Medical histories

Undercover surgeon: the night porter chronicle

When **Ara Darzi** decided to try being a hospital porter for a night, he learnt more than he expected about team relationships

I might have been the professor of surgery at St Mary's in London, but the third year medical student looked right through me as he commanded, "You grab the feet and pull . . . then go up to the ward and bring down the next patient, and hurry . . . it's because of you this list is running behind." He certainly put me in my place.

This wasn't the only humbling or confrontational experience I encountered during the memorable shift that I spent undercover as a hospital porter several years ago. I was drawn to the memory of that evening as I considered the stream of official reports, shocking tabloid headlines, and questionable statistics that have bombarded our NHS workforce and the UK public this year. Regrettably, it feels as though we are navigating our way through a deep slump in the history of the National Health Service at a time when we should instead be celebrating the many great achievements we have made leading up to this 65th anniversary year.

My motivation for putting down the scalpel and scrubs to don the apparel of my porter colleagues was to understand and ease my frustrations with the delays and inefficiencies that notoriously held up our operating theatres and pushed back our lists at St Mary's. I wanted to understand why we didn't have a smooth and constant flow of new patients arriving at the anaesthetic room and returning to the ward but instead experienced a disjointed coffee break fuelled service.

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I cannot claim to be a forebearer of reality television equivalents, as it was certainly not the first and wouldn't be the last occasion that someone would go undercover in their own organisation, but I decided it might be fun and enlightening to put my hand to a busy Friday shift as a porter in my hospital. I thought that by seeing first hand what the job entailed and the challenges involved, I could find out what might be improved with a bit of creative thinking. But I learnt a great deal more than I had expected about the often tense and frayed relationships between staff in the hospital. Particularly, I noted that this was often simply a consequence of people's determination to achieve and maintain high standards and professionalism in a busy and sometimes strained environment within the hospital.

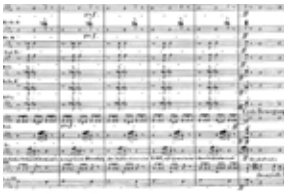
Becoming invisible

The moment I put on the uniform and walked into theatres to transfer my first patient of the shift I effectively disappeared from the view of my medical colleagues and now irreverent students. I was astonished that my peers and the students would no longer look me in the eyes, and I at once felt dismembered from the close knit clinical team. This barrier, a factor that I will have unknowingly contributed to in my capacity as a surgeon, was surely playing a part in the inefficiency of the theatres system. Delayed communication channels and a sense of diminished accountability because of a real detachment from the clinical team were hampering the patient flow.

Later in the busy shift, I was called to the emergency department to transfer a young woman with hyperemesis to the obstetric ward. I will admit that it had been a while since I had experienced the bustle of an emergency department in full swing, but immediately on entering the patient's cubicle, my requests for information and assistance, initially directed to the healthcare assistant and then the tending nurse, were given short shrift. Once I had formally identified the patient and received a thorough handover from the senior nurse, who had just finished administering some antiemetic, I took the clearly uncomfortable and still nauseous patient to the ward. However, en route to the ward it was clear—twice over—that she hadn't yet benefited from her parting dose of medicine. On arrival at the obstetric ward I faced another senior nurse, who was seemingly unaware of my intended arrival and who sternly rebuked me for failing to call in advance. Throughout this quite extended telling-off—and to the credit of neither of us—the patient remained unamused and feeling quite ill on the bed next to us. I'm sure this example will not be new or shocking to many clinical staff, but it serves to emphasise the unintended yet detrimental effect on patients and their experiences that failed teamwork and interdisciplinary conflict can have.

Nearing the end of my busy shift, I once again found myself in the emergency department. On this occasion, I was asked to take a set of blood samples to the laboratory for tests and cross matching as part of a major haemorrhage protocol, which had been activated for a patient with what seemed to be a serious upper gastrointestinal

DUNCAN SMITH



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Growing up over the shop. Author John Jones talks about his paper at http://www.bmj.com/multimedia/podcasts

bmj.com/video

Wagner's migraine. Carl, Anna, and Hartmut Göbel show how Wagner interwove migraine attacks into his music and libretti

bleed. After handing in the tubes to the laboratory and remaining on standby for a short period, I rounded off my shift. It was 3 o'clock in the morning, and I made my way home after what I considered to be a busy and exhausting shift.

ADRIAN DENNIS

Professor Ara Darzi moonlighting as a porter on the Friday night shift

Back to the day job

Shortly after 6 am I received a telephone call from the surgical registrar on call at the hospital in my capacity as the named out of hours consultant for surgery. I was informed that a middle aged man with a background of alcoholic variceal disease with an acute upper gastrointestinal bleed had been resuscitated successfully and now required surgical management. I immediately recognised the clinical details from the blood tubes I had deposited earlier that morning. On arrival at theatre, now dressed in scrubs and clearly identifiable as a surgeon ready to operate, I received quite a different welcome from that I had had only hours before.

During the short time for preparation before surgery, I had the opportunity to reflect and consider the important role of communication in relation to patient safety. Back then, we didn't have checklists or a dedicated "time out" for each member of the hierarchy to have their moment to speak, seek clarification, and raise concerns. We now have strong evidence to show that such practices, and empowering members of the wider clinical and non-clinical team, reduce mortality and morbidity significantly.[1] However, at the time we relied on soft communication and the ease with which we interact on an interpersonal level to mitigate the risks and provide members of the team with the voice and confidence to raise concern. Indeed, outside the operating theatre, where checklists are not routinely used, we still rely on these skills today. In my contrasting roles as a porter and the surgeon in theatre, I noticed that much more could be done by all levels of the hospital team to empower each other and support better interdisciplinary communication.

Later that morning, once the patient's bleed had been managed and I had returned home, I received a call from my gastroenterology colleague. He warned me in a somewhat sarcastic tone, "As professor of surgery, Ara, you must be informed . . . there's a porter in the hospital who is operating on your patients—and the thing is . . . he's not that bad."

