Investigating infection management and antimicrobial stewardship in surgery: a qualitative study from India and South Africa

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Abstract

Objectives

To investigate the drivers for infection management and antimicrobial stewardship (AMS) across high infection risk surgical pathways.

Methods

An qualitative study, ethnographic observation of clinical practices, patient case studies, and face-to-face interviews with healthcare professionals (HCP) and patients was conducted across cardiovascular and thoracic and gastrointestinal surgical pathways in South Africa (SA) and India. Aided by Nvivo 11 software, data were coded and analysed until saturation was reached. The multiple modes of enquiry enabled cross-validation and triangulation of findings.

Results

Between July 2018–August 2019 data were gathered from 190 hours of non-participant observations (138 India, 72 SA); interviews with HCPs (44 India, 61 SA); patients (6 India, 8 SA), and, case studies (4 India, 2 SA). Across the surgical pathway, multiple barriers impede effective infection management and AMS. The existing, implicit roles of HCPs (including nurses, and senior surgeons) are overlooked as interventions target junior doctors, bypassing the opportunity for integrating infection-related care across the surgical team. Critically, the ownership of decisions remains with the operating surgeons and entrenched hierarchies restrict the inclusion of other HCPs in decision-making. The structural foundations to enable staff to change their behaviours and participate in infection-related surgical care is lacking.

Conclusions

Identifying the implicit existing HCPs roles in infection management is critical and will facilitate the development of effective and transparent processes across the surgical team for optimised care. Applying a framework approach that includes nurse leadership, empowering pharmacists and engaging surgical leads is essential for integrated AMS and infection-related care.

Keywords: antibiotic prescribing, infection control, ethnography, low- and middle-income country, surgery

Word count: 2650

Introduction

Delivering safe surgical care, across multidisciplinary and multi-locational (spanning the boundaries of primary and secondary care) peri-operative pathways remains a challenge, particularly in low- and middle- income countries (LMICs) [1]. Infections are the most common post-operative complication, with LMICs patients more likely to be infected with antibiotic resistant bacteria [2] and twice as likely to die due to infection-related complications compared to patients in high-income countries [3]. Surgical site infections, though preventable, are the most common healthcare associated infection [4]. In LMICs, healthcare associated infections remain a significant yet poorly quantified burden, compounded by a lack of surveillance and antibiotic consumption data [5,6].

Antimicrobial resistance (AMR) is becoming an increasing burden on healthcare organisations globally [7], and is rapidly spreading in Africa and Asia, due to strains on the healthcare system [8,9]. For actionable and impact-driven AMR research, it is essential to include all stakeholders, including different healthcare professional groups, patients and the public [10,11]. Variations in the social norms, values, and behaviours between surgical and medical teams have been reported, with different approaches to antibiotic decision-making [12]. The surgical teams attribute value to different outcomes and risks in relation to patient care, for example attributing greater priority to infection prevention than following antimicrobial stewardship (AMS) principles in order to prevent the emergence and spread of AMR in their patient populations[12,13]. Additionally, quantitative data reports more broad spectrum antibiotic use and longer course durations, in surgical patients with no evidence of infection[14]. Most of this evidence is from high income settings, with less known about the processes, behaviours, and drivers for AMS and infection prevention and control (IPC) in surgical specialties in LMICs [15], where due to lack of adequate healthcare infrastructure and cost implications patients may not always have access to healthcare, including surgery [16]. We conducted a qualitative study utilizing non-participant ethnographic observations, face-to-face interviews, and in-depth case-studies on infection management and antibiotic prescribing across surgical specialties in two academic institutions in South Africa (SA) and India.

Methods

The setting

This study was conducted across adult gastrointestinal and cardiovascular and thoracic (CVTS) specialties in two university hospitals with established AMS in SA [17,18] and India [6,19]. Hospital A in Cape Town is a 950-bed government funded hospital which in addition to being a tertiary centre, provides non-tertiary services to the local population. Hospital B in Kerala is a not-for-profit charitable 1350-bed tertiary centre. Data were gathered between July 2018 and August 2019. Ethical approval was granted by the University of Cape Town Human Research Ethics Committee (HREC ref. 499/2018) and the Amrita Hospital Institutional Research and Ethics Committee (IEC-AIMS-2018-INECONT-005A). All healthcare professionals in the selected surgical teams and their patients were eligible to participate in the study. Full informed consent was obtained from all study participants prior to inclusion in the study.

Inclusion and exclusion criteria

Using purposive sampling, all healthcare professionals involved in patient care in the included specialties and patients (medically cognisant, and able to provide a coherent account of their history) were eligible to participate in the study.

Study design

Ethnographic methods included non-participant direct observations, interviews (Appendix 1, supplementary data). Documentary analysis of handover sheets, multidisciplinary team meeting notes and existing policies provided contextual knowledge and supported cross-validation and triangulation of

the findings. The interviews took place following the observations to ensure that healthcare participants could be questioned about their infection management without affecting their behaviours during the observations. The interviews were semi-structured using interview guides for healthcare professionals, and patients (Supplementary data) developed through review of literature, and drawing upon previous work of the research team[12]. The interviews were audio-recorded and transcribed verbatim and anonymised prior to analysis. Case studies were generated by in-depth documentary analysis of medical records and patient interviews.

In India, several interviews were conducted in the Malayalam dialect. These interviews were transcribed in Malayalam, the transcriptions translated to English, and back-translated again to Malayalam (by VN and S Surendran) for accuracy. One patient interview in SA was conducted in English and Afrikaans and the transcription was translated by CB. All other interviews were conducted in English.

Analysis

A grounded theory approach[20,21], using inductive inquiry was used to analyse data aided by Nvivo 11®software. Grounded theory relies on simultaneous data collection and analysis, in an iterative manner that enables theory construction and does not rely on existing frameworks for analysis. The data from both settings were openly coded to identify key categories, which were developed into themes. The analysis was conducted through a process of moving between the coded data, data collection in the field, and the higher-level themes, until saturation was reached and no new themes emerged. Rigour and reflexivity were assured through regular discussions of the emerging themes between the researchers, and consensus on the emerging themes.

Results

In hospital A (SA), 72 hours of observations and 69 interviews (61 healthcare professionals, 8 patients) were completed (Table 1). In hospital B (India), 138 hours of observations and 50 interviews (44 healthcare professionals, 6 patients) (Figure 1, were completed. Six in-depth (two in hospital A, four in hospital B) case-studies were completed. Two case-studies, are summarised in Figure 2. These case-studies provide a contextual anchor for understanding the findings and represent two female patients, who required treatment for post-operative complications. The case studies illustrate the complexity in infection management in the surgical pathway, highlighting the number of healthcare professionals involved in the infection-related decision-making. These case-studies demonstrate that infections and antibiotic use remain a risk throghout the patient pathway and are not limited to the surgery itself.

The following key themes emerged from the analysis of the data.

Process driven, overlapping and shared roles and responsibilities for inpatient care

Though hospital A has a more developed AMS team, apart from removal of lines, the responsibilites in the surgical teams were similar across the two hospitals. Infection management and antibiotic decision-making for surgical patients require overlapping input, responsibility and action from many healthcare professionals (Figure 3). This can lead to lack of clarity about what needs to be done by whom (Table 2, Quotes 1-3). Identifying these implicit existing roles is important, as historically most AMS interventions target junior doctors, bypassing the existing roles that a wide range of healthcare professionals identify as theirs in relation to IPC and AMS (Table 2, Quotes 2-3), including the influence of the senior surgeons on one another (Table 2, Quotes 4-5).

