

Serious Incident Report

**Unexpected deterioration of a young woman
on the Acute Medical Unit:
updated report (February 2022)**

UCLH SI Log Number: SI619

STEIS Number: 2021/15713

Datix No: **DW**

This serious incident investigation concerns the initial hospital care of a previously healthy 25 year old woman who tragically died with rapidly progressive cerebral oedema (brain swelling). The patient did not appear seriously ill on admission, and suffered an unexpected respiratory arrest the following day on the Acute Medical Unit. This investigation has reviewed the patient's care in hospital up to that point, and highlighted aspects which could have been improved. The likely impact of such potential improvements in the patient's care on her outcome remains uncertain.

The initial report of this investigation was completed before the results of post-mortem examination were available. This updated report is being produced after receipt of the post-mortem reports and in response to further understandable concerns raised by the patient's family.

Serious Incident Report		
GP Practice:	F83021	
Division:	Emergency Services Division	
Exact Ward/Location:	Acute Medical Unit	
Specialty:	Acute Medicine	
Nominated Lead for the investigation report & title:	Daniel Wallis Christine Gregson	Consultant in Emergency Medicine & Governance Lead Emergency Services Consultant Physician & Interim Clinical Lead Acute Medicine
Duty of Candour Lead	Christine Gregson	Clinical Lead Acute Medicine
Incident date:	18 th July 2021	
Degree of harm as a direct result of the incident:	The patient subsequently died.	
Executive sign-off:	Cathy Mooney, Director for Quality and Safety	
Date:	07 February 2022	

Executive summary

A message to the mother of the patient who died

As before, we are very sorry you have endured the pain of losing your daughter. The investigation team can only imagine what you have been through over past months. We are sorry if reading this report is itself distressing. The primary purpose of the hospital's investigation has been to learn whether anything went wrong and if so why, so that lessons can be learnt and healthcare continuously improved; as part of that purpose, we have considered the likely underlying disease process(es), and whether any different care could have resulted in a better outcome. We have tried to be open and transparent both in the investigation and the presentation of its findings. We recognise you want answers to the questions you have asked about what happened, and we have tried to provide these so far as the evidence allows.

We also apologise if the way in which this report is presented appears technical or detached. We are required to follow a prescribed approach and format, which includes anonymising the names of the patient, her relatives and healthcare staff. We have not lost sight, though, of your suffering.

Note

This investigation has been led by clinicians in Emergency Medicine and Acute Medicine, but has drawn heavily on the expertise of colleagues in Imaging, Neurology, Endocrinology and Biochemistry within the UCLH Trust. This report aims to convey the opinions of that range of clinicians.

Summary

This report concerns a previously healthy 25 year old woman who became acutely unwell with headache and vomiting, followed by altered mental state and unusual behaviour. On initial assessment she was also noted to be moderately hyponatraemic. The initial focus of care was on rehydration and observation overnight. The next day the patient had treatment for possible meningoencephalitis, an emergency CT brain scan (initially reported as showing no acute intracranial finding), and attempted lumbar puncture. During this attempted procedure she suffered a respiratory arrest, presumptively due to brain stem herniation ('coning') - although the relationship between the attempted procedure and the patient's deterioration may have been coincidental rather than

causative for reasons explained in this report. By this time the patient had also become profoundly hyponatraemic. The patient was rapidly resuscitated, but a second CT scan showed generalised brain swelling with low lying cerebellar tonsils. She was admitted to the Intensive Care Unit, but tragically brain stem death was confirmed three days later.

This investigation highlights aspects of the patient's care which could have been improved. The potential impact of such improvements on the patient's outcome remains uncertain. The investigation acknowledges there is a range of medical opinion regarding some aspects of the patient's care – in particular the interpretation of the first CT scan, and the significance and treatment of the patient's hyponatraemia.

This report also attempts to address the patient's mother's understandable concerns, in particular relating to:

- her daughter's care, including the fact a diagnosis of intoxication was considered initially and the impact of that on subsequent care; whether neurological compromise was considered; the basis for concluding her daughter was not photophobic; and the rationale for the attempted lumbar puncture and its association with her daughter's deterioration
- staffing levels
- apparent inconsistencies in visiting policy
- difficulties in communication with the clinical team on the Acute Medical Unit (AMU), and
- the information provided by the Acute Medicine team.

Care Delivery Problems

CDP 1: Lack of monitoring of the patient's serum sodium, administration of three litres of intravenous fluid without relevant investigations having been performed, and the response to profound hyponatraemia on the afternoon of 18 July 2021

CDP 2: An emergency CT head scan not arranged on admission as it should have been.

Root cause

Presumptive unawareness of relevant guidance; and possible availability bias*

*(a tendency to favour information that is most readily available – for example that altered mental state or unusual behaviour in young people presenting to the Emergency Department (ED) is commonly due to ingestion of alcohol or drugs).

Lessons Learned

1. Importance of trying to contact family for background information to inform the care of patients unable to give a coherent account themselves (particularly in a time of pandemic).
2. Requirement for documented regular neurological observations for a patient with altered mental state.

Recommendations

1. Guidance on the care of patients with hyponatraemia to be reviewed at local Clinical Governance meetings (Acute Medical Unit and Emergency Department).
2. Creation of a guideline on hyponatraemia for the Trust's Medical Emergency Document Library.
3. To ensure formal teaching on the care of patients with neurological presentations - and in particular patients with altered mental state / behaviour - is included in the rolling training programmes in Acute Medicine and Emergency Medicine.
4. To ensure formal regular teaching on hyponatraemia is included in the rolling training programmes in Acute Medicine and Emergency Medicine.
5. Review of the patient's initial CT scan at the Imaging Department's Learning Meeting.

Immediate actions taken to mitigate risk (identified at the 72 hour review if applicable)

No immediate actions identified.

<p>Scope of investigation</p> <p>The patient's care from the time of arrival in the Emergency Department to the patient's respiratory arrest on the Acute Medical Unit the following day. The patient's mother's concerns relating to this time period.</p>	
<p>Terms of Reference</p>	
<p>The aims of the incident investigation are:</p> <ul style="list-style-type: none"> • To identify and describe the course of events leading to the SI by: <ul style="list-style-type: none"> 1. reviewing the patient's medical records 2. reviewing staff statements and interviewing the clinical staff involved as appropriate • To identify care and service delivery problems which may have contributed to the incident. • To undertake root cause analysis to identify the root causes and contributory factors leading to the incident. • To evaluate practice against local and any national guidance or standards of good practice using change analysis. • To identify potential ways in which systems and processes currently followed could be improved • To make recommendations to reduce the risk of similar incidents occurring in the future • To identify any additional learning during the investigation • To address questions asked by the patient's mother about the investigation and treatment of her daughter's illness, staffing ratios, apparent inconsistencies in visiting policy, difficulties in getting through to the ward, and medical staff giving partial information and false hope. 	
<p>Involvement and support of staff</p>	
<p>The junior doctors concerned have been supported by Consultants on the Acute Medical Unit. Nursing staff were offered support through their local Senior Nurse and the staff psychology service.</p>	
<p>Information and evidence gathered</p>	
<p>The patient's electronic healthcare record Conversation with the patient's mother (on 08/11/2021) Recollections of clinicians Manchester Triage Group <i>Emergency Triage</i> 3rd edition, 2013 ('Manchester Triage') NICE <i>Headaches in over 12s: diagnosis and management</i> Clinical guideline [CG150] Published: 19 September 2012 Last updated: 12 May 2021 ('NICE headache guidance') Spasovski G, Vanholder R, Allolio B <i>et al.</i> Clinical Practice Guideline on diagnosis and treatment of hyponatraemia. <i>European Journal of Endocrinology</i> 2014;170(3):G1-G47 ('Hyponatraemia guidance 1') Ball S, Barth J, Levy M and the Society for Endocrinology Clinical Committee. Society for Endocrinology Endocrine Emergency Guidance: Emergency management of severe symptomatic hyponatraemia in adult patients. <i>Endocrine Connections</i> 2016; 5(5): G4-G6 http://www.endocrineconnections.org DOI: 10.1530/EC-16-0058 ('Hyponatraemia guidance 2').</p>	
<p>Duty of Candour</p>	
<p>Patient and / or Relative Involvement Name of allocated Trust Liaison Contact</p> <p><i>(Note this person will now be considered part of</i></p>	<p>Chris Bright, Quality & Safety Manager Emergency Services</p>