Value the whole team

It was an eventful shift and not one I will forget in a hurry. I try to hold in mind some of the lessons I learnt that evening to inform my practice as a surgeon today. Of course, I can't speak for all staff in the NHS, but if my experiences are anything to go by, I think we should remain reassured that compassion is very much alive within the NHS. Often it is the frenetic atmosphere of a busy hospital and the necessity for speed and efficiency that become the determinants that compromise the unity and spirit of staff and lead to the progression of inefficiency. All too often, this is to the detriment of our personal interdisciplinary relationships and ultimately the patient's experience. It became quite clear to me that the high pressure atmosphere inherent within many operating theatres and clinical settings often leads us to underestimate the value that others bring—whatever their role. I learnt a great deal about inclusion and the importance of working together for the common goal, but also, crucially, the reality that you can never be completely certain who you might be dealing with.

Full details including references and competing interests are in the version on bmj.com.

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Slipper ulcers

A patient with diabetes developed a foot ulcer after wearing new slippers. Fourteen patients with new ulcers were seen in the diabetic foot clinic in the first 10 working days of 2012. Seven of them stated that new slippers for Christmas were implicated in their ulceration. Appropriate footwear is a critical component of diabetic foot care. Patients are educated about the need for adapted shoes and insoles, but also need to be aware of the risk of using non-prescribed footwear, including slippers.

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Growing up over the shop

Living in hospital accommodation as a child gave **Gareth Jones** an unusual insight into his future career

It is Christmas Day in the workhouse . . .
and the guardians and their ladies,
Although the wind is east,
Have come in their furs and wrappers,
To watch their charges feast.
George R Sims

Many medical families in mid-20th century Britain grew up in hospital residence. I lived with my family in what had been Cardiff Union workhouse, built for 900 inmates. The workhouse was a feature of British life until 1930. I was born six years later in this institution, now renamed City Lodge Hospital, where my father was senior resident medical officer, and we lived there until he retired 18 years later, when I went to medical school.

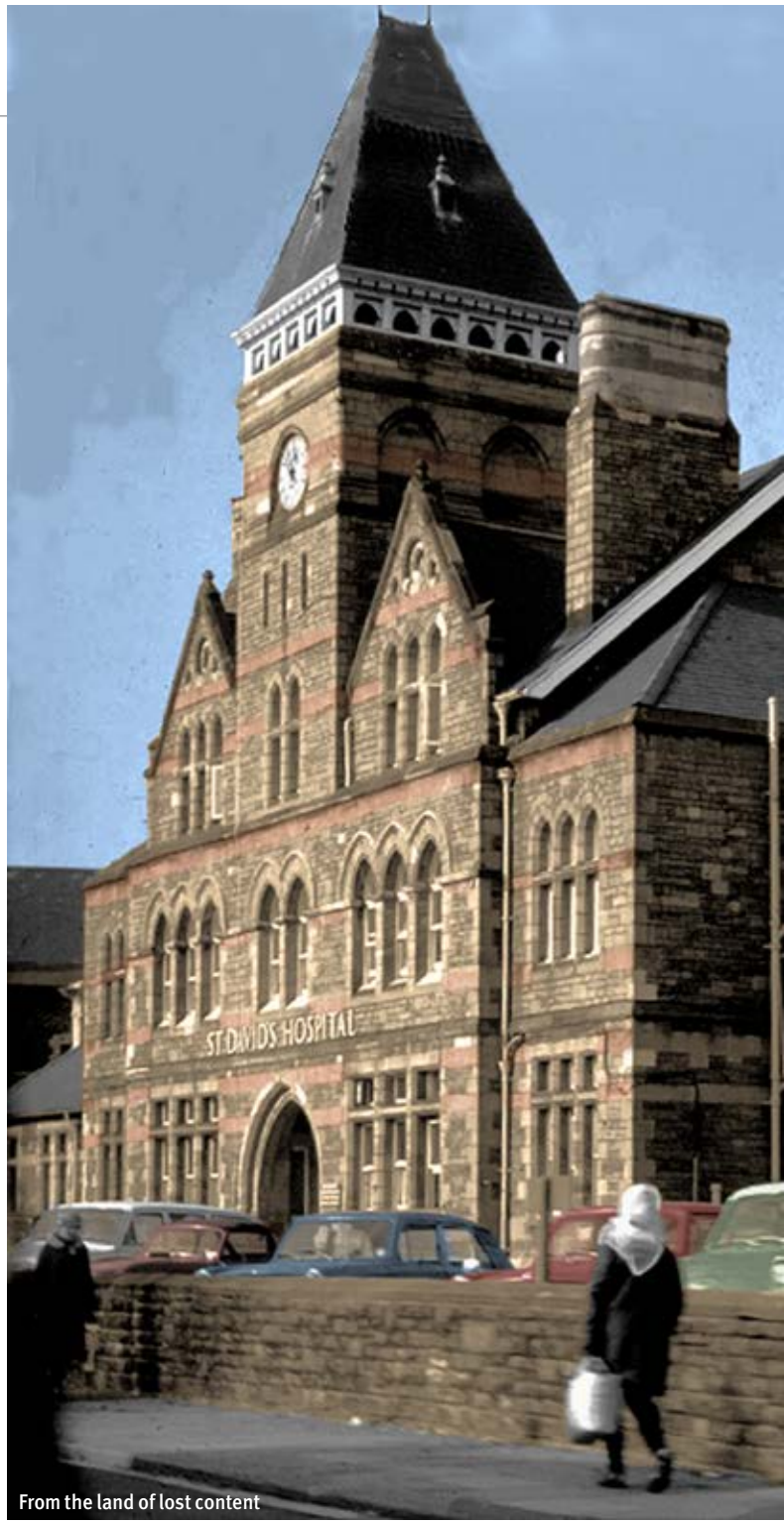
My home still had the features of the workhouse: three storey stone buildings surrounded by high walls, iron gates, and railings; a church; and a terrace of 12 cottages in which elderly couples could live. Tall double wooden doors divided the grounds into lawned exercise yards. These doors were closed at night to isolate the hospital from the outside world. The hospital continued to accommodate some of the former workhouse inmates. Male and female inmates were segregated in wards, where the dominant colours were bottle green and cream. I sampled the green leather padded cells (his 'n' hers) in the male and female "mental" wards. Male vagrants, or casuals, were still housed in a building with 45 cells and an adjacent stone breaking yard. Ambulant inmates ate in the hospital dining hall under a barrel vault ceiling. This, with its permanent stage, was the venue for the staff Christmas ball and concert. The former workhouse master, Mr Roffey, married to the matron, continued to administer City Lodge and lived in a three storey mansion in the grounds.