Ownership for antibiotic management is focused within specialties

The bulk of decision-making about infection management and antibiotic use remains with the surgical and intensive care unit (ICU) teams; the pharmacists have a limited role. Nurses are not involved in decision-making, though they are responsible for the administration of antibiotics. An important factor highligted by nurses in hospital A is how direct communication, or the lack thereof, between the prescriber and nurses impacts timely antibiotic administration (Table 2, Quote 6). The anaesthetists are recognised as being responsible for ensuring timely surgical prophylaxis. Post-operative care is administered in the ICU or surgical wards, depending on the type of surgery and patients' condition (Figure 2). Though the intensivists take major decisions in ICU, the ownership for the post-operative antibiotic management can be tenuous. Other surgical colleagues, avoid challenging or intervening in unless invited to do so by the operating surgeon, whilst intensivists usually make decisions on antibiotic therapy in collaboration with the operating surgeon (Table 2, Quote 7-9).

Uncertainty and fear of failure influence how the surgeons manage infections, viewing antibiotics as a safety net more than a therapeutic cure (Table 2, Quote 10). The choice of post-operative antibiotics and targeting of therapy is driven and monitored by senior surgeons (Table 2, Quote 11). A similar approach is followed in the decision to send for culture and sensitivity. These decisions are often initiated by the junior surgeons but a quick account is sought from and/or by the senior team. Follow up of cultures and communication with microbiology is responsibility of junior surgeons. However, senior surgeons lead decisions related to the removal of indwelling catheters and lines. Whilst the leadership for surgical decision-making is clear, there are gaps in the leadership for IPC and AMS, outside of the ICU setting.

The most multidisciplinary and integrated model of care observed was in the ICU, where the surgical, intensivist, nursing, and pharmacy (in GI India) teams work together with microbiology and infectious diseases services to manage infections. This shared responsibility ensures patients are promptly diagnosed with infections and treated appropriately. The team dynamic between the specialties ensures that antibiotic decisions for patients in the ICU get reviewed and questioned and surgeons recognise this can have a positive impact on patient outcomes (Table 2, Quotes 12-13). The surgical teams recognise the input from microbiology and infectious diseases in targeting antibiotic therapy through the multi-disciplinary ward rounds. Their input however, is viewed as a consulting service and the antibiotic decision-making for surgical patients remains within the surgical teams (Table 2, Quote 14).

Hierarchies restrict the integration of IPC practices

The patient case-studies (Figure 2) highlight the vulnerability of surgical patients to post-operative infections, and the complexity of care pathways that include multiple healthcare professionals. Organisational policies and expectations in both settings considers IPC the responsibility of all staff. In practice, however, there is significant variation in terms of how much staff engaged with IPC as a core part of their role, or considered it their responsibility (Table 2, Quotes 15-19). As in the previous theme, the most integrated IPC care is in the ICU, where cohesive teamwork enables nursing staff to participate in and amplify their concerns (Table 2, Quote 16). Hand hygiene was sporadic across all specialties and units, and often not performed appropriately (Table 2, Quote 14). On wardrounds, senior surgeons would use alcohol gel between patient consults, though they had not examined the patient, performed a procedure or touched the patients' surroundings whilst the junior doctors who had been carrying out these tasks would sometimes not adhere to hand hygiene. The responsibility for promoting and monitoring IPC is apportioned to nursing staff, who often due to entrenched hiearchies may not feel able to challenge deviations from expected behaviour (Table 2, Quotes 18-22). The existing hierarchies mean that often, it is the head nurse or sister who is relied upon to feedback on IPC behaviours, causing a delay in correcting behaviours (Table 2, Quote 16- 18). Contact precaution measures and isolation rooms can have consequences for patients who may feel that they are responsible for their infection (Figure 2, case study A), whilst clinicians consider it a barrier to patient rapport (Table 2, Quote 16).

Patients as drivers for antibiotic prescribing

Healthcare staff recognise that they need to consider individual patient factors, and that the patient can influence their decision-making. In hospital B, clinicians recognise the need to consider the financial implications of treatment decisions for patients, as patients are paying out of pocket or need procedures not covered by their insurance. In such cases, therapy is often tailored to meet financial capability (Table 2, Quotes 23-24). Additionally, if treatment is expensive, this may result in patients having to be transferred to state hospitals once their personal funding is depleted (Table 2, Quote 25). Where patients are able to choose the healthcare provider, it is difficult for clinicians to negotiate with patients to delay antibiotic treatment or take a more conservative approach to antibiotic use, as patients could choose to go elsewhere for their care if they were not satisfied (Table2, Quotes 25-28).

Discussion

Infection management and AMS remain key priorities for safe surgery. As illustrated by the case studies, AMS should focus on post-operative antibiotic prescribing. The expectation placed on surgical teams to optimize antibiotics needs to be managed in the context of the way those teams work and the roles and responsibilities that individuals have in relation to infection management. To date, AMS programmes in hospitals have focused on medical specialties and taken a one size fits all approach. This means that often an expectation is placed on healthcare professionals to adopt behaviours which may not be appropriate for the challenges they face within their practice and the resources available to them. Where surgical AMS programmes do exist, they tend to target junior doctors[22], overlooking the collective nature of clinical decision-making and the important role of senior surgeons in overseeing care and making critical decisions[12,13]. This may speak to a universal truth in surgery having a named surgeon responsible for the outcome of individual patients (and many accept that this is important). Individual surgeons cannot however be at the bedside at all times (and neither can members of their team) - therefore we need shared responsibility and better interdisciplinary team working - for many decisions, particularly those not directly related to the surgery. There needs to be greater recognition of the role of the wider workforce (e.g., nursing) within surgical teams. Learning from models of care in the ICU and developing nurse leadership and other stakeholder engagement will enable their participation in infection management[23].

Engendering a sense of responsibility to ensure consistent practices, requires clarity on expectations from staff and defining explicit roles and responsibilities. We propose a framework approach to help identify and fully utilise the existing roles of surgical team members within IPC and AMS programmes (Figure 4). This can be supported by a better understanding of where individual staff feel responsibilities lie, and how they see their role in the process. Whilst stewardship teams can initiate this process, successful outcomes can only be achieved when there is local ownership for infection management and AMS. To support this we need to broaden the definition of surgical teams to include pharmacy and nursing staff[24,25]. When developing AMS programmes for surgical teams, the proposed framework can be applied to ensure that the key components necessary for sustainable change are addressed. This framework builds on research from high-, low- and middle income countries[9,26,27].

Patients and carers' roles in self-care and their experience of infection related care in the surgical pathway also need greater recognition. The dynamic of patient participation in and expectation of care is further complicated when the patients are paying for the healthcare services. The expectation to be given effective therapies often includes being prescribed antibiotics. An understanding of the wider social and cultural determinants is required in order to effectively foster an environment where patients can be more involved in their own care. This is important in the pre-operative preparation and post-operative wound

care and recovery process. These findings are particularly pertinent in the current viral severe acute respiratory syndrome coronavirus pandemic which has highlighted the not only the critical need for IPC and AMS measures but has identified surgical populations at increased risk of poorer infection outcomes[28]. Applying a framework approach to integrating IPC and AMS practices in surgical pathways will help address these challenges and assure safe surgical outcomes and track the long-term impact of this pandemic on infection related outcomes.

