1 *Introduction – The changing nature of care provided in the hospital*

MARTIN MCKEE, SHERRY MERKUR, NIGEL EDWARDS, ELLEN NOLTE

The emergence of the modern hospital

Sometimes it seems that the hospital *is* the health system. Whether in popular culture, such as the American television series *ER*, in political and popular discourse, with its focus on opening and closing of hospitals, in statistical databases that give prominence to numbers of hospital beds, or in budgetary breakdowns, showing that the bulk of health service spending is concentrated in hospitals, it is clear that the hospital is seen as being at the heart of the health system (McKee & Healy, 2002). Even when the many other components of the health system are recognized, the hospital typically sits at the top of the pyramid. This is perhaps inevitable. Hospitals are highly visible. They are large buildings, well signposted, and adorned with the symbols of health care, such as red crosses. When politicians wish to make a statement on health services, they typically find a convenient hospital as a backdrop. Hospitals are also important for the public, not just when they are ill, but by providing reassurance that they will be cared for nearby if they become ill in the future. They play other roles too, as settings for the education of the next generation of health workers and through their contribution to the local economy. So even though they are only one part of the overall health system, they are an important part, and are recognized as such by almost everyone.

Yet the concept of the hospital is a relatively recent one. Before the 18th century most people were cared for in their own homes, usually by family members or traditional healers. Institutionalized care, to the extent that it existed at all, was often in the hands of religious orders, providing somewhere that those with incurable illnesses could spend their last days in peace and tranquillity (Porter, 1999). What changed was the scientific revolution. Advances in a number of different areas brought new opportunities. In physics, the discovery of X-rays made it possible to look inside the human body as never before (Reed, 2011). Advances in optics paved the way for microscopes, and thus the

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development of histopathology (Wollman et al., 2015). In chemistry and biology, technical advances made it possible to gain new insights into a patient's condition from samples of their bodily fluids (Moodley et al., 2015). Acceptance of the germ theory led to the emergence of bacteriology (Roll-Hansen, 1979). Meanwhile, the development of safe anaesthetics and an understanding of the importance of asepsis made possible surgical procedures inside bodily cavities (Jessney, 2012).

The technology required to exploit these developments was rudimentary and there were few with the necessary skills to take advantage of it. There was a need to concentrate resources. The hospital was an obvious setting to bring together laboratories, operating theatres, and X-ray departments. It was also the obvious place to train people in their use.

Throughout the 20th century the opportunities to intervene to save lives and reduce suffering advanced rapidly. Paradoxically, it was from the death and destruction of war that many of the most important developments arose, such as the mass production of penicillin (Neushul, 1993) and advances in plastic surgery (Geomelas et al., 2011), the management of burns, and orthopaedic surgery (Dougherty et al., 2004) during the Second World War, as well as new approaches to major trauma in the Korean and Vietnam Wars (Eiseman, 1967; Molnar et al., 2004). The earliest treatments for cancer were derived from chemical weapons, such as mustard gas (Mukherjee, 2010).

All of these expanded the scope of work of the acute hospital. Yet there were also changes that were reducing the work of some hospitals. From the 19th century onwards public bodies in many countries had invested in large hospital facilities, typically away from urban centres, in which they could place those with infectious diseases, especially tuberculosis, as well as mental illness. By the early 1950s the introduction of streptomycin had transformed the management of tuberculosis. Death rates in many countries were falling year on year and it was no longer necessary to incarcerate patients for long periods of time in the hope of spontaneous recovery (Daniel, 2006). By the early 1960s new antipsychotics had transformed the management of schizophrenia. Coupled with new models of care in the community, the days of the large psychiatric hospital were numbered (Clifford et al., 1991). Similar changes were happening within the acute hospital. Improvements in hygiene, linked to better living conditions, brought about a dramatic reduction in the number of children requiring admission for infectious jaundice, gastroenteritis, and respiratory infections (Wolfe & McKee, 2014).