<i>the team whose responsibility is to maintain communication with the patient or their family and to ensure that the investigation report answers any specific questions raised by the patient or family.)</i>	
Details of initial Being Open discussion Date informed of investigation: Method used: By Whom:	Phone call from Chris Bright to the patient's mother on 26/08/2021, to explore whether she wished to meet the investigating clinicians. The patient's mother has helpfully forwarded a copy of correspondence she has sent to HM Coroner.
Involvement of Patient / Relative in the investigation	
Have they been asked if they have anything they wish the investigation to consider?	Yes
Will the findings or report be shared once the investigation is completed?	Yes
Is there an associated PALS enquiry or formal complaint?	No
Details of any updates provided or contacts made <i>(The Patient / Family Liaison should complete this with any further contacts made to update if appropriate)</i>	A further phone conversation took place between the patient's mother and Daniel Wallis on 8 th November 2021.
Arrangements for sharing completed investigation Letter/Meeting	Updated SI report to be sent by email and letter, with a further offer to meet (by video call) with the investigating clinicians.
Safeguarding	
Has a safeguarding alert been considered?	Yes
If deemed required, has a safeguarding alert been raised?	N/A

Date	Time /	Source	Events	Comments / concerns/opinion
			vomiting resolved following ondansetron 4mg intravenously at 22:50.	<i>includes normal orientation to time person and place.</i>
	23:05	UCLH electronic healthcare record (EHRS)	The patient was registered in the Emergency Department.	<i>The patient was brought to the Emergency Department alone because of restrictions on visiting, as part of infection prevention and control measures during the covid-19 pandemic to mitigate the risk of the spread of infection and to protect patients.</i>
	Approximately 23:12 – 23:36	EHRS Statement of Triage nurse	Initial assessment in the Rapid Assessment & Treatment area of the ED. The note of the handover from the ambulance crew includes the information that the patient had been cycling at about 17:00; had then lain in the sun, and drank 2-3 bottles of cider and water; she had had a frontal and generalised headache, and after the onset of headache, had vomited; and following antiemetic treatment given by the ambulance crew, her symptoms had resolved. Observations of vital signs recorded pre-hospital were [within the normal range / unremarkable for a young woman]; in particular her temperature was normal at 36.6°, and her pain score 0/10.	
	23:18	EHRS	Following Manchester Triage assessment, a triage priority of Green was allocated, with a target time to be seen within 120 minutes.	<i>If it was confirmed the patient's headache was of abrupt onset (as suggested by the ambulance crew's report), a triage priority of Orange with a target time to be seen within 10 minutes, should have been allocated. If not,</i>

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				and at the time of assessment the patient's conscious level was normal, her headache only mild, and her vomiting not persistent, a triage category of Green may have been reasonable (Manchester Triage).
	23:19	EHRS	Observations of vital signs were within normal limits; specifically she did not have a fever (temperature 36.2°) and her Glasgow Coma Scale score (GCS) was 15/15. Pain score: mild.	
	From 23:29	EHRS	The patient was transferred to the waiting room to be seen by a doctor in the Urgent Treatment Centre.	
18/07/2021	00:00 – 00:33	EHRS	An intravenous cannula was inserted, and a blood sample taken for venous blood gas analysis: results included moderate hyponatraemia (low sodium) at 129 (normal 135-145) mmol/L, and raised lactate at 2.7 mmol/L.	Lactate is produced by most tissues in the body, particularly muscle. A raised blood lactate is commonly caused by impaired tissue perfusion and consequent impaired tissue oxygenation.
	00:38-00:41	Statement of Triage nurse EHRS	The Triage nurse recalls that while in the waiting room, the Navigation nurse reported the patient was demonstrating unusual behaviour – muttering incomprehensible words, and appearing to reach out for things that were not in front of her. Accordingly the patient was taken back to the Rapid Assessment & Treatment area, and then (due to an episode of vomiting) into a Majors cubicle. The patient was transferred to a Majors cubicle.	

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	Around 01:00	EHRS Statement of Emergency Department (ED) Dr1	<p>The patient was seen by an ED junior doctor (ED Dr1) at around 01:00. ED Dr1 found her slumped in a wheelchair but easily rousable. But the patient wasn't making sense, or able to give any information about what she had been doing that day, or how she was feeling. She kept repeating statements like 'I made a mistake', 'I need to wait'.</p> <p>ED Dr1 asked if she had been drinking and she said 'not enough'. When ED Dr1 asked about alcohol, she initially said 'yes' but couldn't clarify further, and later denied alcohol.</p> <p>ED Dr1 noted she could not smell alcohol, but the patient appeared to be behaving as though she were intoxicated. The patient also denied illicit drug use.</p> <p>ED Dr1 asked about phoning her mother: she said 'no', and then said she had been out with her mother that day.</p> <p>Later the patient was rolling around, complaining of feeling sick; she couldn't follow instructions and wouldn't open her eyes.</p> <p>ED Dr1 recorded she was unable to elicit any further history from the patient; and that the patient seemed to have deteriorated since she had first been seen in the Rapid Assessment & Treatment area.</p> <p>ED Dr1 called the patient's mother's mobile number once, and there was no reply.</p> <p>On further examination the patient's Glasgow Coma Scale score was 14/15 (consistent with confusion), and her pupils about 7mm in diameter and reactive. General examination was otherwise unremarkable.</p> <p>ED Dr1 noted the results of venous blood gas analysis.</p> <p>Her impression in summary was that the patient was suffering from confusion of uncertain cause and vomiting; she did not have a fever but had slightly deranged electrolytes.</p> <p>ED Dr1's plan was for blood tests, intravenous fluid rehydration, antiemetic</p>	<p><i>The patient was seen by a doctor around 2 hours after arrival. Once her Glasgow Coma Scale score had dropped to 14/15 (time not certain), she should have been seen without delay. However, delay to her being first assessed by an ED doctor did not evidently have a significant impact on her deterioration some 12 hours later. There were 6 doctors + 1 Emergency Nurse Practitioner on duty in the ED after midnight (with one doctor's shift unfilled because a locum could not be secured).</i></p> <p><i>On clinical assessment, ideally the patient's optic discs and fundi (at the back of the eye) should also have been examined: abnormalities may be seen in patients with raised intracranial pressure. In hindsight it seems likely this would not have been possible because of the patient's inability to co-operate due to the effect of</i></p>

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			treatment (for nausea and vomiting) and further review.	<p><i>encephalopathy (abnormal function of the brain).</i></p> <p><i>At this time the patient's symptoms could have been due to a wide range of possible causes, including the effect of drugs, or a primary problem in the brain such as encephalitis (which itself might be associated with hyponatraemia). With the benefit of hindsight the patient's symptoms were presumptively already due to raised intracranial pressure. Discounting hindsight so far as possible, the serum sodium was not so low that it would be expected to be causing symptomatic cerebral oedema. Moderate to severe symptomatic hyponatraemia would not be expected in association with a serum sodium of 129 mmol/L.</i></p> <p><i>It is thought many clinicians would also have prescribed intravenous fluid to rehydrate the patient who had</i></p>

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				<p><i>been vomiting, appeared dehydrated, and had a borderline raised heart rate and a raised blood lactate, in anticipation that the serum sodium would correct. And if significant extracellular fluid depletion was thought likely, fluid challenge with careful monitoring of the serum sodium would have been reasonable. Alternatively fluids might have been restricted pending the results of investigations - serum and urine osmolality and urine sodium - were available to inform treatment.</i></p> <p><i>The patient could have been referred to the Acute Medicine team for admission at this stage.</i></p>
	01:00 to 01:30	EHRS	Metoclopramide 10mg IV was given, and compound sodium lactate (Hartmann's) infusion 1 litre administered intravenously.	
	01:35	EHRS	Further blood samples were taken for laboratory blood tests.	<p><i>In hindsight investigations should have included serum and urine osmolality and urine sodium to help elucidate the cause of</i></p>