Limitations

Collecting data across different healthcare organisations, using multiple researchers posed challenges to systematic comparison of the data. To mitigate against this, we employed a rigorous extended-period face-to-face training for the researchers to ensure consistency in the data gathering and analysis process. The findings may not necessarily be generalizable to other hospitals in South Africa or India, where the availability and level of staff training, and increased demand on healthcare services, compounded by the limited infrastructure, may present additional, significant challenges.

Conclusions

Effective and sustainable integration of optimised infection management and AMS in surgical pathways needs a framework approach that recognises the structural foundations to support staff to be able to change their behaviours. We need to broaden the definition of surgical teams to recognise the role that nurses and pharmacists can play in patient care, leading to optimised outcomes. To optimise practices, inter- and intra-disciplinary models of care which recognise the critical need for co-management of surgical patients across professional boundaries and across the surgical pathway are needed.

Author contributions:

S Singh, MM, CT, AH, and EC developed the study design. S Surendran, VN, CB, OM, and EC were responsible for data collection. S Surendran, VN, CB, OM, CT, AB, TP, S Singh, PD, MM, and EC assisted with data interpretation. EC, VN, CB, OM wrote the first draft of the paper. All authors have critically read and commented on draft versions of the manuscript and approved the final version.

Transparency declaration

All authors have completed the ICMJE form for uniform disclosure Form for Disclosure of Potential Conflicts of Interest and declare. No disclosures were reported.

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Figure 1 The data gathering and analysis process

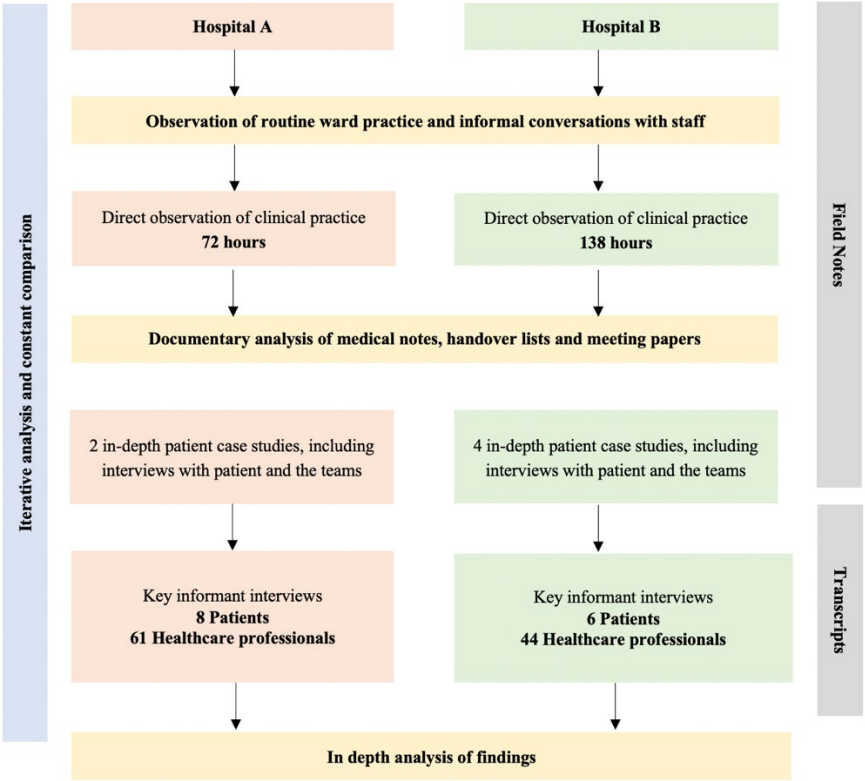
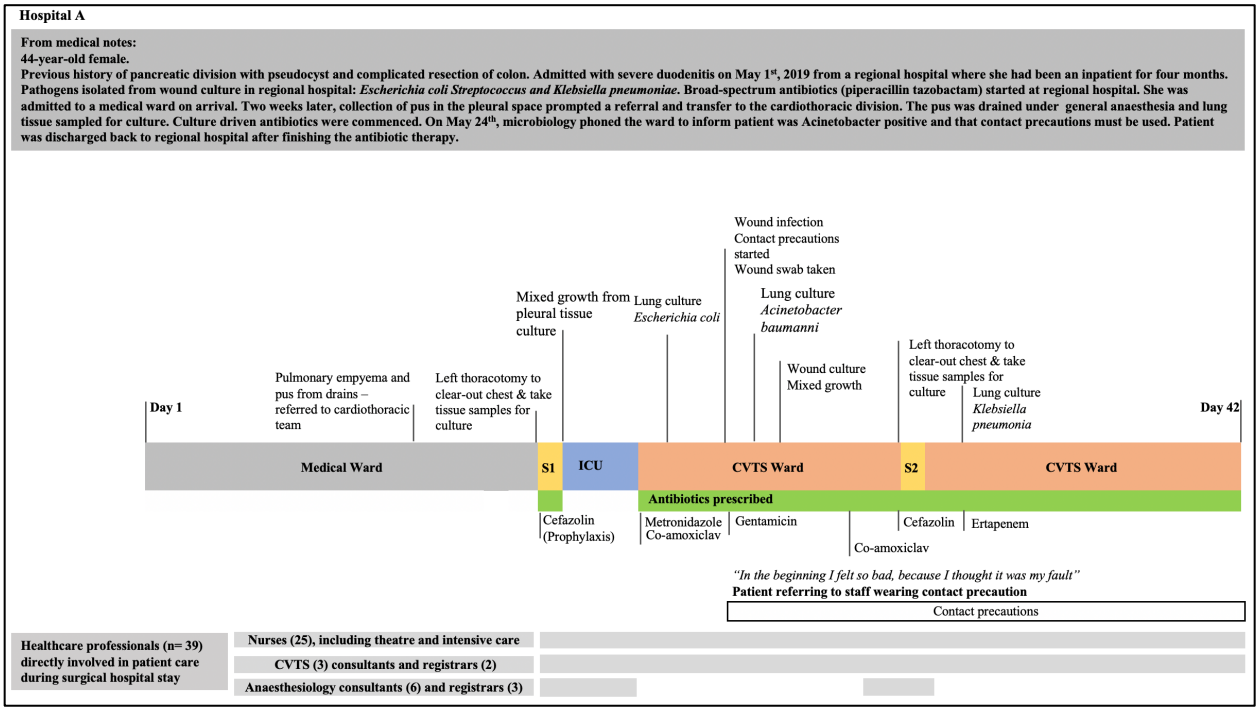
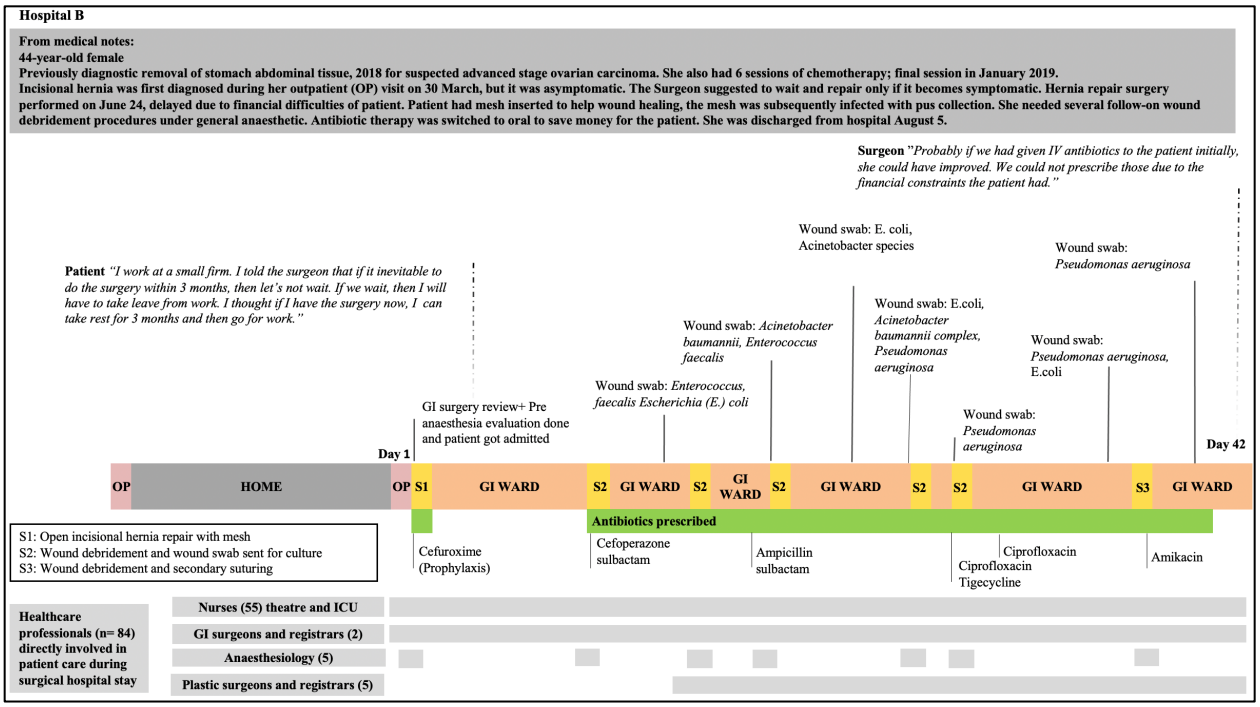