But much more was happening in the hospital. Populations were ageing, benefiting from a remarkable increase in our ability to control many common chronic diseases. The consequence was that patients who would have died in previous years, were now surviving but with growing numbers of clinical conditions, a phenomenon termed multimorbidity (Barnett et al., 2012). Ultimately, many experienced what has been termed frailty, involving decline in a wide range of bodily functions (Nicholson, Gordon & Tinker, 2016). When they became seriously ill, they could require inputs from a wide range of health professionals, working together. But it was not just changes in the characteristics of patients. New opportunities to intervene also required new models of working based on teamwork, whether the problem was cancer (Prades et al., 2015), gastrointestinal haemorrhage (Lu et al., 2014), or major trauma (McCullough et al., 2014). The evidence was accumulating that a multidisciplinary team (MDT), using shared protocols, achieves the best results.

Sometimes, changes in patterns of disease have even more profound consequences. The epidemic of HIV infection that began in the 1980s led to widespread changes in some of the fundamental elements of health care. These ranged from new approaches to infection control, in particular the risk of transmission of infection through surgical and medical procedures, to a new way of thinking about patient confidentiality and informed consent (Hayter, 1997). Similarly, the growth of antimicrobial resistance has major consequences for many aspects of care delivered in hospitals and, in the future, is likely to have even greater impact, potentially threatening the fundamental principles on which hospitals are organized (Goff et al., 2017).

At the same time it became increasingly apparent that what was important in achieving the best outcomes was not *where* treatment was provided but *how*. In particular, waiting for the patient to arrive at hospital often meant missing important opportunities. Innovative treatments, such as thrombolysis for patients with myocardial infarction, could be initiated in an ambulance on the way to hospital, thereby reducing delays in this time-critical treatment (McCaul, Lourens & Kredo, 2014). The use of advanced techniques to stabilize patients at the scene of major trauma meant that they arrived at the hospital in much better condition (Wilson et al., 2015).

It is not, however, only those things that happen before the patient gets to hospital that are important. Changes in family structure and in labour mobility mean that growing numbers of older people, including

those with multiple disabilities, are living alone. Once they have completed active treatment in hospital they may have inadequate support at home, reflecting both the breakdown of traditional extended family structures and reductions in services, exacerbated since 2008 in countries that have imposed austerity policies leading to cuts in social care (Loopstra et al., 2016). The result in some countries is that much-needed hospital beds are occupied by patients who would be much more appropriately cared for elsewhere, if only appropriate accommodation and support structures existed (Turner, Nikolova & Sutton, 2016).

Other technological changes have challenged some aspects of the rationale for the hospital. The original justification for concentrating resources in hospitals stemmed from the need to avoid duplication of three sets of resources: imaging equipment, laboratories, and operating theatres. However, the advent of portable ultrasound machines, coupled with mobile magnetic resonance imaging (MRI), offered new means of seeing inside the human body. Advances in near-patient testing, from the first simple test strips to complex micro-arrays (Voswinckel, 1994), have challenged the role of the laboratory. Injectable anaesthetics, endoscopic procedures, and minimally invasive surgery have enabled what were once major procedures to be undertaken outside hospital. Many treatments that still need to take place in hospital can be completed in hours rather than days, and the pace and intensity of hospital work has changed beyond recognition; however, many processes, ways of working, and individual professional roles have struggled to keep pace.

In summary, the challenges facing hospitals have changed enormously in recent decades. The factors involved are extremely complex and interlinked. However, in broad terms, they can be divided into: changes in technology, including diagnostics and treatments; changes in patients, who have become older, frailer, and often more socially isolated; changes in models of care, involving networks and integrated pathways; and changes in staffing, affecting the need for both specialists and generalists.

The changing policy context within which hospitals operate

The preceding paragraphs have outlined the clinical changes that have driven developments in hospitals. However, there have also been many changes in the broader policy context within which they operate.