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				<i>hyponatraemia. It would also have been appropriate to check the patient's cortisol in case of impaired adrenal gland function (although the patient's features do not appear to have been typical for this diagnosis).</i>
	01:49	EHRS	National Early Warning Score (NEWS) was raised at 5, based on observations including a GCS of 11/15. Pupils were symmetrical and reacting briskly.	
	02:03	EHRS	Sodium 129 mmol/L on venous blood gas analysis.	<i>This serum sodium result would have been after a first litre of Hartmann's (compound sodium lactate) had been given.</i>
	02:16 (to 04:16)	EHRS	Compound sodium lactate infusion 1 litre administered intravenously.	<i>As the serum sodium had not improved, further intravenous fluid should have been withheld, pending the result of investigations to elucidate the cause of hyponatraemia, and the patient referred to the Acute Medicine team for inpatient care.</i>
	03:00	EHRS	Review by ED Dr1. Serum sodium 128/mmol/L [from sample taken at 01:35]. The patient was still very drowsy and had vomited more. It was also noted she seemed more alert however, and able to answer some of the doctor's questions directly: she said she had only had a small	

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			<p>amount of alcohol that day and had been 'out'. She still appeared dehydrated.</p> <p>The patient was referred to the Acute Medicine team [for admission]; creatinine kinase was added as an investigation; and it was planned that the venous blood gas analysis should be repeated after the second bag of intravenous fluid.</p>	<p><i>Creatinine kinase is a muscle enzyme, the level of which may be raised in the blood of patients with heat stroke. It appears the serum sodium was then not checked again until 12:56pm that day.</i></p>
	02:32-03:30	EHRS	Results of blood tests taken at 01:35 included: serum sodium 128 mmol/L, ethanol (alcohol) < 100mg/L (driving limit < 800 mg/L), creatinine kinase 54 (normal 26-140) IU/L, C-reactive protein (CRP) 0.6 (0-5) mg/L.	
	03.00	Statement of AcMed Dr1	<p>Phone referral from ED Dr1 to AcMed Dr1 (the night Duty Medical Registrar – a middle grade doctor).</p> <p>The key components of the referral were that the patient had presented to the Emergency Department with headache and dehydration. She had been cycling earlier that day and spent some time in the sun. She had vomited once in the ambulance, and this had settled following an antiemetic. She had vomited once more around 2am. The headache did not appear to be a prominent feature of the presentation to hospital, and she did not appear to be in pain. It was not a 'thunderclap' headache. There was concern regarding her behaviour which seemed erratic: she had initially appeared confused, but on review at 03:00 she appeared more alert. She was oriented to person, place, and time. Her pupils were equal and reactive to light but approximately 7mm [in diameter]. ED Dr1 reported that examination was otherwise unremarkable. She suspected intoxication but felt this warranted further observation and therefore referred to the medical team. AcMed Dr1 accepted the referral.</p>	

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	03:36	Entry of SN1 (Staff Nurse) in the patient's healthcare record (EHRS)	<p>Observations: pulse 103 bpm, BP 137/68, respiratory rate 19/min, SpO₂ 100%, temp 36.8°.</p> <p><i>'... Alert and oriented.</i></p> <p><i>GCS 15/15</i></p> <p><i>Assisted minimally to the toilet as patient is a little unsteady on feet at the moment.</i></p> <p><i>Normally independent and mobile.</i></p> <p><i>Passed urine freely ...'</i></p>	
	03.30 – 04.00	EHRS Statement of AcMed Dr1	<p>Assessment and admission note by AcMed Dr1.</p> <p>The patient was reviewed on the Same Day Emergency Care (SDEC) unit [a short stay area where Medical patients are routinely reviewed prior to admission to the Acute Medical Unit].</p> <p>While AcMed Dr1 was standing on the ward, the patient walked from her bed to the toilet which was located a few metres from her bed, and back. The nurse was standing near her as she walked, as she initially appeared unsteady on standing; but she subsequently walked without assistance. There was no gait abnormality and no obvious focal neurological deficit while walking.</p> <p>Prior to review in person, Ac Med Dr1 reviewed the patient's vital signs and noted: no fever since presentation to the Emergency Department, raised heart rate (99-103 beats per minute), normal blood pressure (137/68 mmHg), normal oxygen saturations (100%), normal respiratory rate (19 breaths a minute). AcMed Dr1 also reviewed the result of her blood tests: normal markers for infection, specifically a normal white cell count (WCC) and normal C-reactive Protein (CRP); a low sodium at 128 (normal 135-145) mmol/L, and a low phosphate at 0.8 mmol/L.</p> <p>The patient gave only one word answers to questions, including saying 'no' when asked if she had had alcohol or drugs. She repeatedly turned away from AcMed Dr1, and moved around the bed. When asked where she was, she replied 'in hospital'. The patient did not answer questions</p>	<p><i>The Acute Medicine team was fully staffed overnight on 17/18th July. The Acute Medicine night shift comprises the Duty Medical Registrar, 'Clerking Senior House Officer (SHO)', 'Tower Senior House Officer', and Foundation Year 1 doctor on the Acute Medical Unit. About 10 to 15 patients on average are admitted per night - generally by the Duty Medical Registrar and 'Clerking SHO', with some assistance from the 'Tower SHO' if required.</i></p>

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			<p>regarding events prior to admission. When asked if AcMed Dr1 could look at emergency contacts in her phone, she said 'no.'</p> <p>On physical examination the patient did not follow requests, such that it was difficult to complete a full neurological examination.</p> <p>From the bedside AcMed Dr1 was able to establish the following clinical findings:</p> <ul style="list-style-type: none"> - There was no evidence of fever while in the department. - The patient's speech was not slurred or dysarthric during the limited conversation they had. - Her gait appeared normal on walking to the bathroom after a moment of unsteadiness on standing. - Additionally, the patient had turned over several times in bed and pulled the sheets over her head on two occasions; there was no visible weakness in any of her limbs; her face appeared symmetrical. - The bedspace was brightly lit, and the patient was not avoiding looking at the light, which suggested no evidence of photophobia. - She did not appear to be in pain but did not answer questions about this. - She was not in respiratory distress, and she was not coughing. - She was not sweating excessively. - During this assessment, although limited, the patient did not answer any questions incorrectly and she knew where she was; this was better than on earlier assessment in the Emergency Department. - AcMed Dr1 was unable to perform a full neurological exam - specifically, he was unable to re-assess the patient's eyes. <p>AcMed Dr1 discussed the patient's care again with ED Dr1 and the Specialist Registrar in the Emergency Department at around 5am to get a full impression of what had happened in the ED.</p> <p>AcMed Dr1's impression was that the patient was acting unusually, but no longer seemed overtly confused. He noted the assessment that she was dehydrated</p>	<p><i>The possible causes of abnormal behaviour of acute onset potentially</i></p>

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			<p>on admission after being in the sun and that she had hyponatraemia (low sodium) on her blood test. The normal WCC and CRP and absence of fever suggested no evidence of infection as a cause. AcMed Dr1's impression was that unusual behaviour with dilated pupils (mydriasis), without any evidence of infection or focal neurological deficit, was possibly explained by intoxication with drugs or alcohol.</p> <p>AcMedDr1 therefore decided to admit the patient to the Acute Medical Unit for further observation and assessment. He stated that further information was needed, in the form of collateral history from the patient's mother if her condition did not improve, as this had not been possible when tried earlier in the night. He prescribed a further 1 litre of IV fluid due to the presentation with dehydration.</p> <p>AcMed Dr1 noted from the nursing notes that on transfer to AMU, the nursing assessment demonstrated a Glasgow Coma Scale score of 15. It was documented at this time that the patient was not showing any sign of pain. Her behaviour was stated to still be erratic when answering questions.</p>	<p><i>include almost any medical condition, and psychiatric conditions as well. Drug and / or alcohol intoxication is a common cause in young people, but should not be assumed without considering alternative treatable causes (the blood ethanol was not raised). Raised (and low) blood glucose had been excluded. Hyponatraemia in a young person presenting acutely (as opposed to chronic hyponatraemia in an older person) is uncommon; although the serum sodium was not so low that it would be expected to be causing symptomatic cerebral oedema, it would have been appropriate to have initiated investigations into the cause of hyponatraemia (as above). The patient's clinical features suggested the need for further investigation of her headache, which in the context of acute presentation to the Emergency Department, would generally be</i></p>

