms 1 or 2 were very low, in the region of 2%. “Survival” in this context refers to someone who is able to leave hospital after a period of time.

31. In order to have the best chance of survival, someone who entered cardiac arrest would require high quality CPR as quickly as possible, meaning within a minute or so. The chances of survival decline quite rapidly with time, and every minute counts.

The pathology evidence

Brain weight and cerebral oedema

32. Pathologists are interested in the weight of the brain at autopsy as it may indicate what injury the brain has received and how it responded to it. In the context of those who died at Hillsborough, there was particular interest in **cerebral oedema**.
33. Cerebral oedema is a condition caused by water or fluid leaking out of the vessels in the brain, into the brain tissue itself. This causes the brain to become wet, swollen and heavier than it would be normally. If true cerebral oedema is present and detectable by a pathologist at autopsy, then this indicates that the person survived for an hour or thereabouts before dying.
34. A considerable amount of work has been done by pathologists and neuropathologists (those who specialise in the pathology of the brain) on assessing the original autopsy records, and in particular the brain weights recorded in them. It had been hoped that this may provide objective evidence that would assist in assessing the period of survival for some of those who died. However, when giving evidence on 22 October 2015, Dr Nat Cary (instructed by the families) and Professor Jack Crane (instructed by the Coroner) both expressed disappointment in what they had learnt from these sources. There were several reasons for this.
 - a. They were not convinced that they could rely on the accuracy of the weights given in the original autopsy reports. If the brain weight data is inaccurate, then reliable conclusions cannot be drawn from it.
 - b. There is scientific uncertainty as to how an increase in brain weight should be interpreted. The brain could become swollen by mechanisms other than cerebral oedema. There is little data available for the pathologists to use and

some disagreement among the neuropathologists about alternative explanations for brain swelling. In short, they are at the limits of scientific understanding.

- c. The terms used to describe the appearance of the brains in the original autopsy reports were not applied consistently. Some of the descriptions recorded also gave rise to difficulties, for example the brain may be described as “slightly swollen” but with features that are indicative of a very swollen brain.
 - d. No microscopic examination of the brain tissue was undertaken in 1989.
 - e. An individual may, naturally, have a very heavy brain.
 - f. In some instances, the brain weight of an individual suggested a period of extended survival whereas the factual evidence did not.
35. Professor Crane and Dr Cary concluded that while brain weight may be of assistance in individual cases, and should be addressed, overall it was not likely to be helpful for the majority of cases. It was one of the factors that would have to be considered along with all of the other evidence.

Petechiae

36. **Petechial haemorrhages (petechiae)** are small, pinpoint bruises that may become apparent on the face and other parts of the body when someone is caught in a crush. Petechiae can develop quickly, particularly when Mechanism 2 (where circulation is compromised) is operating. However, they are of no real assistance in assessing the period of survival or time of death as someone may have florid petechial haemorrhages and yet survive.
37. **Skin colour and other external descriptions** given in the original autopsy reports are also felt to be of little value now in assessing the same issues of the period of survival and time of death. Individuals with very florid signs may have survived, while those with very few signs may still have died at an early stage, for example as a result of suffocation.

Conclusion

38. Dr Crane and Professor Cary considered that there was no particular feature of the pathology evidence that would be of great value in assessing when an

individual died. They noted the importance of the eyewitness accounts, the AV footage, and the interpretations given by the intensivists. The pathology evidence might help to corroborate the other evidence that we have.