The first of these changes is in relation to accountability. For most of the 20th century what a hospital did, and how it did it, was determined largely by the medical profession (Freidson, 1974). Typically, each department was headed by a specialist physician or surgeon whose rule was absolute. Each department was largely autonomous, maintaining strict control over staff and resources. There was a tacit assumption that the senior physicians knew best, drawing on their long experience and status. It was inconceivable that their decisions would be questioned, no matter how idiosyncratic they seemed. Their relations with other health professionals, their junior staff, and patients were characterized by deference and, in some elite hospitals, their ward rounds could assume the trappings of a royal visit (Osterberg, 1990).

This situation reflected the prevailing approach to the professions. Professions were granted certain rights, in particular that of self-regulation, and high status. Members of professions had accumulated knowledge through a long process of apprenticeship. They were expected to exercise complex judgement, often in the face of uncertainty. It was not clear how anyone from outside the profession could second-guess them. In return, they were expected to maintain high ethical standards and obligations to the public (Freidson, 1988).

In all but a few places such situations are no more. There are many reasons. One is a wider societal rejection of deference to authority of all sorts. Another is a recognition that sometimes the professions fail to live up to the high standards they are expected to adhere to, whether in terms of competence or probity (Kaplan, 2007). A third relates to the growing commercialization of health care in some countries, whereby professional knowledge and status are seen as a barrier to the operation of the free market. Although health professionals remain among the most trusted groups in society (Appleby & Robertson, 2016), politicians and the media are unwilling to countenance the high level of professional autonomy that once existed (Rao et al., 2017). The extent to which this has happened varies enormously among countries and in some the concept of the liberal profession still holds sway. In others, however, health professionals are finding their work increasingly subject to high levels of regulation and monitoring, impacting adversely on morale and levels of burnout (Chamberlain, 2016; Rao et al., 2017).

A second development relates to the explosion in data for monitoring. Health professionals have been monitoring outcomes of patients at least since the days of Florence Nightingale, albeit in very basic ways

(Caelleigh, 1997). Advances in information technology, psychometrics, and health services research more generally have led to new ways of monitoring health outcomes, often using linked data, for example, to the deaths occurring after discharge from hospital, as well as a wide range of patient-related outcome measures (Black, 2013).

These developments have facilitated a revolution in methods for assessing quality of care since the 1980s. However, this brings both opportunities and risks. In particular, publication of outcomes by individual health professionals has proven highly controversial, for several reasons. One is the challenge of adjusting adequately for case-mix or attributing an outcome to the action of an individual when the care is provided by a team (Jacobson, Mindell & McKee, 2003). A second is the potential for opportunistic behaviour, which can range from changes in recording of patient characteristics to avoidance of those patients at greatest risk of an adverse outcome (Burns et al., 2016). Finally, there are questions about whether publication accelerates or slows improvements in outcomes (Joynt et al., 2016). Notwithstanding these concerns, it is clear that hospitals now and in the future will increasingly be evaluated in terms of the health gain that they bring about and not just the money they spend and the patients that flow through their wards.

A third issue, also related to the first two, has been the emergence of what has been termed "patient safety" on the policy agenda (Longo et al., 2005). While overlapping to some extent with the concept of quality of care, this explicitly reflects a recognition that hospitals may, on occasions, damage health. This can happen in many ways (Institute of Medicine, 2001). Failures to put in place appropriate procedures can lead to patients receiving the wrong treatment, for example, an incompatible blood transfusion, a drug to which they are allergic, or even a surgical procedure on the wrong patient or on the wrong side of the right patient. Recognition that this is a problem has led to new organizational structures, to ensure that problems are identified early and dealt with effectively. Lessons have been learnt from other sectors, such as the system used by airline pilots experiencing near-misses (Nicholson & Tait, 2002).