Figure 2 The illustrated surgical pathway for two patients in SA and India

2 a) Case study hospital A



2 b) Case study hospital B



South Africa Gender M:F (Total)	Specialty/ Profession	India Gender M:F (Total)
AMS (ID, Microbiology, Infection Prevention and Control)		
5:3 (8)	Consultants	-
1:0 (1)	Registrar	-
0:3 (3)	Nurses	-
Pharmacy		
0:3 (3)	Pharmacists	1:0 (1)
Anaesthesiology		
1:0 (1)	Consultants	2:1 (3)
Cardiothoracic Surgery/ICU		
7:1 (8)	Consultants	5:0 (5)
2:0 (2)	Registrars / Residents	1:0 (1)
0:13 (13)	Nurses	2:5 (7)
0:3 (3)	Patients	1:2 (3)
-	Medical Social Worker (patient liaison staff post only in India)	0:1 (1)
GI/Acute Care Surgery		
5:2 (7)	Consultant	10:0 (10)
-	Registrars/ Resident	7:0 (7)
2:13 (15)	Nurses	0:6 (6)
2:3 (5)	Patients	1:2 (3)
-	Medical Social Worker	0:3 (3)
23:38 (61)	**Total healthcare workers**	28:16 (44)
2:6 (8)	**Total Patients**	2:4 (6)
25:44 (69)	**Total participants**	30:20 (50)

Table 1 Participant demographic data for the face-to-face interviews

Table 2 The key emerging themes from interviews and observations, normal text denotes observation notes, italics denotes quotes from participants

Theme 1 Process driven overlapping and shared roles and responsibilities
Quote 1 Registrar asks nurse (doing an extra shift from a different ward) whether the social worker had seen the patient as discussed in a grand round. The nurse leaves the bedside to check with ward staff who worked on the previous day. None of them had seen the social worker. A senior nurse (who just returned from leave today) enters the space. She is asked by the registrar, who wants to know who is in charge, why this order was not followed through. The senior nurse explains that she has been away and that the manager is off sick. The registrar mentions a list of people who he will report this to and compares it to another case, where a patient's hospital stay was extended for weeks because a similar issue was not sorted. He says firmly: 'I want this sorted out today!'. Frustrated, he pages through the patient's notes and when he sees the medication charts, he aks: 'Why is this in such a mess? It's like dog meat!'… He then asks if the patient has any lines *in situ*. The nurse lifts the sheet off the patient's arms and hands, saying she doesn't think so. The researcher points towards an intravenous bag connected to a line running under the sheets down the middle half of the bed. The team follow the line and find that the patient has a central line in the left groin. The registrar asks for the line to be removed. **Observation notes, Hospital A Ward round, CVTS**
Quote 2 *A surgeon's advantage is that, we have a lot of medical background, obviously because we all go through the same training, but unfortunately what the medical doctors lack is the surgical background, which is not easy, I mean if we read up, we can get a lot of medical knowledge, but unless they are in the war zone they won't learn any of the guerrilla warfare. I mean you know it is very difficult for them to actually think in our perspective of things. I might not realize for example, two days back, I operated on a lady for biopsy, infected biopsy and she is off antibiotic now. Move on to day 2 and they started her on cefaperazone-sulbactam, I stopped it yesterday, because the source control is attained, everything is fine, she is not having fever, no tachycardia and no leukocytosis, nothing, CRP is normal, already controlled, we can reserve it for her future.'* **Consultant Surgeon (29), Hospital B, GI**
Quote 3 *'You can't do everything yourself. There are other fires to fight and you have to choose which one is going to burn down the forest first and sometimes they (registrars) have done all they can at that time. They've prescribed the antibiotics. Because they've got another patient to see, another patient to book for theatre, another patient needs to be treated before they can go to ICU, so they can't physically follow antibiotics around all the time…so things get weighted. As I say, the patient is … if sepsis is their main problem and you've addressed it surgically, then the antibiotics need to happen. We think surgery is going to make them better, not the antibiotic, but they work together…we prescribe antibiotics and then we expect it to be done, because I don't administer antibiotics. I don't mix any antibiotics. I've never been shown how to do it. I have a reasonable expectation that that is their* [nursing] *job and that they will see it through.'***Consultant Surgeon (26), Hospital A, GI**
Quote 4 Surgeon A suggested to stop antibiotics as procalcitonin is low and cultures are negative. Surgeon B asked the team why an antibiotic was started. Surgeon A and C said: "patient's platelet was low, and temperature was 99^0F". They then had a discussion. Surgeon B wanted to continue the antibiotics for 7 days and Surgeon C also suggested the antibiotics be continued until the central line is removed. Surgeon A however wanted to stop the antibiotics as there was no indication to continue them. Finally, after an intense discussion, Surgeon B convinced Surgeon C that antibiotic should be continued. Surgeon A did not seem convinced by the decision. **Field notes, Hospital B, A three-consultant led ward round, CVTS**