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				<p><i>by emergency CT head scan (NICE headache guidance). In retrospect the patient had clinical features consistent with raised intracranial pressure at this time. It is not certain how a CT scan, had it been performed at this time, would have been reported: the first scan performed later that day was initially reported as showing no acute intracranial finding, while neurologists considered there was evidence of generalised brain swelling. Central nervous system infection is a serious and treatable cause of abnormal behaviour with headache and vomiting; but given the patient did not have a fever, inflammatory markers were normal, and headache was not a prominent symptom at this time, it is considered reasonable not to have performed a lumbar puncture (LP) after CT, or started antimicrobial</i></p>

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				<p><i>treatment at this time.</i></p> <p><i>Carbon monoxide poisoning had also been excluded on the initial venous blood gas analysis. And there was no evidence of seizure(s).</i></p> <p><i>Admission for observation and, in the event of no improvement, further specialist investigation and opinion was appropriate.</i></p>
	04:28 (to 10:28)	EHRS	Compound sodium lactate infusion 1 litre administered intravenously.	<p><i>Unfortunately there was no documented further monitoring of the patient's serum sodium for almost 11 hours after the venous blood gas analysis at 02:03.</i></p> <p><i>Further compound sodium lactate intravenous fluid should not have been given at this time, pending the result of investigations to elucidate the cause of hyponatraemia. If these had shown urine osmolality \geq 100 mOsm/kg and Na > 30 mmol/L, administration of hypertonic saline in a monitored environment could have been considered, on the grounds that symptoms might have been due to</i></p>

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				<i>acute hyponatraemia. The risk of the deterioration in the serum sodium which occurred subsequently could have been mitigated by investigations to elucidate the cause of hyponatraemia, and closer monitoring of the serum sodium over the hours following admission.</i>
	04:49	EHR	Transferred from SDEC to the Acute Medical Unit (AMU).	
	04:56	EHR	GCS 15, NEWS 1 Pupils symmetrical and reacting briskly.	
	05.00 – 08:30	EHR Statements of NIC1 (Nurse in Charge) and SN2 (Staff Nurse) on AMU	Observations by SN2 looking after the patient between 05:00 - 08.30 included erratic behaviour especially when questions asked - for example nodding head, putting both hands over her face and answering 'yes' loudly. Not cooperating with assistance. Conscious of environment, knew her name and date of birth, no slurred speech or confusion; but noted that she covered her face when asked questions. GCS 15. No sign of pain, no vomiting or reported nausea. Afebrile. Mild tachycardia, pulse rate between 90 - 110 bpm. She had denied any pains or dizziness. Full limb power noted on both sides 5/5; pupils equal 3/3 and both reactive to light. NEWS 0-1.	
	05:40	Entry of SN2 in the healthcare record (EHR)	<i>'... Conscious of environment, knows her name and DOB, there were no signs of slurred speech or confusions., but noted that she constantly covers face when asks questions. GCS is 15/15, Ventilating well on air, shows no signs of pains. CVS Stable, afebrile, nil vomiting, VIP:0 mild tachycardiac NEWS Scoring: 0-1 Full limbs</i>	

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			<i>powers noted....'.</i>	
	Around 08:40	Statement of SN3 (Staff Nurse looking after the patient on the morning of 18/07/2021)	SN3 observed the patient was alert and responsive, but restless, turning from side to side as if trying to get comfortable in the bed. When SN3 introduced herself, she responded appropriately, answering 'hello'; she then pulled the sheets over herself and turned away in the bed. This appeared similar to the behaviour reported by the night team.	
	09:00	EHR	GCS 14, NEWS 2 Pupils symmetrical and reacting briskly.	<i>Absence of documented formal neurological observations over the next 6 hours is an omission – apparently due to the fact an agency nurse did not have a log in to access the patient's electronic healthcare record to document her observations.</i>
	09:41	EHR	SN4 (Staff Nurse 4) tried to phone the patient's mother without success. The patient was unable to cooperate with checking the phone number.	
	09:48	EHR	Intravenous paracetamol was given for headache.	
	10.00	Statement NIC2 (Nurse in Charge) EHR	Phone call from the patient's mother to NIC2, asking for an update as she had not heard anything; said she had one missed call on her phone. NIC2 updated the patient's mother about her daughter's admission and her behaviour. The patient's mother stated this was very out of character. Collateral history of events preceding the admission from the patient's mother was that the patient had gone for a 40 minute bike ride in the sun and then come back and had an ice cream in the garden along with a friend, her mother and her mother's	<i>The fact patients are brought into hospital unaccompanied, as part of infection prevention and control during the pandemic, may limit the collateral information immediately available.</i>

Date	Time /	Source	Events	Comments / concerns/opinion
			<p>friend. She then went to lie on the sofa as she had a headache. She then took herself upstairs to lie down on the bed and had to call her mother by the landline as she really didn't feel well. When her mother got to her, she was vomiting and continued to do so. The patient's mother called 111 who directed her to call an ambulance. When asked if there was a possibility her daughter had taken any drugs or anything that could have caused her to become unwell like this, the patient's mother said not; and it seemed she would think this to be very out of character.</p> <p>NIC2 asked if the patient's mother had spoken to her daughter since she had been admitted, and she said no and that she had tried to ring her mobile. NIC2 took the phone to the patient and gave her the phone. NIC2 could see she was disengaged with the conversation, saying only 'yes' and 'mmm'.</p> <p>NIC2 was concerned the patient was very drowsy and not following commands entirely, and the history given by the patient's mother did not fit with what nursing staff had been told. NIC2 went straight to the medical team and interrupted the ward round to request that the patient be reviewed, and went on to give them the collateral history the patient's mother had provided.</p>	
	10.26	EHRS Statements of NIC2, AcMed Cons (Consultant Physician), Ac Med Drs 2 and 3 (junior doctors – Internal Medicine Trainee year 2 and Foundation Year 1 doctor respectively)	<p>Post-take ward round on AMU – present on ward round NIC2, AcMed Cons, AcMed Dr2, AcMed Dr3</p> <p>Temperature 37.8°C. Lying in bed, sheet over her face. Reports that she thinks she has heat stroke. States concern that she was missing her ballroom dance class.</p> <p>'... Temp: 37.8 °C (100 °F). SpO2: 100%. Pupils equal but small, sluggish, rolling head around in bed, keeping eyes closed. Investigations: Hb 126, WCC 8.1, CRP 0.6, Na 128, K 3.8, Cr 57, Impression: encephalitis: acute change in behaviour with fever. Doesn't fit with sunstroke (no</p>	<p>Antimicrobial treatment started after the Post-take ward round and CT head scan requested. It was appropriate to start antimicrobials at this stage as there had been no clinical improvement and temperature was 37.8°C. The consultant's</p>