Immediately above the hospital entrance, our flat opened on to a dark stairwell running up to the clock tower and down to the foyer and a maze of terrazzo corridors, excellent for roller skating. Within the entrance were levers to open the gates. Christmas day in the former workhouse had changed little since the turn of the century. The mayor, the former guardians and their wives, and the master were the main actors; the mayor carved the turkey in the dining hall, served lunch, then toured the wards with his entourage. My father brought up the rear.

Adjusting to war

My bedroom had three lancet windows to monitor hospital comings and goings by night and day. The composer Ivor Novello lived opposite the building. Soon hospital gates and railings were removed with oxyacetylene burners for the "war effort." Coal was still delivered daily to the hospital by horse drawn cart, which stopped on the weighbridge beneath my window. Walls of sandbags or blast shutters covered ground floor windows to reduce the implosion of glass fragments. Air raid shelters, including one deep underground, were built in the grounds. Newly excavated deep water tanks supplied the hospital's mobile fire tender; I was warned that it was impossible to climb out if I fell in and told never to pull my cap on too tightly so that it would float off and mark where I had drowned. One ward, empty of patients, stood ready for air raid casualties. I remember only one air raid. Men in helmets carried me off in the night to the underground shelter lit with paraffin lanterns, where I was surrounded by babies in baskets. The same night (January 1941) a parachute mine detonated above the streets opposite the hospital killing 50 people.

My mother, formerly a City Lodge ward sister, knew most of the staff and inmates. She kept ready a small case to take to the air raid shelter with our identity cards, ration books, savings, and birth certificates. I wore a metal identity disc and chain in case I was incinerated. My diet was supplemented by Minadex tonic, malt, and Marmite. My father was physician, obstetrician, and anaesthetist but had no postgraduate qualification. Next to his armchair was a desk, radio set, ashtray, telephone, and obstetric and medical textbooks alongside *BMJ*s, most still rolled in brown wrappers. He was permanently "on-call," and mid-mornings would often find him still in pyjamas under a mixture of day



From the land of lost content

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My model aeroplane engine ran on a mixture of ether, paraffin, castor oil, and amyl nitrate available from the hospital pharmacist. This mixture came in handy on one caravan holiday when a cat presented itself with a fishhook in its mouth

clothes, a white coat topped off with a raincoat, tin hat, and gas mask. One of his notebooks had 50 pages of comments from a Major Anderson dealing with explosives and gas attacks, of which my father had had firsthand experience in the Royal Army Medical Corps in France during the previous war. After mentioning that "nitrogen mustard smells of onions and Lewisite of geraniums," the major pointed out that "Text books on gas attacks are now out of date."

Ambulant wounded soldiers were dressed in "convalescent" sky blue uniforms with red ties. Male inmates wore grey serge hospital suits and caps. One, with shell shock since the first world war, rode his bicycle on errands across the busy road junction to the shops opposite the hospital, his arms see-sawing violently, much to the alarm of strangers. Another had a gait that my father told me, without enlarging, was typical of tabes dorsalis. Another, had syringomyelia and painless cigarette burns on his fingers; the next time I saw a case was in the MRCP clinical.

You can tell a Bart's man

A frequent visitor to the mess, and friend of my father, was Emrys Harries ("Paget was at Barts, Pott was at Barts, and I was at Barts"), superintendent of the City Isolation Hospital.[1] They were regular users of the doctors' billiard room. I was the scorer and runner to the mess for more cigarettes. Emrys had a phenomenal memory, and their conversation, equally fluent in Welsh or English, ranged from poetry to clinical anecdotes. Thus, a patient's family requested that a London neurologist should be asked to see their relative who was under Emrys's care. He met the great man at Cardiff station and introduced himself, saying: "Sir Francis Walshe, I'm Emrys Harries. There's a mistake on page [x] of your neurology textbook." After a game of billiards Emrys and my father would adjourn to the wards to see interesting patients.

Emrys's forte was giving streptomycin by cisternal puncture for tuberculous meningitis. I became his patient when I had scarlet fever. In the same ward was Harold Watkins, economist and BBC Wales broadcaster, recovering from pneumonia.[2] Emrys plied him with anecdotes and cigarettes and later put me in an iron lung so that I could experience it closing around my neck.

My mother said that my father was a good anaesthetist because he "never had a death on the table." When I was 11 years old, he began taking me to the accident unit where he gave anaesthetics. I was soon holding the Schimmelbusch mask, pouring McFarlane's anaesthetic ether on to the gauze, and maintaining the airway while someone else applied a plaster of Paris. I gave a dozen such anaesthetics before I was a teenager.

