The 1% Challenge:

A Quality Improvement Project to reduce the rate of blood culture contamination in the Norfolk & Norwich University Hospital Emergency Department

Executive Summary

Contaminated blood cultures are associated with inferior antimicrobial stewardship, increased length-of-stay, adverse drug reactions and inappropriate investigations. The current blood culture contamination rate in this Emergency Department is 8%. A multi-disciplinary team of Stakeholders, utilising Model for Improvement Quality Improvement methodology, implemented a series of Plan-Do-Study-Act cycles to reduce the number of contaminated blood cultures. The metric applied was the percentage of contaminated blood cultures. The rate of contamination was static during the project. The reasons for this and suggestions for further improvement are presented.

Dr Brendan Fletcher

Candidate Number: 138

I confirm that this Quality Improvement Project is my sole work and that I have correctly acknowledged the work of others.

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WORD COUNT (excluding Contents, Tables, Figures, References and Appendices): 5438

Count something. Regardless of what one ultimately does in medicine…one should be a scientist in the world.... If you count something you find interesting, you will learn something interesting."

- **Atul Gawande, Better: A Surgeon's Notes on Performance** (1)

CONTENTS

ABSTRACT

Background

Hazards associated with blood culture contamination include poor antibiotic stewardship (2), increased rate of hospital-acquired infections (HAIs) (3), increased length-of-stay (4) and poor resource utilisation (2-4). The current rate of blood culture contamination in this Emergency Department is 8%.

Methods

Stakeholders were challenged to identify the causes of this and to find creative solutions for them. Using Model for Improvement Quality Improvement (QI) methodology, three Plan-Do-Study-Act (PDSA) cycles were introduced over a three month period, with the aim of increasing awareness of the problem, educating staff about the aseptic non-touch technique (ANTT) to avoid contamination and finally to 're-connect' Emergency Department (ED) staff with their own episodes of contamination. The metric used was the percentage of contaminated blood cultures in a 24 hour period.

Results

The blood culture contamination rate remained static at 8% despite these interventions. However, it was noted that an intervention that reminded staff of the ANTT on blood trolleys did have an effect, but this was not sustained. There was positive engagement from Stakeholders in this project.

Conclusion

Despite the three interventions not affecting the blood culture contamination rate in this ED, it is noted that effects from PDSA Cycle three might not become apparent for some months. Further iterations of PDSA Cycle One are planned, to see if the effect of bringing information close

to the source of the problem can be harnessed. A novel solution is also proposed: a “Blood Culture Advent Calendar”.

BACKGROUND

Patient Story

In November 2017, a 3 year old girl attended her local ED with fever, tachycardia, hypotension and an evolving rash. A presumptive diagnosis of meningococcal septicaemia was made. A full septic screen was performed in the local ED, including blood cultures (BCs) and cerebrospinal fluid. The requirement for inotropic and ventilatory support supervened and she was transferred to the regional paediatric intensive care unit (PICU), where I met her.

Antibiotics were continued for 48 hours, at which point the BCs at her local hospital were initially resulted, showing a “coagulase negative staph”, inconsistent with meningitis. She recovered rapidly. Given the rapidity of her recovery and that the rash never spread, it was suggested that the underlying diagnosis may not have been bacterial in origin; rather a viral meningitis.

On transfer to the ward, the question became whether or not to commit this patient to two weeks of intravenous (IV) antibiotics on the basis of the initial BC result. The decision was made to continue the IV antibiotics “just in case”: i.e. it was not felt safe to discontinue antibiotics on the basis of a ‘possibly positive’ blood culture result.

After 4 days, the BC result was finalised at *Staphylococcus epidermidis* “consistent with contamination” and the clinical team felt safe to stop the antibiotics.

As an Emergency Medicine trainee, it was the first time I had witnessed the management dilemma caused by contaminated BCs taken in the ED. As a sub-specialty trainee in Paediatric Emergency Medicine (PEM), it was the first time in some years I had cared for in-patients and routinely chased these tests results and seen them affect decision-making.

Context

The setting for this project is an Emergency Department in a 1237 bedded University teaching hospital with an annual ED census of 133,073 attendances in the year July 2017 – July 2018 (5).