Date	Time /	Source	Events	Comments / concerns/opinion
			<p><i>signs of sun burn, only in sun for 40 mins) ...'</i></p> <p>NIC2 recalls that when the consultant spoke with the patient, she was able to answer his questions quite lucidly and even talked about how she needed to cancel her plans for the day (ballroom dancing, which her mother later confirmed was correct); but when the consultant asked the patient if she could open her eyes, she replied 'yes' but then didn't do so, even when asked again. NIC2 recalls the patient was quite fidgety, not really engaging with the conversation, but that she did answer questions when directly prompted.</p> <p>AcMed Cons recalls '<i>EHRs review gave a minimal hx [history], collateral history was sought but added little save that the behaviour was most odd, out of keeping. The young woman in front of me appeared cooperative and non-cooperative in a non-combative style at the same time. She answered some question seemingly lucidly, other remained seemingly unheard and examination, or the cooperation with examination was difficult. She pulled the bed sheets over her head ...I noted- unlike the mydriasis observed earlier- rather small pupils, 2-3 mm sluggish in response to light.</i></p> <p><i>My assumption was an intracerebral process, possibly toxin related, possibly inflammatory but no alcohol or 'conventional' recreational drug (she did not look like it at all) and though it did not strike me as an encephalitic process either- too general, not localisable to an area of the brain- I covered for bacterial and viral (herpes) insult. In addition, we discussed CT head, LP and neuro [Neurology] opinion. Bloods were unhelpful, ABG not acidotic.'</i></p>	<p><i>opinion at the time was that this was more likely to be toxin or inflammation related, rather than infective; but important to cover for infection.</i></p> <p><i>There is no documented review of the patient's hyponatraemia at this time, although the biochemistry tests undertaken at 12:56 may reflect a plan to repeat these.</i></p> <p><i>Medical staffing on the 56 bedded Acute Medical Unit during the day at the weekend comprises a Consultant, Enhanced Care Unit Specialist Registrar and four junior doctors (Foundation Year 1 to Internal Medicine Trainee year 2). That day there was only the Consultant and three junior doctors. The team being two doctors short did not affect the patient's care, as her care was prioritised by junior doctors after the post-take ward round, although it did lead to delays in the care of other patients. (The</i></p>

Date	Time /	Source	Events	Comments / concerns/opinion
				<p>junior medical staffing on the ward is separate from the Duty Medical Registrar and junior doctors who are admitting new patients). Nurse staffing on the unit was also one nurse short.</p>
	11.00	Statements of NIC2 and SN3	<p>A urinary catheter was inserted – the patient had not passed urine and there was 400ml in her bladder.</p> <p>Noted that the patient’s behaviour remained odd. Answering with short answers only, and pulling sheets over her head.</p>	
	11:06	Email from Imaging	Emergency CT head scan requested.	
	11:38-11:52	EHRS	Acyclovir 600 mg IV (antiviral) followed by ceftriaxone 2g IV (antibiotic) administered.	
	Approximately 12.30 onwards	EHRS Statements of AcMed Dr2 and Neuro SpR (the Neurology Specialist Registrar on call)	<p>AcMed Dr2 discussed the patient’s care with the Neuro SpR. She agreed with the likely diagnosis and plan made on the post-take ward round, adding that the Acute Medicine team should arrange a non-urgent magnetic resonance imaging (MRI) head scan in the coming days, and attempt to get an electroencephalogram (EEG) that same day; the Neuro SpR recommended empirical treatment with ceftriaxone and acyclovir (antimicrobial treatment).</p> <p>The request for an EEG was subsequently discussed with the neurophysiologist on call at the National Hospital for Neurology and Neurosurgery (NHNN), who advised she would discuss with her consultant the urgency of the investigation. She phoned back 30 minutes later advising that this test was not currently indicated out of hours, and would be done on Monday.</p>	<p>There is no clear reason to suppose the unavailability of an EEG on the Sunday had an impact on the patient’s outcome. It seems likely that even if the investigation had been available, the patient would have</p>

Date	Time /	Source	Events	Comments / concerns/opinion
				<i>deteriorated before it would have been undertaken.</i>
	12:55-12:56	EHRS	Urine sample for drugs of abuse screen, and blood sample for repeat renal profile, sent.	
	Approximately 13:14 – 13:40	EHRS	A first CT head scan was performed, and subsequently reported by a Consultant Radiologist. The Radiologist’s opinion was that there was no acute intracranial finding.	<i>There is a spectrum of opinion about the interpretation of this CT scan. A Consultant Neurologist subsequently considered the scan showed generalised swelling of the patient’s brain. To inform this investigation, a second Consultant Radiologist has reviewed the scan and the original Radiologist’s report: ‘In hindsight there is very little csf [cerebrospinal fluid] space BUT grey white matter differentiation is preserved (classically lost in cerebral oedema) and a relative lack of CSF space is not unusual in a young patient. The clinical history at the time of the initial report was “odd behaviour”. Given the vague presentation and very subtle/subjective abnormality I don’t</i>

Date	Time /	Source	Events	Comments / concerns/opinion
				<p>think the initial report was significantly in error... Changes on the initial CT were very subtle and of uncertain significance.'</p> <p><i>A further Consultant Radiologist has advised 'Given that the findings were subtle on the first scan and minimal time between scans I do not feel that there has been a care delivery problem here. Our acute CT scans are reported by general radiologists (not neuro radiologists) ...'</i></p>
	14.00	Statements NIC2	<p>Afternoon board round – NIC2 and AcMed Cons. Update was that CT had been reported as normal and LP was planned.</p>	
	Approximately 14:00-14.15 onwards	EHRS Statements of AcMed Drs 2 and 3 and Neuro SpR	<p>Following report of the first CT scan, a lumbar puncture (LP) was attempted by AcMed Dr3, assisted by AcMed Dr2. LP attempted with sterile technique. First pass of LP needle unsuccessful. The patient was very agitated and reported headache, so the procedure was abandoned.</p> <p>Neuro SpR and nurse from PERRT (Patient Emergency Response and Resuscitation Team) arrived to review the patient.</p> <p>The Neuro SpR checked the healthcare record and confirmed the CT scan had been reported as normal.</p>	<p><i>Once the CT scan had been reported as normal, it was rational to undertake the lumbar puncture to investigate for possible infection. Ideally the optic fundi would have been examined also for any sign of raised intracranial pressure before the LP was</i></p>

Date	Time /	Source	Events	Comments / concerns/opinion
				<i>attempted; but as before (and subsequently), it seems likely the patient would not have been able to co-operate with this examination.</i>
	14.30	EHRS	Patient referred to PERRT; note written at 14.48 by PERRT documenting phone conversation.	<i>The Patient Emergency Response and Resuscitation Team (PERRT) is called to review patients and support their care, when a patient is considered to be at risk of deterioration (in line with the Trust's Recording Vital Sign Observations and Reporting Abnormalities policy and procedure).</i>
	Approximately 14.30	Statement of Neuro SpR	The Neuro SpR returned to review the patient. The patient was drowsy but easily rousable, opening her eyes to voice. She was able to respond to specific questions about her clinical history, primarily with yes/no answers; she was able to say that she was in hospital and that she had been for a bicycle ride the previous day. But significant prompting and encouragement were required. She did not tolerate attempted ophthalmoscopy (examination of the optic fundi) due to behavioural resistance rather than photophobia. There was no neck stiffness or rash; she was spontaneously moving her limbs with reasonable strength though unable to cooperate with formal neurological testing, and reflexes were normal. The patient had not had a fever throughout her admission (maximum temperature 37.8°). The Neuro SpR's assessment was that the patient was encephalopathic	

Date	Time /	Source	Events	Comments / concerns/opinion
			[suffering from a condition affecting her brain] with no clinical evidence of a seizure and no lateralising sign [focal neurological deficit]; and that her condition was essentially as described throughout her admission. It was agreed that further investigations, as had been discussed, were indicated, to try to establish a cause and guide treatment. On review of the patient's CT head scan, the Neuro SpR wondered whether there was generalised [brain] oedema despite the normal report.	
	14:36		Result of blood test (sent 12:56) included serum sodium 123 (135-145) mmol/L and potassium 3.3 (3.5-5.1) mmol/L.	<i>The patient was now biochemically profoundly hyponatraemic. The Trust's endocrinologist's opinion is that once the serum sodium had dropped to 123 mmol/L, treatment should have been with hypertonic saline along with fluid restriction to 500mL, on the grounds that symptoms were consistent with, even though not specific for, hyponatraemia. Referral to a High Dependency Unit for a monitored environment would also have been appropriate.</i>
	Approximately 15:10	Statement of Neuro SpR	The Neuro SpR discussed the patient's [original] CT head scan with the Neuroradiology Registrar at NHNN. He agreed there was generalised cerebral oedema, and was not certain whether or not it was safe to proceed with an LP.	
	Approximately 15:15	Statement of Neuro SpR	The Neuro SpR discussed the patient's care with the Consultant Neurologist on	