A fourth issue is a change to the way in which hospitals are funded. Traditionally, hospitals receive their funding in a number of ways, including historical budgets and payments per patient or per bed day (McKee & Healy, 2002). However, the recognition that patients with different conditions incurred very different levels of expenditure created pressure

for a much more differentiated system. The result in many countries has been the implementation of some form of activity-based system, typically based on the diagnosis of the patient and the procedures they undergo, with the best-known being versions of the American Diagnosis Related Groups (Busse, Geissler & Quentin, 2011). These systems are designed to incentivize hospitals to increase their efficiency, treating each patient with the minimum necessary resources. One consequence has been to bring about reductions, often substantial, in length of stay. Often this is a good thing, given the risks associated with being in hospital for prolonged periods (Asher, 1947). However, it presupposes that patients have somewhere safe and supportive to go to.

A final set of issues facing hospitals relates to the broader political context and, specifically, whether health care is seen as a tradable or a public service (Starr, 2008). In some countries, where the latter view has so far prevailed, hospitals are increasingly being seen as corporate entities and profit centres. This creates a powerful incentive to work in isolation, notwithstanding the importance of collaboration across the entire patient journey. Elsewhere, there is an increasing emphasis on networks, allowing patients to move freely within a system, obtaining routine care close to home when needed, but also access to advanced specialized services and specialized facilities if required. In a number of countries there has also been a significant growth in the number of hospitals that are part of groups, partly as a way of responding to some of the challenges detailed here but also as a method of reducing costs and improving quality through standardization and a greater role for professional management.

As with the changing clinical context, these issues are well recognized by those working in hospitals, but less often by those elsewhere who may be responsible for decisions that have profound consequences for hospitals and those who work in them. We believe that there is a need to bring all of these issues together: something that we have attempted to do in this book.

Rather than seeing hospitals as discrete entities within the health system that are often viewed in a mechanistic way through metrics such as numbers of beds or physicians, we view hospitals as complex adaptive systems, each containing a multiplicity of subsystems, some dealing with patients with particular conditions, such as a surgical department for example, while others provide resources that are shared among many of the other systems, such as operating theatres and pharmacies.

All of these systems interact with each other and are shaped by these interactions (Checkland, 1981).

We can only understand how they operate by looking at all levels, from the individual interaction between the patient and health professional through to the design and operation of the facility. However, this approach also recognizes that hospitals are situated within a broader health system, the optimal functioning of which depends on the linkage of many parts. This includes prehospital and post-discharge care. It also includes linkages to the training of health professionals, and the research and development that generates the knowledge on which effective care should be based. All of these systems and subsystems are operating in a rapidly changing environment, involving: the patients and their conditions; the opportunities to intervene, including technological advances and evidence on innovative models of care; and the broader policy and political context in which health care is delivered.

Consistent with the wider discourse in health policy, we have chosen to take a patient-centred approach. Pragmatically, this creates a problem. On the one hand, as we have noted, growing numbers of patients have multiple, complex needs and cannot easily be placed into individual categories. On the other hand, it is necessary to simplify our approach to make sense of the complexity. Consequently, in this book we have focused primarily on the acute general hospital rather than single speciality or specialized hospitals, long-stay facilities, and those providing restricted services or mainly convalescence (although in some chapters we do consider specialist hospitals too). We have looked at a number of the most important activities in which hospitals engage, defined by the conditions of their patients.

Meeting the needs of patients

We now look at the areas of hospital activity that are discussed in this volume. It is impossible to cover everything that is done within the hospital. Nor is it easy to create a simple taxonomy of the areas we could have covered. Consequently, we have selected a series of examples, looking at different patient groups, defined variously by age, disease process, and type of treatment, as well as some other areas where scientific advances have led to changes in patient management, such as imaging and laboratory science. While each contains a number

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of issues specific to the topic of the chapter, collectively they highlight many issues that have applicability more widely.