BCs may be taken from patients in the ED at any time, meaning that this is a 24 hours-a-day issue.

Evidence

Interestingly, there is no universal definition of a contaminated BC in the literature. For the purposes of this project it has been defined as a bacterium isolated in the sample not likely to cause a bacteraemia and more likely than not to have been introduced during the sampling process.

From the literature, a list of bacteria that fell into this category was made (2-4):

- coagulase-negative staphylococci
- alpha-haemolytic streptococci
- *Micrococcus*
- *Propionibacterium*
- *Corynebacterium*
- *Bacillus*

Blood Culture Contamination BCC is a problem because it may lead to both patient-level and system-level negative effects. There is a direct link between BCCs and adverse effects. This is a patient safety issue.

Patient Level	Systems Level
Adverse drug reactions to unnecessary antibiotic use (including anaphylaxis) (2,4)	Increased cost (3,4)
Increased risk of hospital-acquired infections (e.g. *Clostridium difficile*) (2,4)	Inefficient use of laboratory resources (3)
Lead to unnecessary further investigations and associated morbidity (including ionising radiation and lumbar puncture) (2)	Contribution to global antibiotic resistance (3)
Increased length-of-stay (2)	

Table 1: Implications of blood culture contamination

The approach to this project is a logical progression, starting with personal experience. It progresses through 'diagnostic', 'treatment' and then 'assessment' phases, using QI methodology.

- Phase One: Is there a problem system-wide currently in this institution? If there is, is it frequent enough and important enough to solve?
- Phase Two: What do the people involved in the process think might be the cause of the problem?
- Phase Three: What can be done to improve the system?
- Phase Four: Did these interventions work?
- Phase Five: What can be done in the future?

PROBLEM IDENTIFICATION

- One-month 'snap-shot' audit of all BC samples sent from the ED, which identified a blood culture contamination rate (BCCR) of 5.8%.
- Review of patient **safety** incidents related to BCC (by interrogation of the hospital's incident reporting system and associated staff) suggested that there were none (Appendix 1).
- Review of patient **experience** incidents related to BCCR (via the hospital's Patient Advice and Liaison Service) suggested that there were none (Appendix 1).

To decide whether or not the current rate of BC contamination in this institution is a problem, three factors were considered:

1. Is there a national standard?

No. Previously issued guidance from the Department of Health (DoH) suggesting a contamination rate of 3% has been withdrawn without explanation (6). The World Health Organisation (WHO) advocates blood culture contamination being an audit standard but has not produced a target (7).

The National Health Service (NHS) Improvement Model Hospital, which provides data to NHS providers to improve productivity and efficiency, does not collect a BCCR data set (8). Nor is BC contamination a criterion within the NHS Outcomes Framework (9). Similarly, with the Dr Foster

Data sets (10). There is no National Institute of Health and Care Excellence (NICE) guidance (11). The UK Sepsis Trust has produced guidelines for the processing of BCs within the laboratory, but not at the patient-facing stage (12).

2. What is the rate in UK hospitals with a comparable patient population?

Population	ED Census (attendances/year)	Country	BCCR (after intervention)	Notes	Ref.
Adults and Children	127,686	UK	7.2% (no data)	2018 (unpublished data)	App 1.
Adults	50,000	UK	4.74% (became 2%)	2013-2014	13
Adults	110,000	UK	4.2% (became 3.5%)	2016-2018	14

Table 2: UK ED blood culture contamination rates

Essentially, the BC contamination rate is **higher** than other UK institutions and **higher** than the old standard.

3. Are there any related issues? How does this fit with related QI work?

Firstly, at this institution's last inspection by the regulator, performance against sepsis standards set by the Royal College of Emergency Medicine (RCEM) was "generally good" (5). However, it should be clear that the relevant criterion standard is the performance of BCs in a timely manner, not the absence of BCC. It is possible to see how this target may drive up the number of BCs but drive down their quality (i.e. increasing the BCCR).