In 1948, with the introduction of the National Health Service, the master disappeared; we moved into his mansion, and my father became medical superintendent. The 12 cottages were converted into radiology and pathology departments. The vagrants' block became the occupational therapy workshop, where I built a kayak and learnt to use a lathe. The upper floor became the asthma and allergy research unit. My anaesthetic practice ended, although I had one more tutorial. My model aeroplane engine ran on a mixture of ether, paraffin, castor oil, and amyl nitrate available from the hospital pharmacist. This mixture came in handy on one caravan holiday when a cat presented itself with a fishhook in its mouth. My father showed me how to remove the hook by wrapping the cat in a towel then anaesthetising it by holding its muzzle in a jam jar containing an inch of model aeroplane fuel.

My father hoped that I might become a doctor, although I had planned to be an aeronautical engineer. One day, we collected from the mortuary a glass specimen jar containing a human brain in formaldehyde that he had put aside for me years before. Later a human foot, obtained after an industrial accident, appeared in a bucket in our kitchen together with various dogfish, rabbits, and frogs. These, reeking of formalin, he dissected to show me the anatomical features. But this did not arouse as much interest as his eclectic book collection, particularly my surreptitious readings of forensic medicine texts and a book on morbid anatomy that described how to carry out domiciliary postmortem examinations: "Block the key holes with paper, find a large flat surface, like a grand piano, cover it with a rubber mackintosh . . ."

Eight years later he was giving general anaesthetics

News of the world

Years later, after the hospital had been demolished, the listed entrance block was being converted into luxury flats. I had a look around. Workmen were putting the finishing touches to what had previously been the billiard room. As I left one said, "You are from the *News of the World* aren't you?" I responded, "How did you know?" "Oh, we guessed because Charlotte Church [the singer] is living in the clock tower and she's just thrown out her boyfriend."

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1 G Emrys Harries obituary. *BMJ* 1960;2:952. www.bmj.com/content/2/5203/952.1.
2 Watkins HM. Life has kept me young. Watts and Co, 1951.

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Surgery and anaesthesia during the heroic age of Antarctic exploration (1895-1922)

During the heroic age of Antarctic exploration, general anaesthesia was given on at least 11 occasions. **H R Guly** describes some of the surgical procedures performed, including on the doctors themselves

During the heroic age of Antarctic exploration, there were 18 exploring and scientific expeditions to the Antarctic: 14 of these took doctors who performed at least 11 surgical procedures under general anaesthesia (table).[1-14] Other surgery is described with no mention of the type of anaesthesia. This paper describes, for historical interest, some of the operations performed.

The upturned boat on Elephant Island that served as the operating theatre for an amputation

Surgery under general anaesthesia

The first general anaesthetic recorded as having been given on an Antarctic expedition was during Robert Scott's Discovery expedition (1901-04). The chief engineer required a dental extraction for an abscess and anaesthetist Edward Wilson described:

> He will not undergo any treatment at all—simply will not stand the pain of having his gum lanced or a stump drawn. So . . . I gave him ether, and [surgeon Reginald] Koettlitz drew a tooth and we made a job of it. He was under nearly 25 minutes and the whole thing was very successful. He knew absolutely nothing of what had been done, went off almost immediately. There was much amusement on deck over his loud and amusing songs and unparliamentary remarks as he was recovering from the effects of the ether. He was only sick once, and had practically no after effects.[1]

One wonders whether the patient would have been reassured by Wilson's further note: "I gave it him on the practical experience I had gained by receiving it myself last year" (when having an axillary abscess incised).[1]

The worst conditions for surgery undoubtedly occurred during Ernest Shackleton's second expedition (on the *Endurance* in 1914-17). After the ship had been trapped in the pack ice and eventually crushed, the men were forced to camp on the ice for six months. When this ice broke up, they sailed and rowed for a week in small boats to Elephant Island where two upturned boats were converted into huts in which the 22 men lived in squalor (figure, above). Percy Blackborrow, who had been a stowaway but after being discovered was incorporated into the ship's crew, developed frostbite on the boat journey and his toes became gangrenous. A month later, it was decided that he needed surgery, which anaesthetist Alexander Macklin described in his diary:

> Today [surgeon James] McIlroy operated on Blackboro', amputating all the toes of the left foot. I gave $CHCl_3$: he took his anaesthetic very well and was not at all sick afterwards. We managed to sterilise instruments pretty well by using a primus and hoosh-pot [cooking pot]. We heated up water over the stove and [photographer Frank] Hurley took charge of the fire and succeeded in keeping it going without making any smoke in the hut. We managed to get the temperature up to 80° [Fahrenheit; 27°C] and the $CHCl_3$ vaporised splendidly. We had only 8 oz [227 g] of chloroform, but although the operation lasted 55 minutes, I only used an ounce . . . The operating table consisted of packing cases, and I had another one for a stool. We had no sterilised overalls to get into: we merely stripped to our vests . . . Blackboro' was soon round from the anaesthetic and asked for that now rare luxury—a cigarette.[6]

Leonard Hussey, a meteorologist but who qualified late as a doctor, gave more information: "The patient's head was placed as near to our little oil-drum stove as was possible and the stove was then stoked up with lavish supplies of seal-blubber. This helped the chloroform to volatilise, which otherwise would have been difficult owing to the cold."[7] Hurley added a bit more colour, describing "the feeble glimmer of blubber lamps" and "[maintaining] the temperature of