We start with children, the subject of Chapter 2 in this book. As noted above, the population of children in hospital has changed beyond all recognition in the last four decades. The wards that were once filled with children with common infectious diseases have gone. So has the generic paediatrician who once would have cared for children from birth to adolescence. Instead, there has been a remarkable diversification, of necessity given the high level of specialist skills required in many of the new areas that have emerged. This is perhaps most apparent with neonatal care. In 1975 one in every two premature newborns with a birthweight of less than 1500g died in the perinatal period. By 2009 this had fallen to one in eight. Moreover, an increasing proportion of births in some countries are at low birthweight, as a consequence of multiple pregnancies related to in vitro fertilization. This has had enormous implications for both obstetrics and neonatal paediatrics, although not without controversy, as it has brought into sharp relief the tension between centralization, specialization, and medicalization on the one hand and a vision of birth as a natural event, involving a partnership between the mother and her midwife that is usually free from complications. Clearly there is a challenge in getting the balance right. However, this can only be done by close coordination between the different facilities providing obstetric and neonatal care. It illustrates perfectly the need for clinical networks of hospitals and other settings for childbirth working together collaboratively.

The chapter also looks at developments in care for older children. This is also an area that has been transformed by the creation of new knowledge (Wolfe et al., 2013), although there is enormous diversity among European countries (Ehrich et al., 2015). One result is increasing specialization. As with adults, it is not possible to expect a single physician to be an expert in the many body systems in which problems may arise. Moreover, as is frequently pointed out, children are not simply small adults. Consequently, there is a need for the specialist knowledge that paediatricians bring to these areas. The difficulty is that many of these diseases are relatively uncommon. Services must be concentrated to be viable, leading to the growth of highly specialized paediatric centres. This can be a major challenge for many small countries, in this case calling for networks that extend beyond national frontiers (Saliba et al., 2014). Finally, it should never be forgotten that children should

be kept out of hospitals as much as possible. Their physical, mental, and social development is best achieved at home with their families. As the chapter shows, there is much that can be done to make the hospital as friendly as possible for children (Lenton & Ehrich, 2015). However, although it may sometimes be needed, admission of children to hospital should always be a last resort.

The third chapter moves to the opposite end of the age spectrum, looking at one of the most common afflictions of middle and old age: stroke. Fortunately, the incidence of stroke has been falling dramatically in many high and middle income countries, largely as a result of improvements in the detection and management of hypertension (Lackland et al., 2014). However, as populations age, the absolute number of people affected by stroke is rising. The management of stroke has been transformed in recent years. Even as recently as the 1990s, many patients with stroke would simply be admitted to hospital to await a hopefully spontaneous recovery. Now, the focus is on early recognition of symptoms and signs, rapid transfer to hospital, early diagnosis using brain imaging, and definitive treatment. All of this must be achieved within a few hours and, if it can be, levels of disability can be reduced greatly. In a number of places, stroke services are organized on a population basis, reaching outside the hospital to begin the process of restoring blood supply to the affected part of the brain as soon as possible (Alonso de Lecinana et al., 2016; Turner et al., 2016), in some cases using ambulances with computerized tomography (CT) scanners linked by telemedicine to specialist centres (Ebinger et al., 2014). However, this is only the beginning of the process, with subsequent management seeking to tackle the reasons why the stroke occurred, to prevent it recurring, and to provide the rehabilitation necessary to make as full a recovery as possible.

Once again, this chapter makes a very strong argument for a comprehensive approach to, in this case, a particular condition. This involves measures that address all of the building blocks of the health system, including a trained workforce, appropriate technology, and high levels of training. Yet, as it also shows, there are many barriers to achieving this and – still – great variation in the outcomes of treatment. This is an area where there are many opportunities for shared learning and comparisons of policies and practices.

The fourth chapter looks at a group of people whose numbers are growing rapidly but who often fall through the gaps in the hospital

system (Oliver, Foot & Humphries, 2014). These are frail elderly people. Successes of modern medicine have allowed many more people to live into old age, albeit while experiencing the consequences of multiple disorders and declining bodily functions. Yet, with appropriate support, they can still live a fulfilling and satisfying life. The loss of functional reserve does, however, mean that they will require specialist advice in hospital outpatient clinics from time to time, and are prone to episodes of illness when they will require treatment in hospital. The challenge, in an increasingly specialized hospital system, is how best to design hospitals that are appropriate to their often complex needs (Crews & Zavotka, 2006) and how to manage individuals who may have disorders of four or five different body systems, drawing on evidence such as that showing how procedures like comprehensive geriatric assessment can improve management and outcomes (Ellis et al., 2011).