Quote 5

'One thing it [shared decision making between surgeons] *prevents is loose cannons. If I write an antibiotic, somebody else is absolutely free the next day to question, "why is the patient on antibiotics?" And usually if it comes down to an objective analysis, if it is not based on evidence, it tends to be stopped sooner rather than later. For appropriate antibiotic therapy, having a team care model seems to be better than an individual. Individual persons tend to have their biases and when there are no crosschecks, the biases tend to carry on.'* **Consultant Surgeon (21), Hospital B, GI**

Theme 2 Ownership for antibiotic management is focused within specialties

Quote 6

The consultant and registrar discuss the diabetic therapy for the patient on whom the registrar had performed emergency appendicectomy the previous evening. The registrar) retrieves, from her smartphone, a picture taken during the procedure. She shows the picture to the consultant and other registrars. When the consultant sees the picture, she immediately agrees to start antibiotics, telling the patient that the 'uterus looks infected' and that they were going to give antibiotics and then take out the drip and hopefully she could be discharged the next day. The consultant and two registrars present discuss the antibiotic regimen and the registrar who had operated, prescribes them onto the paper chart. He discontinues the co-amoxiclav and writes up azithromycin, ceftriaxone and metronidazole. He gives the chart to the nurse. She reads it and says that it doesn't make sense as 'they want the drip to come out'. The azithromycin frequency is a stat dose, while no frequency is written for the other two antibiotics. **Field Notes, Hospital A, GI ward round**

Quote 7

'*I promise you if I operate on a patient or my colleague operated on a patient, the patient must get better. We didn't come here to make the patient sicker. You must have that in your mind. I light the lamp every morning, I pray for the health of my patients because they must go home, they have got families, they have got kids, I mean, what else are we going to do? Did we get into this job just to look at bloods? No, we got in this job to sort something out. That's what's a surgeon's prerogative is, you are here to do something. A surgeon generally is one or two things, either I can help you or I can't help you. If I can help you, I must help you. If I can't help you, I tell you I can't help you. I'll send you for palliation, that's it. We are not physicians; we don't have much of grey, we are black and white. I can, I did, I put in a lot of hard effort here, get better, have a good life.'* **Senior registrar (16), Hospital A, CVTS**

Quote 8

'Surgeons are still very powerful and when the patient is not doing well, sometimes science defies them, and you cannot do anything to stop. You know that what they are saying is not correct, but they are worried because their patients are doing badly, so you start meropenem today, ceftriaxone tomorrow, move on to ertapenem the day after and you are helpless, because the patient is doing badly and nobody can do anything. I think surgeons will have the final call because after all, it is the patient who comes to them and they operate and they are largely responsible for the outcome, however, suggestions [from anaesthetists, AMS, and ICU doctors] *and seeing the consistency and inputs, which are there, they probably will build a sense of trust and then inputs could be shared as amicably as possible.'* **Anaesthetist Consultant (23), Hospital B, GI**

Quote 9

'What we follow is that whoever has operated on that patient, you know he should not feel that somebody else has caused a problem for him, so we do tend to leave it like that, we do not pull rank there like I would suggest that can we stop it, but if he insists, I would not continue at all [to suggest changing antibiotic or stopping it]. **Consultant Surgeon (2), Hospital B, GI**

Quote 10

'One of my old seniors used to say, 'antibiotics might make a third-class surgeon a second-class surgeon, but they never make a second-class surgeon a first-class surgeon'. I know it is that fear that let me not to take a chance. I do not think it is a challenge rather, you know, fear that their own surgery will be inadequate. Most of them tend to be quite confident about the surgery, but they, we always have this feeling that something else, is going to make a difference in our results. Overtime when they see that it has not made a difference or they have seen across the spectrum, they tend to change those habits. I think it is more that fear of 'let me not to take a chance and something might go wrong' which is there.' **Consultant Surgeon (2), Hospital B, GI**

Quote 11

'The registrars (junior doctors) would be the ones, you are doing a ward round you see a wound that is not looking so good and you start antibiotics. You do the cultures and everything and you start antibiotics. The consultant will come in and say that perhaps these antibiotics are not a right choice, we should change it to this or discuss it with microbiology.' **Surgeon, Hospital A, GI**

Quote 12

And then if this [antibiotic prescription] happens in ICU a decision will be taken by the intensivist. They are the ones who will initiate antibiotics in most cases. And then if a decision is taken on the ward round, it is usually the intensivist together with the consultant cardio thoracic consultant who is there in that ward round. **Surgeon (14), Hospital A, CVTS**

Quote 13

'We are working together as a team; that is a check. If I get overwhelmed by a patient's situation and write something which is not rational at that point of time, for example, if I write a dose of colistin or polymyxin or tigecycline for a patient who probably does not need it, somebody in my team will sound it in the next day, so one dose would go but by then some discussions definitely arise, usually in ICU. So multiple discussions like that has now resulted in a situation where…. there is a restraint, especially in my team I have seen a restraint because there will be a fight otherwise, but many a time, these things are overlooked.' **Consultant Surgeon (11), Hospital B, GI**

Quote 14

'If the registrar initiated it we would continue it but we would also consult microbiology…that's why we have rounds with microbiology so that we can consult and streamline because there is no use going broad- you need to be focused and that's the big thing about our antibiotic protocol.' **Senior Registrar (16), Hospital A, CVTS**

Theme 3 Hierarchies restrict the integration of Infection prevention and control practices

Quote 15

One of the ICU consultants and one of the GI-acute surgeons discuss the patient's progress and plan. The surgeon puts on an apron, ties it at the back and then puts on gloves and goes around to the patient's bedside. He reaches out with his long-sleeve-clad arm and gloved hands to assess the patient's wound, moving some pipes aside. The GI intern goes to the patient's bedside, to help the surgeon. The ICU consultants slaps his hand away playfully, and tells him, 'You don't touch a patient in the ICU without gloves and aprons, especially this patient with *Acinetobacter* and *Klebsiella*. The intern remarked that this ICU works differently from where he normally works. The ICU consultant responds, saying that this is how he should work. The intern laughs and tells consultant that she must tell them. The consultant returns, 'I'm telling you, take it back to them'. **Observation notes, Hospital A, GI ICU ward round**

Quote 16

'We're generally fairly lackadaisical with hand washing, and barrier protection, so people will go into the room [patient isolation rooms] *and it is a problem. I think I find the issue of, putting on aprons and gloves and not sitting on the patient's bed is, you know you lose something. You know if you sit on the patient's bed without aprons and*

gloves you have a much closer contact with the patient and it's, you know it's getting in the way of that relationship. And I think that, perhaps, when we have a colistin resistant drug, or a pan resistant bacterium, if there were people walking around in space suits everyone would take it a lot more seriously. But we've got a kind of like a blue apron and pair of gloves, perhaps the kind of whole HIV epidemic and our dealing of that is that we've become quite casual with infectious diseases. I think we are more casual than we should be. We've got a major problem with nursing ... they're overrun. There is just not enough of them... and the leadership from nursing isn't.. to me, you need a head-sister not letting doctors into the room unless they've got their apron on, and that sort of, it doesn't happen too much. I don't think they'd [doctors to head nurse] *respond to it positively at all but they would do it.'* **Consultant Surgeon (11), Hospital A, GI**