Date	Time /	Source	Events	Comments / concerns/opinion
	onwards		<p>call. It was agreed there was generalised swelling of the patient's brain [on the original CT scan] and that accordingly lumbar puncture should not be performed due to the risk of cerebral herniation. The cause of the patient's condition was not clear, but the appropriate investigations were in process.</p> <p>Immediately following the phone call, the Neuro SpR phoned the medical team; and was told the patient had suffered a respiratory arrest, and was being transferred to the CT scanner <i>en route</i> to the Intensive Care Unit.</p>	
	15.12	EHRS Statements of NIC2 and SN3	<p>IV morphine 2.5mg and antiemetic (ondansetron) given.</p> <p>Controlled drug and patient check done by NIC2 and SN3. Morphine administered by AcMed Dr3.</p> <p>SN3 was reluctant to give oral pain relief medication because the patient's swallow had not been assessed and her behaviour was erratic.</p>	<i>Important to give pain relief medication at this stage, as the patient reported headache. 2.5mg morphine is a small dose, and it was reasonable to give this without additional monitoring.</i>
	15:12	EHRS	Potassium chloride 40mmol in sodium chloride 0.9% 1,000 mL intravenous infusion started (to run over 6 hours).	<i>It is assumed this prescription may have been prompted by the mildly low serum potassium on the patient's biochemistry (from 12:56). The response should have been as above in response to the patient's deteriorating hyponatraemia in the context of symptoms consistent with, if not specific for, the effect of acute hyponataemia.</i>
	15.25	EHRS Statements of	Second attempt at LP, by AcMed Dr2 assisted by AcMed Dr3 and Student Nurse.	

Date	Time /	Source	Events	Comments / concerns/opinion
			21 st July 2021.	

Section 2: Change Analysis

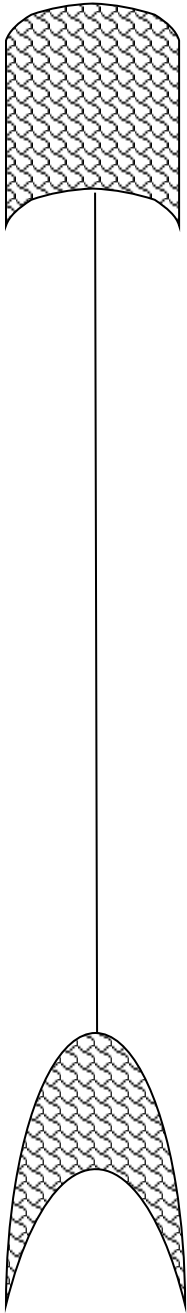
Please include relevant Policies and procedures, guidance to identify care and service delivery problems.

Normal / Accepted Procedure (as defined by Trust policies and procedures, national guidance (e.g. NICE, NPSA))	Actual Procedure at time of Incident (What happened)	Was there a change (Y/N)	Did the change contribute to the incident? (Y/N)	If yes, describe the CDP/SDP that contributed to the incident For each CDP / SDP undertake a fishbone analysis
<p>A differential diagnosis for the patient's hyponatraemia should have been considered, appropriate investigations undertaken (serum and urine osmolality and urine sodium), the response of the serum sodium in response to rehydration monitored, and action taken when the patient's serum sodium fell to 123 mmol/L.</p> <p>(See Spasovski G, Vanholder R, Allolio B <i>et al.</i> Clinical Practice Guideline on diagnosis and treatment of hyponatraemia. <i>European Journal of Endocrinology</i> 2014;170(3):G1-G47)</p>	<p>The patient was given 3 litres of Hartmann's solution (compound sodium lactate) without the relevant investigations having been performed; serum sodium was checked after the first litre, but then after almost 11 hours; further sodium chloride 0.9% was prescribed after the serum sodium had fallen further, on the afternoon of 18th July.</p>	Y	<p>It is not certain to what extent the delay in re-checking the patient's serum sodium, and / or the further fall in the patient's serum sodium following admission, may have contributed to her abrupt deterioration on the afternoon of 18/07/2021.</p>	<p>CDP 1: Lack of monitoring of the patient's serum sodium, administration of three litres of intravenous fluid without relevant investigations having been performed, and the response to profound hyponatraemia on the afternoon of 18 July 2021</p>
<p>The patient's clinical features suggested the need for further investigation of her headache, which in the context of acute presentation to the Emergency Department, would generally be by emergency CT head scan (NICE Headache guidance referenced above).</p>	<p>Emergency CT scan performed around 12 hours after arrival in the Emergency Department</p>	Y	<p>Not if a hypothetical earlier scan had been reported as normal - as the first scan later that day was.</p>	<p>CDP 2: An emergency CT head scan not arranged on admission as it should have been.</p>

Section 3 – ROOT CAUSE ANALYSIS – overleaf for fishbone diagram analysis
<i>Care and Service Delivery problems identified via the use of Change Analysis tool (see section 2)</i>
CDP 1: Lack of monitoring of the patient’s serum sodium, administration of three litres of intravenous fluid without relevant investigations having been performed, and the response to profound hyponatraemia on the afternoon of 18 July 2021 CDP 2: An emergency CT head scan not arranged on admission as it should have been.
Root Causes (please see fishbone diagram) These are the contributory factors which if addressed would prevent the incident from reoccurring.
Presumptive unawareness of relevant guidance; possible availability bias.
Lessons Learned - learning which did not contribute to the incident however could be improved
<ol style="list-style-type: none"> 1. Importance of trying to contact family for background information to inform the care of patients unable to give a coherent account themselves (particularly in a time of pandemic). 2. Requirement for documented regular neurological observations for a patient with altered mental state.

Fishbone analysis

One fishbone to be completed for each CDP or SDP identified via the change analysis

CDP/SDP:	<p>CDP 1: Lack of monitoring of the patient’s serum sodium, administration of three litres of intravenous fluid without relevant investigations having been performed, and the response to profound hyponatraemia when this became evident on the afternoon of 18 July 2021</p> <p>CDP 2: An emergency CT head scan not arranged on admission as it should have been.</p>	
	Factors	Issues identified in this case
	Patient	<p>The fact the patient was not overtly seriously ill at the time of admission may have contributed to clinicians not having initiated further investigations on the night of her admission.</p> <p>The patient’s initial serum sodium was only just in the moderate (rather than mild) range; and hyponatraemia in a young person presenting acutely, not associated with simple dehydration, is uncommon.</p> <p>Presentation at night made it harder to contact the patient’s mother for background information - which might otherwise have prompted earlier investigation for less common possibilities.</p>
	Staff	<p>Cognitive bias may have contributed to clinicians not having initiated further investigations at the time of admission – for example availability bias (drugs and alcohol are a common cause of abnormal behaviour in young people); diagnostic momentum, satisficing and confirmation bias, and premature diagnostic closure (in other words, accepting an initial diagnostic possibility without sufficiently exploring alternative possibilities).</p>
	Task	N/A
	Communication	<p>Clinicians made an attempt to contact the patient’s mother in the early hours of the morning; but when this was unsuccessful, deferred further attempts pending the outcome of observation to see if the patient showed signs of improvement.</p>
	Equipment	N/A
	Work Environment	<p>Junior hospital doctors are often working under greater pressure, with less support immediately available, overnight than during the day.</p>
	Organisational	<p>The threshold at which ED doctors feel they can refer a patient for admission may be set too high in certain cases.</p> <p>The Trust does not currently have a readily accessible guideline on hyponatraemia in its electronic Medical Emergency Document Library (MEDL).</p> <p>There is no formal out of hours on call endocrinology advice (although the switchboard has phone numbers and endocrinologists may be called about an unwell endocrine patient).</p>
	Education and Training	<p>There may have been a lack of awareness of the range of potentially life-threatening problems which can cause a patient to present with headache, vomiting and abnormal behaviour, and of relevant guidelines.</p>
	Team	N/A

SECTION 4-OVERVIEW OF FINDINGS

The patient, a previously healthy young woman, suffered an unanticipated respiratory arrest on the Acute Medical Unit, and despite prompt resuscitation sadly died a few days later from a severe brain injury associated with brain swelling, raised intracranial pressure and herniation of the cerebellar tonsils and / or brainstem.