Secondly, the Trust has committed to "improve screening and compliance with the 'Sepsis 6' Care bundle," and has improved compliance from 84.19% in 2016 to 94% by March 2017, within the ED (15). This is from data submitted as part of Commissioning for Quality and Innovation (CQUIN), for which there is a financial incentive. Again, this standard could be driving up compliance, but driving down quality.

Thirdly, the Trust has an interest in correctly identifying genuine bloodstream *Staphylococcal* infections at the 'front-door' (essentially implying community-origin) because for positive cultures taken on day 3 of an inpatient stay, the Trust is required to report these to NHS Improvement (NHSI). There may be a financial penalty if the Trust has more than its predicted cases. If the Trust believes the sample to be a BCC then they have to go through a process of 'arbitration', which may have been avoidable had BCC been avoided (16).

Finally, in the last year, this institution has amalgamated its pathology services into a network with two other local hospitals. As part of this service reconfiguration there is shortly to be a "(QI) project to improve the quality of our B.C. service (Appendix 1)."

Essentially it appears that BCs are neither clinically or politically benign.

ENGAGEMENT & TEAMWORKING

The **first stage** was to identify the local experts:

1. Trust Director of Infection Prevention and Control (outside the ED)

2. ED Senior Matron

3. ED Clinical Lead

4. Patient Advise and Liaison Service (outside the ED)

The questions for them were initially:

1. Did they believe there was a problem with BCCR in this institution?

2. Did they already have data about BCCR?

3. Did they have information about any previous attempts to reduce the BCCR?

4. Did they have any suggestions to reduce the BCCR if they felt it was a problem?

5. Did they feel there were any unique factors in this institution contributing to the BCCR?

6. Did they have any suggestions as to who the stakeholders might be?

7. Did they have any ideas about how to involve patients the process?

There was an iterative process from these meetings and correspondence to more formally identify the Stakeholders in this project. Each of these people was met with at least once and there was subsequent correspondence (Appendix 1).

The **second stage** was to identify any party who was either affected by the problem or who had potential influence in the success or failure of the project. This was the Stakeholder Analysis.