Quote 17

'We are auditing who are all the people touching the patients without hand washing. My name has come up many times, and all my colleagues' names are there and a lot of anaesthesia colleagues also. One thing is that they know the nurses should be more proactive, and they should have a little more decision-making ability. They should say that okay, no you are a doctor, you have not washed your hands, so please wash your hand before touching. They are not able to say that. Why they are not able to say that is probably the hierarchy and their lack of confidence. See, if you are a nurse with a 10 to 15 years' experience in the ICU, then you will have the confidence to say. If you are a nurse who has just came out from the nursing college and joined the cardiac surgery ICU, then they are scared to talk. There is basically a lot of fear.' **Consultant Surgeon (15), Hospital B, CVTS**

Quote 18

'The main source of infection is from the caregiver when they downplay the importance of handwashing and sometimes when the physician or surgeon is asked to have a hand wash before touching the patient, it may not end on a sweet note, but it plays a major role. If my primary worry is regarding the patient, definitely we will follow this and, in our ICU, each staff is assigned a particular patient for a few set hours. If some clinician is coming in and meeting that patient and if they are not washing their hand immediately, the nurse is noting down the person's name and usually by the end of the week, this information is passed from the head of the department down to every one saying you are scrutinized. So, you do not want to hear your name repeatedly for the same mistake.' **Consultant Surgeon (14), Hospital B, I14 CVTS**

Quote 19

'Usually in surgery, main thing is that [to make sure] *we are changing the dressings well, we are removing the drains. Those are the most important when sisters are giving drugs* [through] *IV* [intravenous] *lines, when they are taking care of the central lines and IV lines. Those are the most important things. Sisters are the ones who are going to give the IV, they are using the central line. They are going to give all the drugs, so they should be more conscious. They should wash their hands before touching the patient before giving the IV drugs. After giving drugs also they should wash because there is high chance that they can* [introduce] *infection directly to the central line which can cause blood borne sepsis, so that is more important, central line care and IV-line care. Then after that the wound infections and wound dressings while doing the dressings. Those two are the important ones.'*
Registrar (7), Hospital B, GI

Quote 20

We tell them [to practice IPC precautions] *but they* [doctors] *just ignore us sometimes. Sometimes you meet difficult doctors and you see you can't tell him or her. Then you just leave it. It is difficult.* **Staff Nurse (34), Hospital A, GI**

Quote 21

"If it is in a ward, we can say the nurse's role is important [in infection control practice], but here in ICU, we can't say that only nurses role is important. It is true that nurses are the one who administer the medications and other things, central line use is more for nurses etc. but when there is an emergency, sometimes doctors do administer the medicine or doing an echo, like this many people are involved. So I feel, in the ICU both doctors and nurses have an equal role in the infection control practices." **staff nurse (34), Hospital B, CVTS**

Quote 22
When the nurse has been assigned a patient, the nurse can always tell anybody; it may be a doctor or any technician or anybody, if they are not following the infection control practice before touch his/her assigned patient, they can directly tell them to follow…. If the staff is less experienced, maybe below 6 months, they may not tell. They would be scared or hesitant to tell, but we train them to tell directly. **Staff nurse (37), Hospital B, CVTS**

Patients as drivers for antibiotic prescribing decisions

Quote 23
'And you are all talking about evidence-based medicine, but in India what matters is a socioeconomic factor. Socioeconomic factors decide the choice of therapy in most cases, not evidence based medicine and who is going to make that socioeconomic, patients won't make, you have to as a doctor, you have to make that choice whether this is good for our patient, you know, or whether I should cut down this and give this.'
Consultant Surgeon (15), Hospital B, CVTS

Quote 24
'If we had started IV antibiotic from the beginning, probably she would have improved quicker. We had initially begun treatment with IV antibiotic but since she could not afford it, it was changed to oral. Even though the microbiologist had suggested [stronger] *antibiotics, we could not prescribe those as she wasn't willing to buy them. We prescribed a* [stronger] *antibiotic towards the end when we could arrange it for free from the hospital pharmacy. However, this could only be given for 2 days.'* **Surgeon (TBC), Hospital B, GI**

Quote 25
'The finance aspect plays a big role for selecting the antibiotic; in some patients who have complete financial restraints, we will have to maybe reduce the doses or take into consideration other drugs, which can cover the bacteria even though if it is not sensitive. In those cases, the other thing that happens is they will want to go to another hospital, probably somewhere in medical college where the medicine is free.' **Pharmacist, Hospital B, GI**

Quote 26
'The surgeon informed me that I have a hernia. He said that a surgery would be required but it is not urgent. The Surgeon said that with medicines, the surgery could be postponed up to 3 months later. Since the surgery is inevitable, I wanted it to be done immediately as it would be difficult for me to get leave later from the firm where I am working.'
Patient 47, Hospital B.

Quote 27
'You need to talk to [patients] *I think, you need to tell them that: "okay you have a fever but the fever need not necessarily mean the presence of an infection… however, if you develop certain signs of an infection, then do come back to me and in that case I would definitely start an antibiotic for you"… basically to convince the patient. If I am able to convince the patient, the patient will go back happily, if I am not able to convince the patient, the patient will go from me to another surgeon, and to another surgeon, ultimately to a surgeon who will actually prescribe an antibiotic and then he would be happy, so he will go off doctor shopping.'* Surgeon, **(6) Hospital B, GI**

Quote 28
'Patients don't give a history of disease, but a history of antibiotics.' **Surgeon (6), Hospital B, GI**

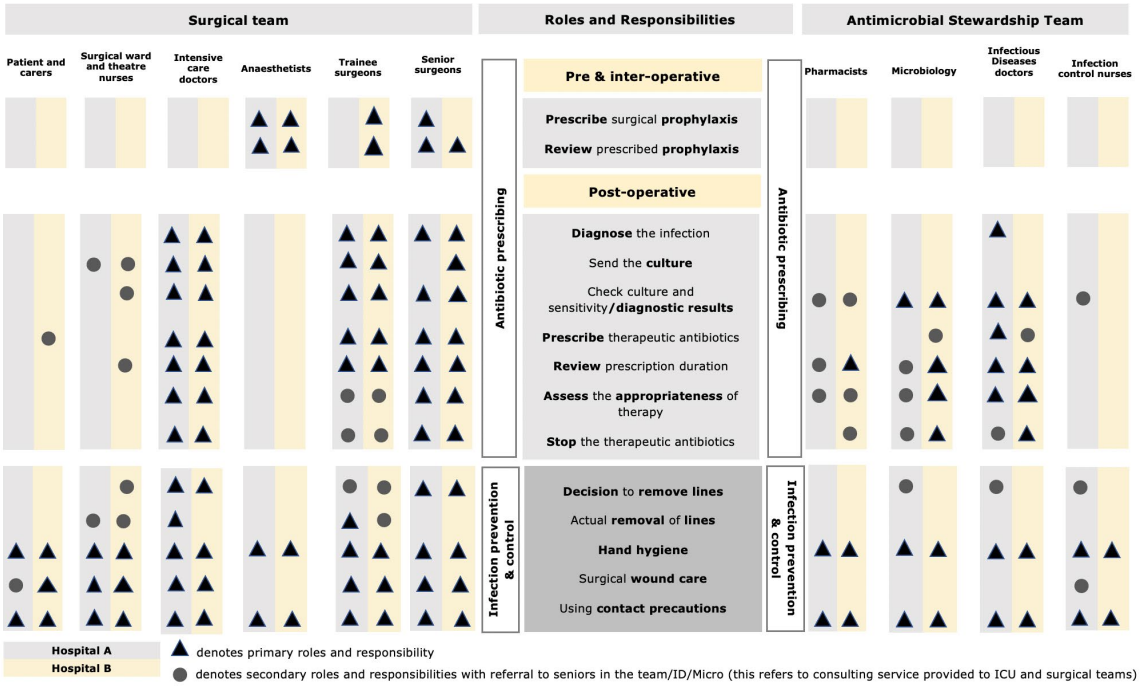


Figure 3 Roles and Responsibilities in relation to antibiotic prescribing and infection prevention and control