It is understood that no primary cause in the brain for the patient's catastrophic brain swelling was found at post-mortem examination, although the possibility of viral infection had been investigated by clinicians and the possibility of this had been raised also in the report of an MR scan. It is understood from a Toxicology Report that no significant drug was identified on a screen of an ante-mortem blood sample. As noted above, the patient was hyponatraemic (had a low serum sodium); and it is recognised that acute hyponatraemia can cause encephalopathy with symptoms including headache, confusion, nausea and vomiting, depressed level of consciousness, seizures, coma and respiratory arrest – related to cerebral oedema. However, it is not clear that hyponatraemia was the primary process (rather than a consequence of an underlying disease); and clinicians of several specialties have volunteered that the patient's tragic rapid deterioration and death are unusual and exceptional. It is speculated that although the patient's symptoms were of relatively abrupt onset, the underlying process causing those symptoms may have been going on for some time, and it is likely she was already seriously ill when she was brought to hospital on the evening of 17th July 2021.

The serious incident investigation, with the benefit of hindsight, has identified learning from some shortcomings in the patient's care; but whether her tragic death could have been prevented is not clear. This overview summarises key themes; and attempts to answer the patient's mother's understandable concerns and questions about her daughter's care during the first 18 hours or so of her admission to UCLH.

Hyponatraemia

Hyponatraemia in a young patient presenting with an acute illness is less common than chronic hyponatraemia in an older patient; and the cause is not always initially clear. The clinical impact of hyponatraemia is not simply a consequence of the biochemical serum sodium, but is also determined by the rate of development of hyponatraemia (acute hyponatraemia developing over a period of less than 48 hours is considered to carry a greater risk of brain swelling because of less time for adaptation), the capacity of the central nervous system to adapt to the 'osmolar stress', and comorbidities (Hyponatraemia guidance 1 and 2, referenced above).

The cause of the patient's hyponatraemia is not certain. Although she had been out on a hot day and was known to have been a keen cyclist, there is no history of significant exertion or of the patient having drunk large volumes of water (or other hypotonic fluid); but there may have been high sodium losses in sweat on a hot day. Significant vomiting can lead to dehydration and a degree of hyponatraemia which may correct with rehydration by intravenous fluid (0.9% saline or compound sodium lactate solution). Hyponatraemia can also occur secondary to a problem affecting the brain – including infection (such as encephalitis) and cerebral oedema (swelling) – in which antidiuretic hormone is secreted 'inappropriately', causing the kidneys not to excrete water, resulting in water retention and so a drop in the serum sodium concentration; in this eventuality intravenous fluid should not be given, as it would be expected to worsen hyponatraemia and potentially brain swelling. Instead fluid should be restricted; and in the event of symptoms due to hyponatraemia, treatment with hypertonic (concentrated) saline considered, to elevate the serum sodium to prevent cerebral oedema. Investigations of serum and urine osmolality and urine sodium, in conjunction with clinical assessment, can help elucidate the cause of hyponatraemia and enable treatment to be tailored accordingly.

Notwithstanding the uncertainty about the cause of the patient's hyponatraemia and its significance for her progressive cerebral oedema, it is considered this feature of her illness should have been investigated and treated in its own right. The initial serum sodium of 129 mmol/L was not so low that it would be expected to be causing symptomatic cerebral oedema; and it is thought many clinicians treating a young woman with an initial serum sodium of 129 and a history of significant vomiting, dehydration, a borderline raised heart rate and a raised lactate, would start intravenous fluid to rehydrate the patient, anticipating that with restoration of extracellular fluid, the serum sodium would correct – with careful monitoring of the effect of treatment on the serum sodium and the result of further investigations. In the event after three litres of fluid the patient became

profoundly hyponatraemic, with the associated risk of brain swelling and ‘coning’ (brain stem herniation). More frequent serial serum sodium estimations, together with the result of urine osmolality and sodium, could have alerted clinicians earlier that the serum sodium was falling rather than correcting, and that it might be necessary to consider an alternative cause for the hyponatraemia and different treatment. The fact the patient’s symptoms of headache, vomiting and confusion were consistent with (even though not specific for) the effect of hyponatraemia, or an underlying intracranial problem which might be associated with hyponatraemia, could also have alerted clinicians to the possibility the patient would need to be treated with fluid restriction and / or hypertonic saline. The Trust’s endocrinologist’s opinion is that once the serum sodium had fallen to 123 mmol/L, treatment should have been with hypertonic saline along with fluid restriction to 500mL, given that symptoms were consistent with hyponatraemia.

However, there are a range of views on the significance of the patient’s hyponatraemia for her rapidly progressive cerebral oedema, and whether or not treatment with hypertonic saline could have made a difference to the tragic outcome. In one view even a serum sodium of 123 mmol/L is considered not low enough to be expected to be associated with respiratory arrest; and several clinicians - with decades of experience between them - cannot recall a similar case of fatal cerebral oedema due to a serum sodium of the levels recorded. Alternatively, and with the benefit of hindsight, it is speculated that in the absence of evidence of a primary disease in the brain causing cerebral oedema, it might be that hyponatraemia (due initially to sodium loss in sweat on a hot day with hypotonic fluid replacement, and subsequently ‘inappropriate’ release of ADH and other neurohumeral changes secondary to cerebral oedema) could have caused progressive cerebral oedema in a young woman with a low body mass. (Young people have less space around the brain in the skull, compared to older people in whom there has been some brain atrophy; and it is suggested smaller body size with less muscle might lead to more rapid development of hyponatraemia). However, this is speculative because information is necessarily incomplete. Similarly, while administration of three litres of fluid is likely to have caused a further drop in the patient’s serum sodium, it is unknown whether fluid restriction and / or administration of hypertonic saline would have altered the course of the patient’s illness. The situation was unusual and progressed rapidly.

The role of earlier investigation and treatment for possible intracranial bleeding or infection

The Duty Medical Registrar included in his impression ‘*Suspicious for drug use +/- alcohol*’. The possibility the patient’s symptoms might be attributable to intoxication was not unreasonable, given the relative frequency of this as a cause of young patients presenting to the Emergency Department with altered mental state on a Saturday evening – although later the patient’s mother’s report that this would have been wholly out of character made this unlikely. This possibility should not have precluded consideration from the outset of a wider differential diagnosis, including the possibility of a significant intracranial cause for the patient’s symptoms.

In particular, the patient’s clinical features at the time of admission (headache reported to have been of sudden onset, a new onset headache with vomiting without obvious other cause, and associated abnormal behaviour) suggested the need for further investigation of her headache, which in the context of acute presentation to the Emergency Department would generally be by emergency CT head scan - to exclude an intracranial bleed, mass or brain swelling (NICE headache guidance referenced above). It is not known how a CT scan performed at this time would have been reported; the first scan later that day was reported as showing no acute intracranial finding (see also paragraph below).

There is a spectrum of views about the patient’s first CT scan: the Consultant Radiologist reported no acute intracranial finding, and subsequent Radiology review concluded changes on the initial CT were subtle and of uncertain significance; whereas a Consultant Neurologist reported features of generalised brain swelling. It is noted that emergency CT brain scans are routinely reported by a general radiologist, in this case a Consultant Radiologist. The Consultant Neurologist has pointed out that the finding of cerebral oedema in the context of hyponatraemia would have increased focus on a potential cerebral cause for the patient’s low serum sodium, and would be likely to have led to fluid restriction and treatment to reduce intracranial pressure (possibly including transfer to an Intensive Care Unit).

Conversely, once a report of no acute intracranial finding on CT had been received, a lumbar puncture to investigate for possible central nervous system infection (and the potential infecting micro-organism) became a

rational priority. It is considered reasonable for the FY1 doctor to have attempted the LP: he had previous experience of having performed the procedure, and was supervised by a more experienced doctor who had been 'signed off' to perform lumbar puncture independently. Lumbar puncture is undertaken under local anaesthesia, and should not have caused any significant pain.

In the event, no cerebrospinal fluid was obtained on attempted lumbar puncture, and the junior doctors have reported they did not get a 'flashback' of any kind [when aspirating to confirm the position of the needle tip before injecting local anaesthetic]. So it seems unlikely (though not impossible) that the patient's deterioration was due to the attempted lumbar puncture. Respiratory arrest may have been due to progression of the patient's underlying disease process. Once the patient had suffered a respiratory arrest, it was appropriate to abandon attempts at lumbar puncture, and to repeat the CT scan after the patient had been stabilised.