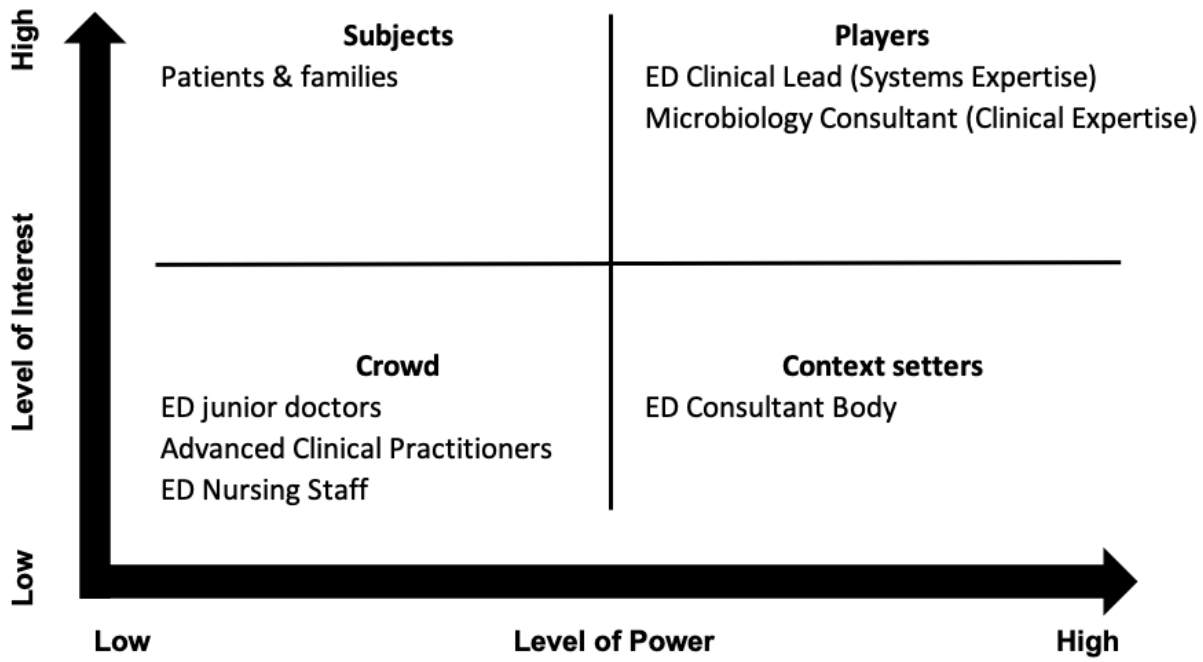


Figure 1: Stakeholder Analysis – Power vs. Player Grid

The advantage of a consultation stage before the more formal Stakeholder Analysis was that it meant that key people (particularly “Players”) were less likely to be missed. It is possible to convert a “Player” into a “Resistor” early by ignoring their contribution, even if inadvertently.

The matrix identified “Players”; those with the most power and whose expectations should be managed most closely. Face-to face meetings were ideal, although these were the most difficult to obtain. The “Context Setters” were less interested parties, but still had significant power to influence success. Face-to-face meetings were more likely to be informal, but effective because they were ‘little-and-often’ (essentially “Opportunistic Meetings”). The “Crowd” had little to gain or lose from the project, but actually had to be the most intensely worked with, as they were the majority. Leveraging personal relationships on the shop-floor was useful, as was developing a ‘brand’ for the project and an easily deliverable pitch.

For this project, significant consideration was given to the “Subjects” – essentially the patients themselves - and to the use of a Patient Reported Outcome Measure (PROM), but there is no such metric relating to BCC in the literature. PALS were asked for ideas, but none were forthcoming. The International Consortium for Health Outcomes Measurement (ICHOM), essentially a repository for existing PROMS, has not explored this (17).

The **third stage** was to build a Core Team from the Stakeholders. This was done by leveraging personal relationships and contacts with the key people. The former was key in persuading people to join the team, when there were so many competing demands on their time.

A Team Assessment Tool was used to map out their roles and skills and to identify gaps (Appendix 3). “Popular with colleagues” was deemed a particular asset. It was felt that people would be more responsive to the ‘brand’ if the person ‘selling’ it was able to successfully use a personal relationship to do so, or was a respected person, whose opinions could be trusted. Essentially this was a form of marketing. Interestingly, when retrospectively applied, the team broadly mimicked the Belbin construct of the ideal team (18). Core Team roles are illustrated in Appendix 4.

The team members are linked because each covers an area of the Stakeholder Analysis, bar “Subjects”, as discussed previously. In addition, they are spread across all the professional groups within the ED who take blood cultures. Healthcare Assistants (HCAs) in this ED were considered, but they do not currently take blood cultures.