Surgery performed under general anaesthesia

Expedition	Operation	Surgeon	Anaesthetist	Anaesthetic	Notes	Reference
Surgery to people						
Discovery expedition (1901-04)	Dental extraction for abscess	Reginald Koettlitz	Edward Wilson	Ether	—	1
First German Antarctic expedition (1901-03)	Drainage of prostatic abscess	Hans Gazert	Non-medical person	Chloroform	—	2
Nimrod expedition (1907-09)	Enucleation of eye for trauma	Eric Marshall	Alister Forbes Mackay	Chloroform	—	3,4
Nimrod expedition	Amputation of toe for frostbite	Eric Marshall	Alister Forbes Mackay	Not stated	—	5
Endurance expedition (1914-17)	Amputation of toes for frostbite	James McIlroy	Alexander Macklin	Chloroform	—	6-8
Pourquoi Pas? expedition (1908-10)	Amputation of fingers following trauma	Jacques Liouville	Ernest Gourdon (a medical student)	Chloroform	Patient was a whaler, not an expedition member	9
Pourquoi Pas? expedition	Repair of foot wound involving joint	Probably Jacques Liouville	Probably Ernest Gourdon	Chloroform	—	10
Second German Antarctic expedition	Appendicectomy	Wilhelm Goeldel	Non-medical person	Ether	Patient was Dr Ludwig Kohl	11
Australasian Antarctic expedition (1911-14)	Dental extraction	Leslie Whetter	Leslie Whetter	Chloroform	Patient was Dr Archibald McLean	12
Surgery to dogs						
Australasian Antarctic expedition	Repair of neck wound	Archibald McLean	Leslie Whetter	Chloroform	—	13
Endurance expedition	Repair of laceration around eye	Probably James McIlroy	Probably Alexander Macklin	Chloroform	—	14

TATIANA GLEBOVA, 1928 FROM INSIDE THE RAINBOW, REDSTONE PRESS

the 'theatre' at 50° by stoking up the bogie-fire with penguin skins."[8] The unsanitary conditions were added to by the presence of a patient with a discharging buttock abscess who was too sick to be moved.

Modern advice would be to wait much longer before amputating in frostbite, but amputation (for open fractures as well as for frostbite) was resorted to at a much earlier stage in the pre-antibiotic era, because of the life threatening consequences of infection.

Only one abdominal operation seems to have been performed. The second German Antarctic expedition (1911-13) sailed with two doctors and one of them (Ludwig Kohl) developed appendicitis. Expedition leader Wilhelm Filchner reports: "Assisted by the captain, the first officer . . . and the steward, his colleague [Wilhelm Goeldel] immediately started the operation; it took 90 minutes . . . Occasionally one of the . . . [members of the mess] would peep down through the skylight into the operating room, in order to report on the progress of the work which was being carried out on the dining table . . . Fortunately the sea was mirror-smooth and calm throughout the operation. The engine was stopped during this period."[2] Kohl got up two days after his operation, but when the ship reached South Georgia he left the expedition to convalesce.

On Shackleton's Nimrod expedition (1907-09), second mate Æneas Mackintosh was struck in the eye by a hook while the ship was unloading stores. Surgeon Eric Marshall's diary says that he "examined him and found what appeared to be a portion of retina protruding through eye. [Ernest] Joyce tells me that when he fell he saw lens lying on his cheek. Kept him under, 1st atropine and cocaine, until 2.30, when assisted by [Alister Forbes] Mackay and [ship surgeon Rupert] Michell we gave him chloroform, with leave to act as we thought right. Found eye collapsed, cornea torn right across centre, lens absent, much of the vitreous humour had escaped and retina torn. We unanimously decided to excise eye. Operation was successfully performed although circumstances adverse owing to lack of space, appliances etc."[3] A typed transcript of the diary (presumably by Marshall himself) gives additional details that are not in his original: "one pair of curved scissors only were available. I made . . . hooks and retractor from rigging wire. Mackay's Edinburgh method of giving anaesthetics with a towel added to the difficulties. Mackintosh lay on the cabin floor, on which we knelt, and the only light was an oil lamp."[4] Interestingly, Marshall had been qualified about 18 months, during which six months had been spent travelling to the Antarctic: how many modern doctors, much longer qualified than Marshall, would contemplate doing such surgery?

Local anaesthesia

Much local anaesthetic was obviously used—Edward Atkinson of Scott's Terra Nova expedition (1910-13) said that more would have been useful, but I have found no mention of its use other than for one dental procedure[12] (and the topical use of cocaine in the eye).

One operation, on the Discovery expedition, was performed under what was, presumably, ethyl chloride spray, although this was not on the list of medical equipment supplied to that expedition.[15] Physicist Louis Bernacchi described:

> When [first lieutenant Charles] Royds was operated upon for a cyst on his cheek, the general reaction was one of pleasurable interest rather than sympathy for the unfortunate victim. Dr [Reginald] Koettlitz, nothing loath to perform the first operation in Antarctica, gladly prepared for the event. The wardroom table became the operating table. I volunteered as nurse, and rolled up my sleeves to play the part convincingly, while Koettlitz brought from their hiding-places a formidable array of knives, pincers, scissors, lint, gauze and bandages, explaining ghoulishly the exact function of each. Armitage took charge of the phial of patent freezing mixture, and the rest of the wardroom gathered round. The effort at first was not a success, for the freezing mixture functioned so thoroughly that the knife would not penetrate the skin, and while we waited for it to thaw a little, all joined in terrifyingly reassuring remarks to the patient. Again the knife was applied, and this time, to our intense satisfaction, blood flowed. Our questions as to whether it hurt or not brought a most emphatic 'Yes'. But the cyst was removed and the cheek stitched up, and Royds was distinguished for the rest of his life by a diminutive scar, a record of the first surgical operation performed in Antarctica.[16]

In summary, conditions for surgery in the Antarctic during this era were makeshift and far from ideal. Much local anaesthetic was used but it is frustrating that we do not have more details of these cases. Two general anaesthetics were given to expedition doctors. Therefore, when planning medical care for an expedition—even now—consideration needs to be given to the fact that a doctor is as likely to become ill or injured as any other expedition member.

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A prophet to modern medicine: Ernest Amory Codman

Caitlin Hicks and **Martin Makary** describe the life of the pioneer of healthcare registries

Fig 1 | Passionate about quality improvement

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Remarkably, the outcomes of medical procedures are rarely tracked today. As a result, establishing the best medical treatment can be difficult. Trials to establish best practices are often isolated, underpowered, and lag behind widespread adoption. Moreover, standardized methods to capture complications are lacking for most interventions.