It was not unreasonable for the patient to have been given a low dose of intravenous morphine for headache. Morphine is a respiratory depressant; but the dose given would be considered small, even for a patient who had not previously been exposed to morphine, and was appropriate pain relief for the patient's headache.

Antimicrobial treatment is considered not to have been indicated at the time of admission. In the absence of any infecting micro-organism having been identified so far as is known, and the absence of evidence of central nervous system infection on post-mortem examination, it seems unlikely the patient's outcome would have been altered by administration of antimicrobial treatment up to 12 hours earlier.

Role of fundoscopy and the basis for clinicians having concluded the patient was not photophobic

Raised intracranial pressure is associated with changes in the appearance of the optic fundi (at the back of the eye, visualised with an ophthalmoscope), although there may be a time lag between the acute onset of raised intracranial pressure and changes seen in the optic fundi. That said, it is considered that in hospital with access to emergency CT brain scanning, it is not clear visualisation of the optic fundi would have added additional information beyond that available on an emergency CT scan.

The Duty Medical Registrar recalled the patient's bed space was brightly lit and that the patient was not avoiding looking at the light, which suggested to him no evidence of photophobia. Later that day, the Neurology SpR found that the patient did not tolerate ophthalmoscopy (examination of the optic fundi) due to behavioural resistance rather than photophobia. This is interpreted as meaning the patient was unable to cooperate with examination due to the encephalopathy (abnormal functioning of the brain) she was suffering from.

Role of an earlier drug screen

It is understandable to anticipate that an earlier screen for drugs could have ruled out the possibility of drug ingestion as a potential cause of the patient's symptoms in the hours following admission, and so directed clinicians' attention to other possibilities earlier. In practice there are reasons why a drug screen is unlikely to have been helpful initially – although that does not detract from the expectation that clinicians would consider a sufficiently wide differential diagnosis early in the patient's care.

Neither a negative or positive result of a urine drug screen is definitive for diagnosis and treatment. The drug screens available as an emergency investigate for a limited range of 'classic' recreational drugs and would not detect novel psychoactive substances, so a negative result could be falsely reassuring. Conversely a positive result may be an incidental finding and alternative possible serious causes for a patient's symptoms still need to be considered. For these reasons toxicology screens are not routinely undertaken in the Emergency Department; and in practice treatment overnight has to be directed by clinical features (of poisoning or other conditions) and by the result of other investigations.

Adequacy of attempts to obtain 'collateral history' from the patient's mother; and restrictions on visiting

Further attempts should have been made to contact the patient's mother for background information on the night of 17/18th July - although in the absence of this information, clinicians should still have considered the range of potential clinical problems which might have been causing the patient's symptoms. The Duty Medical Registrar that night noted in his statement that ED staff had previously attempted to contact the patient's mother, and included in his treatment plan that further attempts should be made if the patient did not improve.

The investigators acknowledge the distress which may be caused to patients and their family as a result of restrictions on visiting, required as part of infection prevention and control measures during the pandemic to mitigate the risk of spreading infection and to protect patients – distress compounded in this case by the patient’s mother’s difficulty in getting through to staff on the Acute Medical Unit by phone. On admission the patient did not appear critically ill, and clinicians may have initially thought she might be discharged home shortly. But when medical staff phoned the patient’s mother on the afternoon of 18th July (after the patient had suffered a respiratory arrest), the patient’s mother should have been asked to come into the hospital for a face-to-face conversation.

The Trust apologises to the patient’s mother that she had such difficulty getting through to the ward at what would understandably have been an anxious time. The patient’s mother was given the phone number for the Nurse in Charge’s mobile which is exceptionally busy. In July last year there was no admin support on the ward at weekends, and calls put through to the phone in the Nurse in Charge’s office might be unanswered when nursing staff were out on the ward.

The Nurse in Charge on the Acute Medical Unit during the day on 18th July recalls she asked one of the junior doctors to phone the patient’s mother with an update following the ward round, as the patient’s mother was understandably worried; and phoned the patient’s mother herself to explain the doctors had reviewed her daughter and the plan which had been put in place. She recalls she explained the patient had been able to have a conversation with the consultant (and discussed the ballroom dancing); but that the patient was still not presenting quite right and gave the example of her not opening her eyes. The Trust also apologises if a promised phone call from the medical team was not made following the ward round that morning – an omission which is likely to have been due to the pressure of work on the ward. The Nurse in Charge recalls that around 6pm that evening she noticed the text message the patient’s mother had left at about 1.15pm, asking how her daughter was; and that although medical staff had by then spoken to the patient’s mother, she tried to call her anyway because they had spoken that morning and she wanted to reply to the message. The Nurse in Charge recalls the patient’s mother’s phone was busy at that time, and continued to be for the next hour or so. She tried again at around 7.30pm (or maybe later) as she wanted to let the patient’s mother know she had told her daughter her mother had wanted to come to see her; when she spoke to the patient’s mother, she passed on her thoughts and said she would be thinking of them.

We are sorry the patient’s mother experienced communication from the Acute Medical Unit as obfuscating. As indicated above, the cause of the patient’s illness was unclear; and it appears that when the junior doctor phoned the patient’s mother on the afternoon of 18th July [at 4:27pm], the second CT scan had not yet been performed and so the result was not yet known. The doctor concerned had not spoken to the patient’s mother before and accordingly would have asked her questions to try to elucidate what had happened - albeit it was inappropriate for the patient’s mother to be asked about her daughter’s life for 20 minutes on the phone and again whether the patient used recreational drugs. On review, the phone call from the junior doctor should ideally have been made by a more senior doctor; and (as noted above) the patient’s mother should have been invited to come into the hospital to be updated in person.

Significance of immunisation against covid-19

The patient had completed immunisation against coronavirus some months previously. And the Consultant Neurologist has commented that subsequent radiology effectively excluded [cerebral sinus] venous thrombosis.

Impact of gaps in medical and nursing staff rotas

The investigation found no evidence of an adverse impact on the patient’s care as a result of gaps in clinical staffing rotas (details in comments in Chronology section above).

In conclusion, the investigators acknowledge the tragedy of this young woman’s death. Her initial care was necessarily based on the facts that could be known, and the inherent uncertainties, at the time. But on review there are aspects of her care which should have been improved. It is not currently certain, even with hindsight knowledge, whether the patient could have survived the underlying disease process.

SECTION 5– IDENTIFIED GOOD / NOTABLE PRACTICE

Prompt and effective resuscitation led by AcMed Dr2 following the patient’s unanticipated respiratory arrest. Nursing care by the Nurse in Charge on the Acute Medical Unit during the day on 18th July 2021.

SECTION 6: RECOMMENDATIONS (please list below and copy and paste your recommendations into the separate Excel spreadsheet. This spreadsheet is for completion by the division)

- Recommendations
1. Guidance on the care of patients with hyponatraemia to be reviewed at local Clinical Governance meetings (Acute Medical Unit and Emergency Department).
 2. Creation of a guideline on hyponatraemia for the Trust’s Medical Emergency Document Library.
 3. Ensure formal teaching on the care of patients with neurological presentations - and in particular patients with altered mental state / behaviour - is included in the rolling training programmes in Acute Medicine and Emergency Medicine.
 4. To ensure formal regular teaching on hyponatraemia is included in the rolling training programmes in Acute Medicine and Emergency Medicine.
 5. Review of the patient’s initial CT scan at the Imaging Department’s Learning Meeting.

SECTION 7: ARRANGEMENTS FOR SHARING RECOMMENDATIONS, ACTIONS AND LEARNING LOCALLY

Acute Medicine and Emergency Medicine Clinical Governance meetings.

SECTION 8: ARRANGEMENTS FOR SHARING LEARNING ACROSS THE TRUST

Learning will be shared through the Trust’s Quality and Safety bulletin, the Patient Safety Committee, and the Quality and Safety Committee.

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Director Sign off	Cathy Mooney, Director of Quality & Safety	Date:	07 February 2022