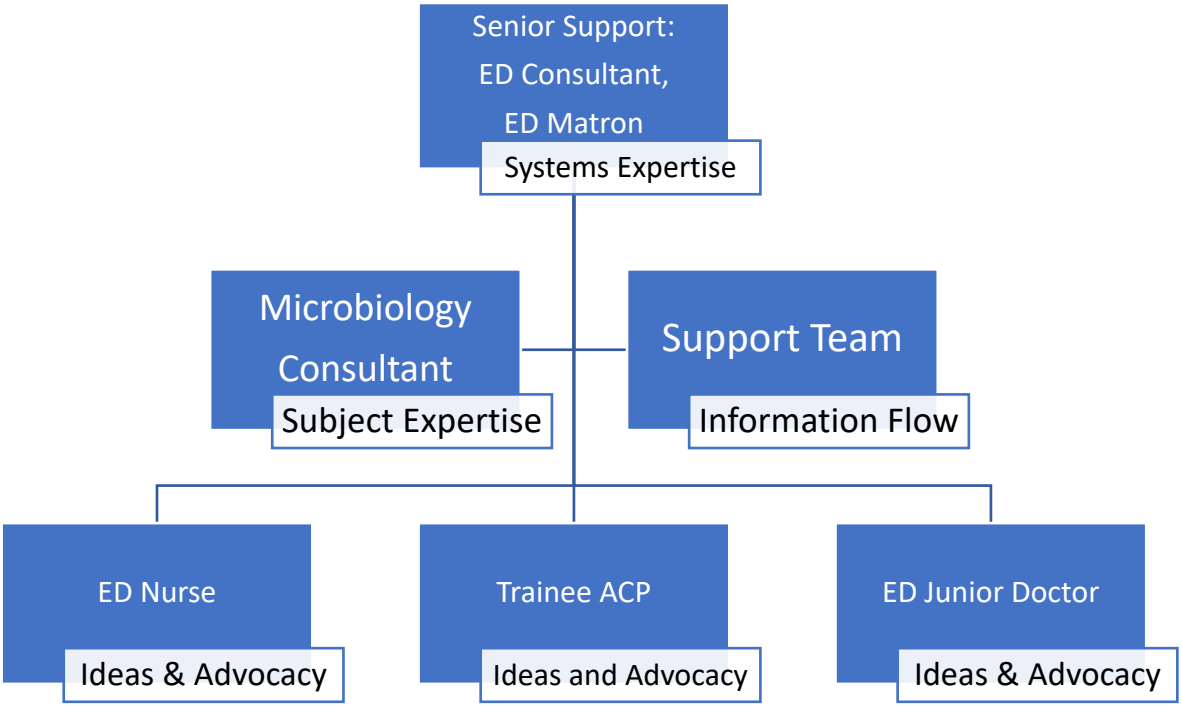


Figure 2: Core Team

The **fourth stage** was to identify 'Resistors'. The following efforts to mitigate against this were:

1. Expect the unexpected (i.e. 'Resistors' may be covert): having someone with access to more discreet conversations than me
2. A Quality Improvement Project (QIP) that was not controversial in terms of both theme and imposition on the resources of others
3. Identify and engage with key Stakeholders (essentially the "Players") **early**
4. Involve popular and respected team members
5. Have an **emotive** patient narrative
6. Using Stakeholders' preferred communication option (generally, aiming to keep emails to a minimum)
7. Informal rather than formal discussion, but 'little and often'
8. Targeted "What's in it for me?" approach (see Appendix 5)
9. Avoiding task overload

Having gone to significant efforts to apply this, no 'Resistors' were identified. The disadvantage of this approach is that:

1. The QIP 'signal' may become lost in the 'noise' of a busy ED.
2. There is less in the way of formal documentation of meetings, as they tended towards opportunistic meetings.
3. There is no opportunity to convert a 'Resistor' into a 'Champion' and therefore the modal Stakeholder is a 'Bystander'.

The **fifth stage** delivered the "What's in it for me?". This was considered in two parts that have been combined into one table: getting the Core Team involved and then the wider Stakeholders (Appendix 5).

This is a slightly complex process because people may not disclose what they want or need immediately, if at all, and thus a prediction has to be made. The "Offer" is also made more difficult because I had nothing in the way of new capital resource, but I did have knowledge, time and relationships that I could leverage.

Failure to consider the "What's In It For Me?" in light of multiple competing priorities is unrealistic. Considering the "Offer", it provided clarity on what is in my gift: essentially time, contacts and teaching. Some members of the Core Team identified that they needed help with examination skills. I therefore hosted monthly "Cake & Competency" sessions at home, where they were able to practice on a model and receive teaching and feedback. This was a very effective way of maintaining 'buy-in'.

My leadership is represented by the "EM trainee" in Appendix 3 and 4, hence I did not have to offer myself anything to complete this QIP. The following tasks were all mine:

1. Project identification
2. Context-setting
3. Identifying a Core Team
4. Liaising with the Core Team
5. Conducting the brainstorming sessions

6. Conducting the PDSA cycles
7. Data collection and reporting

In addition to Microbiology, a further team outside of the department with whom there was engagement was Paediatrics. This will be explored in further iterations of the QIP.

INDENTIFICATION OF ACTIONS

The **first** stage was to understand what is **currently** happening. A Process Map was created and modified through brainstorming sessions with the Core Team (following on from a "Cake and Competency" session).