This problem is as old as medicine itself. But one man boldly sought to challenge the status quo and tackle the problem—Ernest Amory Codman (fig 1). Codman was a surgeon who believed that by prospectively tracking outcomes we can learn from our patients and advance the field of medicine quickly. He helped usher in the concept of the regular morbidity and mortality conference and started the first national registry in American healthcare. Given the challenges of medicine today—endemic rates of medical errors, wide variations in quality, and an expanding cost crisis—many physicians are calling for Codman's basic tenants to be re-visited and applied.

Born in 1869, Ernest Amory Codman was a natural academic. He won the prestigious founder's medal at St Mark's School as a high school senior and graduated with honors from Harvard College in 1891.[1] He undertook his medical education at Harvard Medical School, where he met Harvey Cushing. In 1895, Codman graduated from medical school and joined the staff at Massachusetts General Hospital as an assistant in anatomy, where he became the apprentice of the chief of surgical services, Dr Francis Harrington. In 1900, he was appointed assistant in clinical operative surgery. Through his work with Dr Walter Bradford Cannon, among others, Codman developed strong x ray imaging skills, which led to a career in orthopedic surgery. He developed an interest in shoulder surgery and pioneered a rotator cuff operation. His case based textbook of shoulder surgery, *The Shoulder*, is still considered one of the pre-eminent textbooks on shoulder disease.

Reality check

Codman's true passion was the science of quality improvement. He proposed that, "If some arrangement could be made by which the house officer should see these late results, it would be very instructive for them, for I feel sure that the house officer in graduating from this institution gets a very much more favorable idea of the results of surgical operations than he is really justified in having."[2] Codman was not afraid to challenge the status quo, and he developed the idea of tracking patient outcomes further to form the concept of the "end result system." He described this concept in a publicly disseminated pamphlet in 1914: "Every hospital should follow every patient it treats long enough to determine whether the treatment has been successful, and then to inquire 'if not, why not' with a view to preventing similar failures in the future."[1]

Codman believed that by understanding the

Fig 2 | The "Back Bay golden goose ostrich" cartoon highlighted how fee-for-service enriched doctors through poor quality care and encouraged overtreatment

Fig 3 | Dr Codman's national registry of patient outcomes

Content of Ernest Codman's end result cards

Symptoms or conditions for which the patient seeks relief

The diagnosis that the treating doctor believes to be the cause of symptoms and on which treatment is based

The general plan or important points of the treatment given

Complications before the patient left the hospital

The diagnosis that proved correct or final at discharge

The result each year afterwards

results of patient care, doctors could change their practice to improve future care. He also pushed for transparency of results, so that physicians could learn from each other's mistakes and patients could make informed decisions about where to obtain medical care.

Unfortunately, the administration at Massachusetts General Hospital did not entirely support Codman's push to implement the end result system. But that wasn't the only thing that frustrated Codman. He disparaged the hospital's paternalistic approach to hiring; he believed in meritocracy and advocated vehemently for adjusting the hospital's hiring and promotion policies. He eventually resigned from his full time position in 1911 because of disagreements about the hospital administration's lack of action regarding his ideas on both topics.

Ends and means

Codman then started his own hospital, called the End Result Hospital, which required all physicians who practiced there to follow his system.[1] Codman kept "end result cards" for each patient he treated, on which he recorded demographic, disease, treatment, and outcome data (box). From 1911 to 1916, he meticulously recorded the results for all 337 patients treated, during which time 123 errors were recorded. Ironically, this error rate is close to the 25.1% rate described in a 2010 Harvard study.[3]

In keeping with his call for transparency, Codman paid to publish the results of each of the cases in his landmark book, *A Study in Hospital Efficiency: As Demonstrated by the Case Report of First Five Years of Private Hospital*.[4] He thought that sharing mistakes and experiences in a public forum would improve quality and advance the science of medicine.

In 1912, Codman helped develop what is known today as the Joint Commission for Accreditation of Hospital Organizations (JCAHO).[5] Together with Dr Edward Martin, a Philadelphia based gynecologist, Codman formed and then chaired the Committee on the Standardization of Hospitals.[6] The committee's stated purpose was to raise "the standard of American hospitals" through "the establishment in each hospital of a follow-up system of tracing the outcome of treatment given to each individual patient."[2] To start, the committee asked that all hospitals adhere to a standardized set of basic guidelines[7]:

- Each hospital should have a medical staff
- The members of the medical staff should be chosen on the basis of graduation from medical school, competency, and character
- There should be regular staff meetings to review cases
- Medical records should be written and filed for all cases
- Each hospital should have a clinical laboratory and radiology section.

These standards were based on Codman's belief in the value of meritocracy and embodied his end result system, including the concept of morbidity and mortality conferences and patient tracking. Only 89 of the 692 existing hospitals met these basic standards, and Codman's efforts were widely rebuffed at the time.[8] But others saw the value of Codman's insights, and eventually his ideas were endorsed.

Codman's attempts to promote his system were also opposed in the Boston community. To raise awareness of his cause, Codman presented the "Back Bay golden goose ostrich" cartoon at a meeting of the Suffolk District Medical Society in Boston in 1915 (fig 2).[8] The controversial cartoon depicted an ostrich (representing the public/patients, labeled by a section of Boston known as Back Bay) laying golden eggs with its head buried in the sand. A caricature of the Harvard president, A Lawrence Lowell, contemplated whether his employees could continue making money if the truth about the outcomes of their clinical services was known publicly. The cartoon highlighted how the fee-for-service system made doctors rich through poor quality medical care and encouraged overtreatment. It noted how Harvard's leaders oversaw ethical actions and suggested that this broken healthcare marketplace created a moral dilemma. One trustee was depicted scratching his head and questioning the system. The cartoon caused much indignation. Codman was quickly asked to resign as chairman of the society. Today, recognizing Codman's achievements and prophetic vision, Harvard has come full circle; the ostrich cartoon currently hangs in the Harvard medical school library, and the Massachusetts General Hospital's quality and safety department is named the Codman Center.