This chapter looks at some of the more innovative approaches to responding to the needs of this vulnerable group of people. It includes the creation of care coordination mechanisms, whereby they are helped to navigate through the complexities of the health care system, and in particular, avoiding the risk of falling through the gaps. It also includes the availability of rapid access and response teams, located either in hospitals or in the community, but able to provide assessment and treatment wherever it is needed (Wright et al., 2014). In some ways, the process of ageing is the mirror image of development in childhood. Just as with children, frail elderly and, especially, confused people can find hospitals unfamiliar and disorientating. Yet, as with children, there is much that can be done to ensure that hospitals are friendly to older people when they do need to be admitted. One solution is the creation of dedicated frailty units, where patients can be cared for by specialized nurses with experience in issues such as falls, dementia, and incontinence (Conroy et al., 2014). And finally, it involves attention to hospital design, to ensure that the accommodation in which frail elderly people find themselves can meet their needs and expectations as effectively as possible.

The fifth chapter looks at another complex problem: cancer. This is an area that has been in the forefront of developing networks and multidisciplinary teams, recognizing the need for patients to be able to move seamlessly through a complex system from diagnosis to treatment and, if this is unsuccessful, to palliation. Often the management of cancer is straightforward, with surgery or radiotherapy achieving high levels of cure. But in many cases it is extremely complex. There have

been remarkable advances in our understanding of the biology of cancer cells, leading to innovative new treatments that target them precisely. However, this can only be achieved with close working between a wide range of specialists. As with many of the other areas considered in this book, this increased knowledge has brought about a high level of specialization, with oncologists, or in some cases teams of surgeons, interventional radiologists, oncologists and others working together, now increasingly specializing in cancer of a single organ.

Cancer care has also been at the forefront of monitoring and evaluation, with most countries having well-functioning cancer registries. This has made it possible to identify, and in many cases explain, variations in outcomes. In some countries this knowledge has contributed to major reorganizations of cancer services, and in particular the creation of integrated networks. Yet again, cancer reveals the importance of organization, with collaboration rather than competition among hospitals.

The burden of disease in high income countries is dominated by chronic disorders. Increasingly, these are managed out of hospital. This was not always the case, and even now in many countries people with diabetes spend long periods in hospital, especially if they have complications. To illustrate the challenges involved in the hospital management of chronic diseases, we have selected, for the sixth chapter, one condition: chronic obstructive pulmonary disease (COPD). In most cases, those affected will be managed outside hospital, but they will, from time to time, often experience exacerbations that require admission. As with stroke, in the past such patients were often admitted, treated, and discharged. Many of them would return frequently, especially in winter, so they became well known to the hospital staff. As this chapter shows, treatment has been revolutionized by new approaches to the active management of this condition, and in particular a major focus on prevention, involving measures to improve lung function. Yet, as with stroke and cancer, there are still large variations across and within industrialized countries in the extent to which services for these people have moved from a reactive model to one that actively seeks to restore them to as good health as possible.

The seventh chapter deals with that part of the hospital that has come, in the popular imagination, to represent acute health care. This is the case of emergency medicine. As with all of the other areas, this has changed remarkably. Traditionally, the emergency department functioned as the front door of the hospital, through which an undifferentiated mass of

people, with problems ranging from the trivial to the life-threatening, would pass. Those in the emergency department were confronted with the challenge of sorting them out, deciding which required immediate treatment and which could wait. Mixed among them were children, often exposed to sights that they would be forbidden from watching in a movie theatre. Now, however, the management of the acutely ill patient often begins before they ever reach the hospital, with trained paramedics commencing treatment in the patient's home, at the roadside, or in the ambulance. Once they reach the hospital, they are triaged rapidly, their needs prioritized, and appropriate treatment begun as rapidly as possible. As with the conditions discussed in the other chapters, technological advances have transformed many aspects of emergency medicine. There has been a growing recognition of the importance of early stabilization and resuscitation and in many cases definitive treatment. Yet again, this demands a high level of organization. Teams need to be brought together, they need shared protocols, and they need to be present, with the appropriate equipment and facilities, at all times.