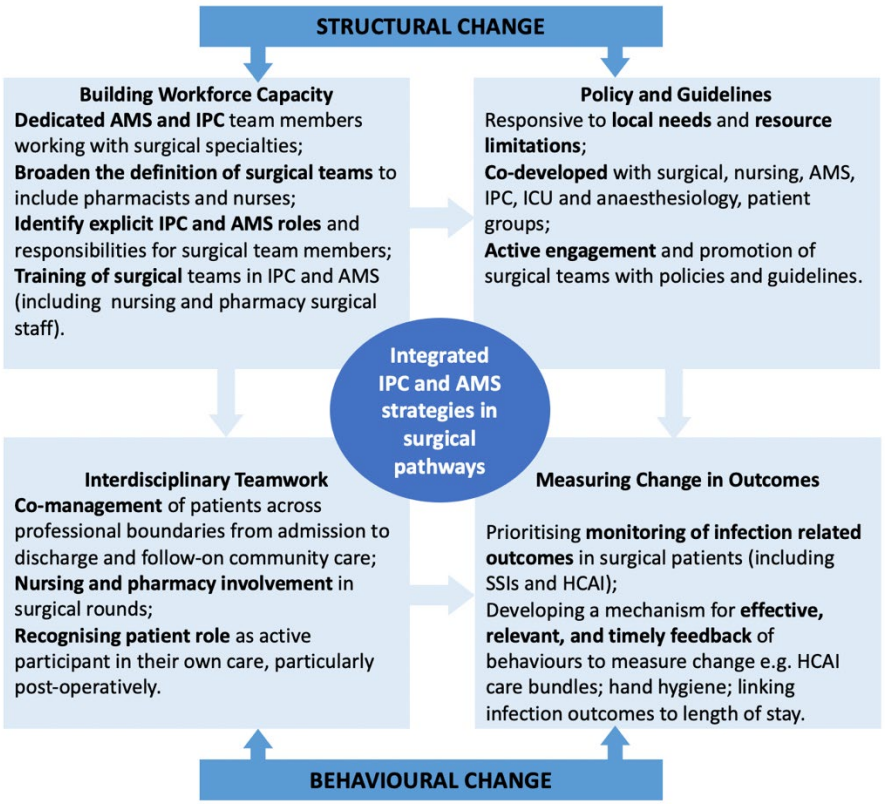


Figure 4 A framework for more integrated care in infection management across surgical pathways

Supplementary Material

Investigating infection management and antimicrobial stewardship in surgery: a qualitative study from India and South Africa

Authors: Sanjeev Singh et al.

Appendix 1: Ethnographic data collection guide

Episode of Observation	Ward practice	Ward Rounds	Multidisciplinary Meetings	Shadowing individuals
Data Collected	Duration The time of day A general description of the ward layout Number of bay and side beds A description of the activities taking place A description of the people working on the ward The patterns of activity	Duration People in attendance Who lead the ward round The number of wards visited The number of patients visited What was discussed – who lead the discussions, who contributed What tools were used e.g. electronic prescribing, smartphones What tasks were identified Who was responsible for carrying out tasks What interactions there were with patients What interactions there were with other healthcare professionals What each member of the team did during the ward round i.e. what they contributed or if not contributing what they were doing Any emotions expressed or felt My contribution, if any, to the activities e.g. pulling curtains, getting gloves for consultant Any disruptions to the activity	Duration Meeting type e.g. Morbidity & Mortality meetings Who attended What was discussed Who lead the discussion Who contributed to the discussion What, if any, data was used or presented Who presented the data Any emotions expressed or felt	Duration Type of activity e.g. nurse medication administration Any dialogue between observer and participant Any disruptions to the activity The interactions of the healthcare professional with patients and other members of staff Places visited Tools used e.g. guidelines, electronic systems My contribution, if any, to the events taking place e.g. helping the pharmacist/ doctors with the electronic prescribing trolley

Appendix 2: Healthcare Professional Interview Guide

Research study: Antibiotic use across Surgical Pathways - Investigating, Redesigning and Evaluating Systems (ASPIRES Study)

Work Package two: Roles and Context, an ethnographic research of the surgical patient pathways in Cape Town: Part of an ESRC funded project optimising antibiotic use along the surgical pathway

Healthcare professional sample interview questions (to be developed and piloted) – *These are template guiding questions and will be supplemented by any points that are raised during the ethnographic observations*

Category of enquiry	Sample questions
Opening questions:	**1. Can you describe your role in the surgical pathway within your team?**
Roles and responsibilities – antibiotic prescribing/management	1. Thinking about surgical antibiotic **prophylaxis** – who is responsible for this in your opinion in the surgical pathway? - Do you think this is clear within your team? - How is this delegated? - How does it work in practice? 2. What factors influence when you decide to start **therapeutic** antibiotics for your patients? - What factors influence/determine when and how you review the antibiotic prescriptions for your patients? - What factors influence/determine when you decide to stop antibiotic prescriptions for your patients? 3. Who is **responsible** in your team for antibiotic prescribing decisions post-surgery? - How is this delegated? - How does this work in practice? 4. Do you think you personally have a role or responsibility in determining how antibiotics are used for patients being cared for by your team/specialty? What does this involve?

	5. How easy is it to work with other members of your team to make decisions about antibiotic use? What roles do other staff members play? 6. Does the patient have a role to play? If yes - In what way? 7. Who within your team would you say has the most influence on your antibiotic prescribing decisions (or your role in the way antibiotics are used)? 8. What do you think about the way antibiotics are used in this hospital for surgical patients? - Can it be improved? If yes, - How can it be improved? 9. **What influences how you allocate the available resources both human and economic?** 10. Are you aware of any **policies or guidelines** in your organisation/specialty for antibiotic prescribing? How effective do you think these are? 11. What is your point of reference if you wanted to seek more information about using antibiotics? 12. Do you get any feedback about the way antibiotics are used in this hospital? 13. What are the **external (if any) influences such as policy, governance, inspections** on the way antibiotics are used within your team/ hospital? 14. **What or who influences** how much priority you give to antibiotic prescribing and management? 15. Thinking across the surgical pathway, where along the pathway do you think it is critical in terms of antibiotic prescribing?
Roles and responsibilities – infection management including SSI	1. To what extent is infection prevention and control in surgical patients a high priority in your day-to-day work? Why? 2. Do you think you personally have a role or responsibility in preventing infection in surgical patients? What does this involve? 3. How easy is it to work with other members of your team to try to prevent infections? What roles do other staff members play?