Concept of national healthcare registry was born

Despite these setbacks, Codman pushed on with his cause. In 1920, he developed the first national registry to track bone sarcoma cases [9] after receiving a $1000 gift from a patient's family (fig 3).[1] The American College of Surgeons (ACS) soon followed with an additional $8000 in support. However, the implementation of patient tracking proved more difficult than anticipated; despite multiple solicitations to the 7000 members of the ACS, Codman collected only 17 cases to add to his database.[10] Nonetheless, the concept of the national healthcare registry was born and has since been adopted throughout the world.

Codman died in 1940 in Ponkapog, Massachusetts, but his legacy lives on. Codman's end result system is now the foundation for many quality improvement efforts, and medical transparency is emerging as a priority for many healthcare systems. In addition, transparency is a first step in current endeavors to tackle dangerous and costly variations in care. The problem of overtreatment, which Codman also warned about, is also the subject of many new efforts. Most recently, in a major 2012 report, the Institute of Medicine concluded that as much as a third of all US healthcare costs may be unnecessary and may not improve health outcomes.

Recent studies have shown how patient outcome registries can lead to scientific discovery and sustained improvements in quality. Despite these benefits, however, their adoption has been limited. Registries are expensive and they require auditing, outcome definitions, and sound data collection for outcomes to be measured in a standardized manner, as well as risk adjustment to make benchmarking fair. In a recent review, we found that only 19 of 117 medical specialties recognized by the American Medical Association house a clinical registry or are affiliated to a registry (H Lyu and colleagues, unpublished data, 2013). The new transparency movement to make healthcare registries more common and more robust should credit the man who pioneered the cause—Dr Ernest Amory Codman.

References and competing interests are in the version on bmj.com.

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"Compulsive plague! pain without end!" How Richard Wagner played out his migraine in the opera *Siegfried*

Carl Göbel and colleagues explain why listening to Wagner can sometimes be a headache

The medical problems of composer and poet Richard Wagner have been widely investigated. He is known to have had functional disorders, skin disorders, acute infections, and minor ailments, as well as heart disease.[1-4] However, the condition that Wagner described as the "main plague of his life"[5] was recurring headaches. The details presented in his writings and letters[5-7] as well as the numerous diary records of his second wife, Cosima,[8 9] confirm that Wagner had a severely disabling migraine disorder producing frequent migraine attacks, sometimes with aura.[10] Here, we show how Wagner deeply interwove his migraine attacks and auras into his music and libretti, using the opera *Siegfried* (1876), the third part of the *Ring Cycle*, as an example.

Musical depiction of migraine

The first scene of act 1 of the opera *Siegfried* provides an extraordinarily concise and strikingly vivid headache episode. The music begins with a pulsatile thumping, first in the background, then gradually becoming more intense. This rises to become a directly tangible almost painful pulsation (fig 1). While the listener experiences this frightening headache sensation, Mime is seen pounding with his hammer, creating the acoustic trigger for the musically induced throbbing, painful perception. At the climax Mime cries out: "Compulsive plague! Pain without end!"

Wagner carves out the temporal and qualitative aspects of the headache phenotype in astonishing detail. This has also been recognised by renowned opera stage directors. In Anthony Pilavachi's stage direction of *Siegfried* at Theater Lübeck (2009), Mime explicitly experiences a severe headache. The musical description of migraine is strengthened by Mime's painful facial expression, the way he holds his trembling head, and ultimately by avoiding movement and resting on the floor (fig 2). Similarly, in Claus Guth's *Siegfried* stage direction at Hamburg State Opera (2009), Mime takes an overdose of aspirin tablets in a desperate attempt to relieve the pain (fig 3, www.youtube.com/watch?v=GJbD2Ck0pRY).

In his memoirs, Wagner gives an account of the symptoms he had in September 1856 when he was composing these bars. The words show a marked phonophobia[5]:

> I began to sketch the overture [of *Siegfried*] on September 22. That time one of the main plagues of my life arose, causing critical distress. A tinker had established himself opposite our house, and stunned my ears all day long with his incessant hammering. In my disgust at never being able to find a detached house protected from every kind of noise, I was on the point of deciding to give up composing altogether until the time when this indispensable condition should be fulfilled.

In a letter to Franz Liszt on 27 January 1857,[6] Wagner voiced the suffering and disability caused by the "nervous headaches" he had while working on Siegfried:

> My health, too, is once more so bad, that for ten days, after I had finished the sketch for the first act of *Siegfried*, I was literally not able to write a single bar without being driven away from my work by most tremulous headaches. Every morning I sit down, stare at the paper, and am glad enough when at least I get as far as reading Walter Scott. The fact is, I have once more over-taxed myself, and how am I to recover my strength? With *Das Rheingold* I got on well enough, considering my circumstances, but *Die Walküre* caused me much pain. At present my nervous system resembles a pianoforte very much out of tune, and on that instrument I am expected to produce *Siegfried*. Well, I fancy the strings will break at last, and then there will be an end. We cannot alter it; this is a life fit for a dog.