The eighth chapter looks at another aspect of the work of the hospital that, for many people, characterizes it. This is what happens in operating theatres, but now increasingly also what happens before patients get to theatre and how they recover afterwards. Technological advances, for example in intravenous anaesthesia, allowing people to recover rapidly, as well as in minimally invasive surgery and interventional radiology, have transformed surgery. For many people, especially if they are young and healthy, this means that a procedure that would once have required an admission over several days can now be completed within hours, allowing them to return home that evening. However, these advances have also lowered the threshold for intervention, especially with regard to those whose conditions might once have precluded surgery (Moug et al., 2016). This, coupled with new opportunities for the more complex types of surgery, means that there is an increasing need for post-operative care, which has developed into a specialty in its own right. Again, this is something that requires careful planning, not just to put the systems in place, but to ensure the flow of patients through the hospital.

The final two chapters look at two of the reasons why the modern hospital developed in the first place: laboratories and imaging. As noted earlier, these are areas that have changed remarkably, in many different ways. Once, an imaging department depended on X-rays to look inside the body. Now, it can call upon ultrasound and MRI, with the bodily

organs highlighted using a multiplicity of contrast agents and, in some cases, radioactive tracers. It can do so with a precision undreamt of in the past, allowing the radiologist to view the patient in three dimensions and creating a form of virtual reality. In parallel, a new specialization has emerged. This is interventional radiology, where endoscopic instruments are manipulated under radiographic guidance, making it possible to undertake major proceedings without actually opening the body cavities. However, this has created tensions in some countries, with demarcation disputes between this new group of interventional radiologists and surgeons (Baerlocher & Detsky, 2009).

Laboratory medicine has also changed, again driven by advances in technology. There has been a remarkable growth in opportunities for near-patient and self-testing (Larsson, Greig-Pylypczuk & Huisman, 2015) but this has also created challenges as the results must frequently be interpreted by those with the expertise and ability to make an assessment of the whole patient. Increasingly, this means that pathologists are moving out of the laboratory, becoming part of the MDT caring for the patient, advising on the most appropriate tests that should be done and how their results should be interpreted, especially in patients that have multiple disease processes simultaneously.

Conclusion

As this introduction shows, the work of the hospital has changed beyond all recognition in a few decades. Yet its design has often failed to keep pace with these developments. In the final chapter, we will look at some of the challenges that face the hospital in the future. These include the growth of antimicrobial resistance, a problem that has largely been created by hospitals in the way that they operate. Yet there is now extensive evidence that the design and function of hospitals can do much to prevent its emergence. They also include the need to design hospitals in ways that take account of the needs of different groups of patients (Rechel, Wright & Edwards, 2009). As discussed already, these include children and frail elderly people. There are already many examples of good practice, with designs that address their needs, but too often there is a sense that the hospital has been assembled with no thought about those who will use it, whether this involves the use of materials that amplify noise at night, thereby preventing people from sleeping (DuBose & Hadi, 2016), or the lack of signposting that allows

people to get lost (Wright, Hull & Lickorish, 1993). Finally, it is often forgotten that those who spend the most time in hospitals are not the patients but the staff. At a time when many countries are facing acute shortages of health workers, it is essential that the hospital is configured in a way that is welcoming to them and allows them to do their work as effectively and efficiently as possible.

Above all, the pace of change is so rapid that it is essential that those facilities being designed today are built in a manner that is flexible, and allows them to adapt to these changing circumstances. We hope that this book will assist those who, in whatever role, are interested in hospitals and, in particular, how they can best meet the needs of patients and staff in the future.

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