	4. Does the patient have a role to play? In what way? 5. Thinking across the surgical pathway, where along the pathway do you think is critical in terms of infection prevention and control? 6. Who do you see as having **responsibility** for preventing infection at this stage? 7. How well do things work in this hospital in relation to avoiding infections in surgical patients? Why? What are the main problems? 8. What do you see as the **external (if any) influences such as policy, governance, inspections** on the infection management procedures within your specialty/the surgical pathway in your hospital? 9. **What or who influences** how much you priority you give to infection prevention and management? a. **What influences how you allocate the available resources both human and economic?** 10. Are there any **policies or guidelines** in your organisation for infection prevention and management? a. Do you use some sort of checklist at any point in the surgical pathway? b. What has been your experience of using these checklists? 11. Are you aware of any data on surgical site infection rates and/or infection outbreaks in the patients within your specialty? What about within your hospital? - Would you like to receive data on surgical site infections in your patient group?
Reporting structures and data – antibiotic prescribing and infection prevention and control	1. Is there a **reporting structure** for antibiotic use and prescribing within your specialty? a. What about within the hospital? 2. What are the **quality indicators**, if any, for antibiotic prescribing at specialty level? 3. **Who** measures these? 4. How are indicators **reported**? How often?

	5. How much of the data collected is shared within the specialty? a. If it is shared, how is it shared? b. Via what mechanism? Mass email? Newsletter? c. How often is it shared? Weekly, monthly, etc. d. Is there any **demand within your specialty** for information/data on antibiotic prescribing? 6. Is there a **reporting structure** for infection prevention and control within your specialty? a. What about within the hospital? 7. What are the **quality indicators**, if any, infection prevention and control at specialty level? 8. **Who** measures these? 9. How are indicators **reported**? How often? 10. How much of the data collected is shared within the specialty? a. If it is shared, how is it shared? b. Via what mechanism? Mass email? Newsletter? c. How often is it shared? Weekly, monthly, etc. d. Is there any **demand within your specialty** for information/data on antibiotic prescribing? e. What about for infection prevention and control? 11. In relation to antibiotics **what kind of data** would you like to have available at organisational or local level? a. Why this particular data? b. What about for infection prevention and control? c. Why this particular data? *If not picked up in above then ask:* 12. Are you aware of any specific antibiotic prescribing or infection control related **committees/meetings/units**? a. Who is represented here? b. How often do they meet?

	c. Is there cross-representation at other units/teams? i.e. how is information shared across teams/committees?
Final questions	13. Is there anything you'd like to add to what we have discussed?

Thank you for taking the time to participate in this research.

Appendix 3: Patient Interview Guide

Research study: Antibiotic use across Surgical Pathways - Investigating, Redesigning and Evaluating Systems (ASPIRES Study)

Work Package two: Roles and Context, an ethnographic research of the surgical patient pathways in Cape Town: Part of an ESRC funded project optimising antibiotic use along the surgical pathway

Category of enquiry	Sample questions
Opening questions:	1. Can you tell me about the operation you had recently at X hospital – what operation did you have? Was this planned ahead or was it an emergency/urgent operation? 2. Were you alone or did you have a relative/friend/carer accompany you and provide help?
Infection prevention pre-op	3. Were you seen by a healthcare professional prior to the operation in order to prepare you? What did they do? 4. Before the operation, were you worried at all about the risk of getting an infection from the surgery? Why? 5. Did the doctor tell you about anything they would do to help you avoid getting an infection? (e.g. give you antibiotics before surgery)
In hospital post op care	6. Who in your opinion was in charge of your care whilst you were in hospital? 7. To what extent did you feel involved in the decisions made about your care whilst you were in hospital? 8. While you were still in hospital after the operation, how well do you feel the staff worked to keep the wound clean and avoid you getting an infection? To what extent do you feel they were careful about hygiene when they cared for you? Why? 9. Do you think there are any problems in this hospital that mean patients who have surgery are more likely to get an infection? What are they, for example, cleanliness in the operating theatre, having to share a bed? 10. While you were still in hospital, did your wound become infected at all? 11. Why do you think this happened? 12. How did you feel when you thought it was infected?

	13. What happened to treat the infection? i. Were you prescribed antibiotics? Who by? ii. How did you feel about taking antibiotics? iii. How long did you take them for, and who decided when you could stop taking them? iv. What else did the hospital do to care for the infected wound? v. Were you still taking antibiotics when you got home? What happened then? vi. Is it better now? 14. Were you given antibiotics in hospital for any other reason? Why? 15. Are you aware of any problems that come from taking antibiotics?
Discharge and post op care	Before discharge, were you given any advice about how to look after your surgical wound? How easy did you find it to look after your wound and keep it clean at home? Why? Were you contacted after discharge by a member of the staff at the hospital or your local doctor to ask about how the wound was healing? When you were back at home, did your wound become infected at all? - How did you know it was infected? - Why do you think this happened? - How did you feel when you thought it was infected? What did you do about the infection? - Did you seek advice from anyone? - Did you take antibiotics? Where did you get them from? Could you get them easily? - How did you feel about taking antibiotics? - How long did you take them for, and why? - Is it better now? If your wound didn't get infected at all, what do you think was important in helping to prevent this?

	1. Have you ever bought antibiotics to treat a suspected infection without a doctor's prescription? - If yes, why did you think you needed the antibiotics? What made you think you had an infection?
Closing questions	Is there anything that would have made things better for you during your hospital stay or recovery at home? Is there anything else you wish to add to what we have discussed?

Appendix 4: Case-study data collection template

Identifying a patient:

Patient demographics

In brief, gender, age, occupation, past medical history
Any past surgical relevant history e.g. readmissions

Presenting presenting complaint

The reason that has brought them to the hospital to receive care – can be presented both in patient's own words and also as documented in the medical notes
Had patient sought any care before coming to hospital? – e.g. taken any self-prescribed remedies? Antibiotics? Previous hospital admissions? Any laboratory and microbiology results from the previous hospital stay or in community?

Diagnoses made and treatments received

According to the patient account what was identified as wrong with them and what treatment did they receive
According to medical notes what was wrong with the patient and what treatment did they receive
Include type of operation, any investigations, infection, antibiotics received – time in ICU etc.
All the investigations leading to the diagnosis (we are interested in the infectious diagnosis so any imaging, blood results, microbiology and culture) – to focus on:
Culture and sensitivity done, the date in relation to when antibiotics were initiated
What sample was sent for testing e.g. urine, wound swab, tissue sample from theatre etc.
What pathogens grew? E.g. what pathogens did the laboratory report?

If patient was for isolation due to infection e.g. C. diff or ESBL what control measures were in place – if contact precautions were implemented when were these implemented?

Who made decisions – what specialties were involved in care, number of healthcare professionals and their profession in patient care and the nature of their involvement

Outcomes

How was the patient's condition resolved?
Length of stay in hospital
Antibiotics to take home?
Any follow up surgical care? According to patient what was the outcome of their hospital stay