Scintillating aura

An example of the musical depiction of the visual disturbances of a typical migraine aura can also

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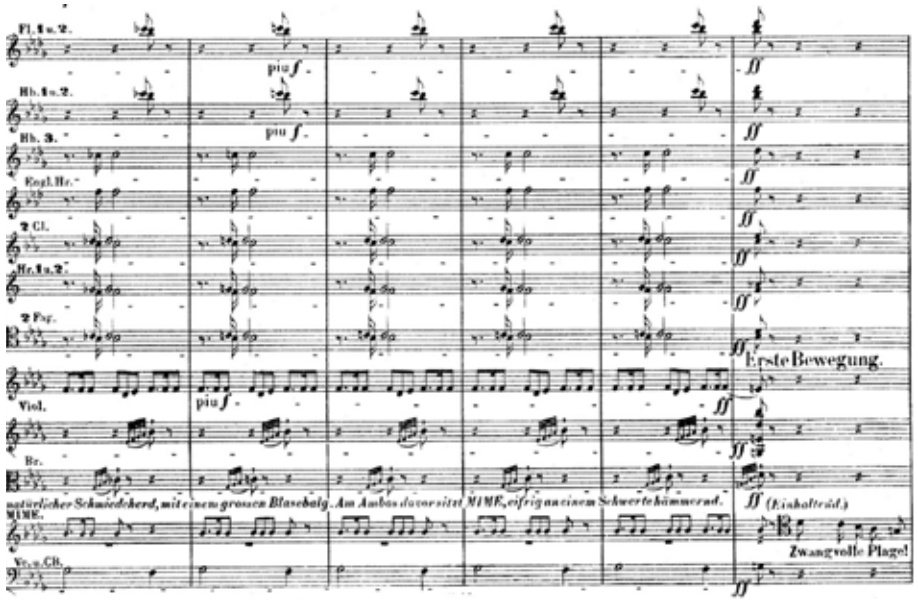

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Fig 1 | "Migraine headache leitmotif" in *Siegfried*, act 1, scene 1

JÖRG METZNER

Fig 2 | Hammered. Anthony Pilavachi's production of *Siegfried* at Theater Lübeck (2009) shows Mime as a laboratory scientist whose hammering leads to an intense headache

MONIKA RITTERSHAUS

Fig 3 | Claus Guth's production at Hamburg State Opera (2009) shows Mime (left) in bed with headache tablets and water within reach

be found in act 1, scene 3 of *Siegfried*. It is introduced by a scintillating, flickering, glimmering melody line with an underlying zigzag pattern, which integrates the previously mentioned "migraine leitmotif" (fig 4). Mime, irritated, sings: "Loathsome light! Is the air aflame? What is it flaring and flashing, glittering and whirring, what is swirling and whirling there and flickering around? It glistens and gleams in the sunlight's glow. What is it rustling and humming and blustering there?"

The text expresses typical visual disturbances seen in a migraine aura. The music illustrates this further by imitating scintillations and continuously extending visual disturbances, characteristics of a typical migraine aura. In Anthony Pilavachi's Lübeck production (2009), the scene is intensified by flickering light, from which Mime tries to turn away in pain.

An analysis of the perceived scintillation rate of migraine aura with an objective task reported that the rate of flicker averages 17.8 Hz.[11] Wagner composed these bars in two-four time, and the string instruments responsible for the musical scintillation (violins and viola) play 16 demi-semiquavers per bar. This corresponds to 16 Hz at an assumed tempo of 120 beats per minute, close to the experimentally determined rate of flicker during a migraine aura. Most conductors choose a slightly slower tempo, but in the rehearsal remarks for the *Siegfried* premiere in 1876, Wagner gives clear instructions for faster tempi to conductor Hans Richter: "If you were not all such tedious fellows *Das Rheingold* would be finished within two hours."[12] The experimentally determined flicker frequency in migraine probably also gives important clues about the performance speed that Wagner intended.

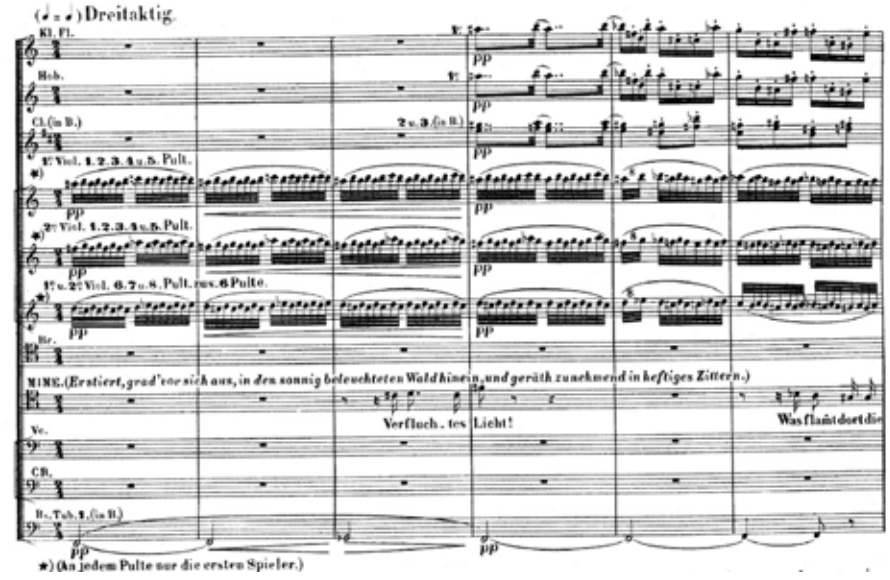

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Fig 4 | "Migraine aura leitmotif" in *Siegfried*, act 1, scene 3 uses a scintillating melody line with an underlying zig-zag pattern

Wagner thought the completed act 1 of Siegfried exceeded all expectations.[13] However, he had to interrupt his work a year later in the middle of the second act. In a letter to Otto Wesendonck on 22 December 1856, Wagner writes:

> I fear soon everything will leave me—eventually also my desire to work. I cannot motivate myself for *Siegfried* anymore, and my musical sense, just like my mood, is falling into gloom. Everything appears truly flat and superficial! Do not just think of my loneliness, my health is also heavy and leaden.

The interruption lasted a total of 12 years—act 2 was completed in 1864, and it was 1871 before Wagner finally completed the opera. The premiere took place in Bayreuth on 16 August 1876.

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