Figure 3: (Kitchen) table-top outcome of Focus Group Process Mapping exercise

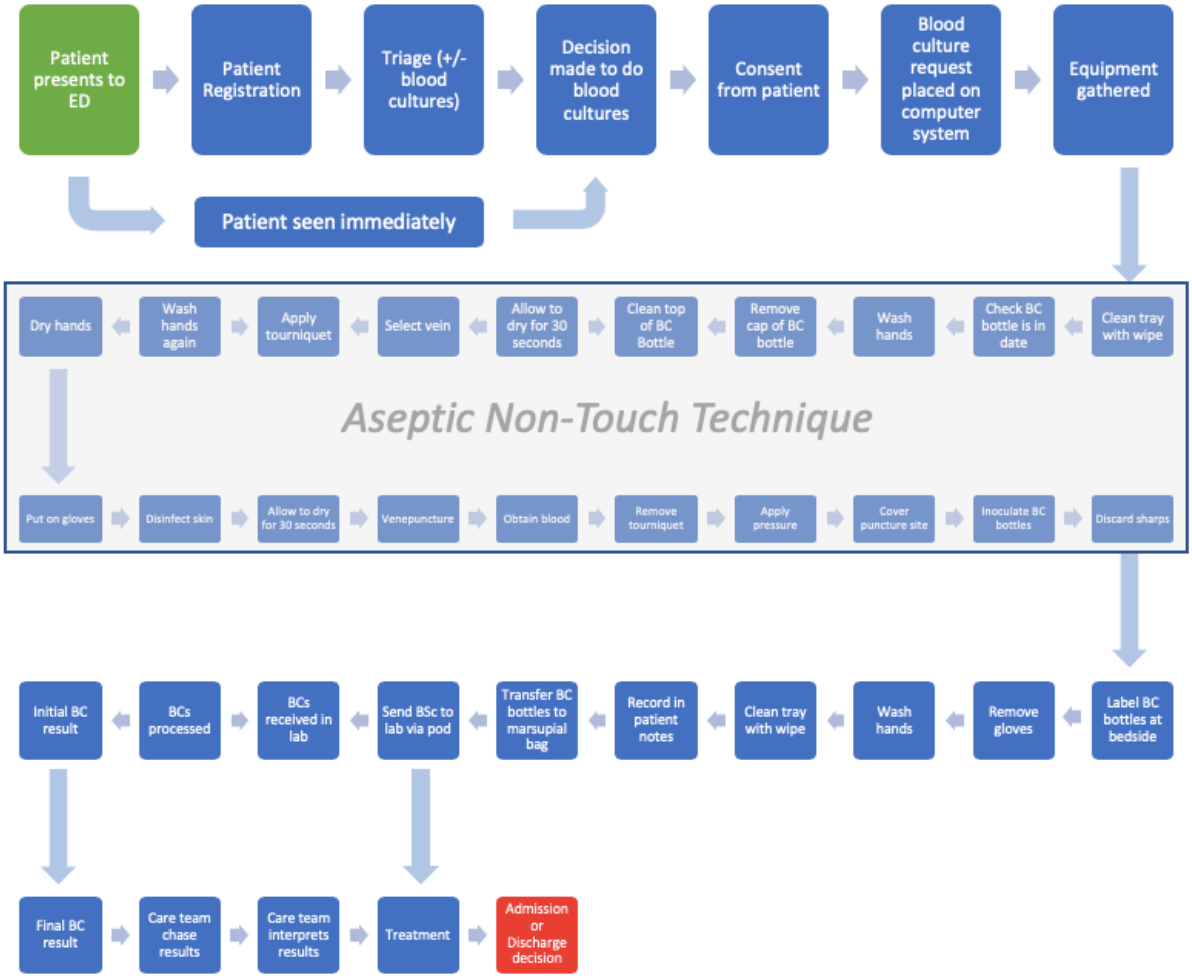


Figure 4: Process Map

A personal goal of mine was that this should never be a 'solution-driven' QIP. Whilst I had ideas of what the problems and solutions might be, the PDSA cycles ultimately arrived at were reached **prospectively**.

The **second** stage was to identify from the Process Map where it was believed that BCC might be caused.

This was then formalised into an Ishikawa diagram to graphically represent possible causes of BCC and divide the causes into categories.

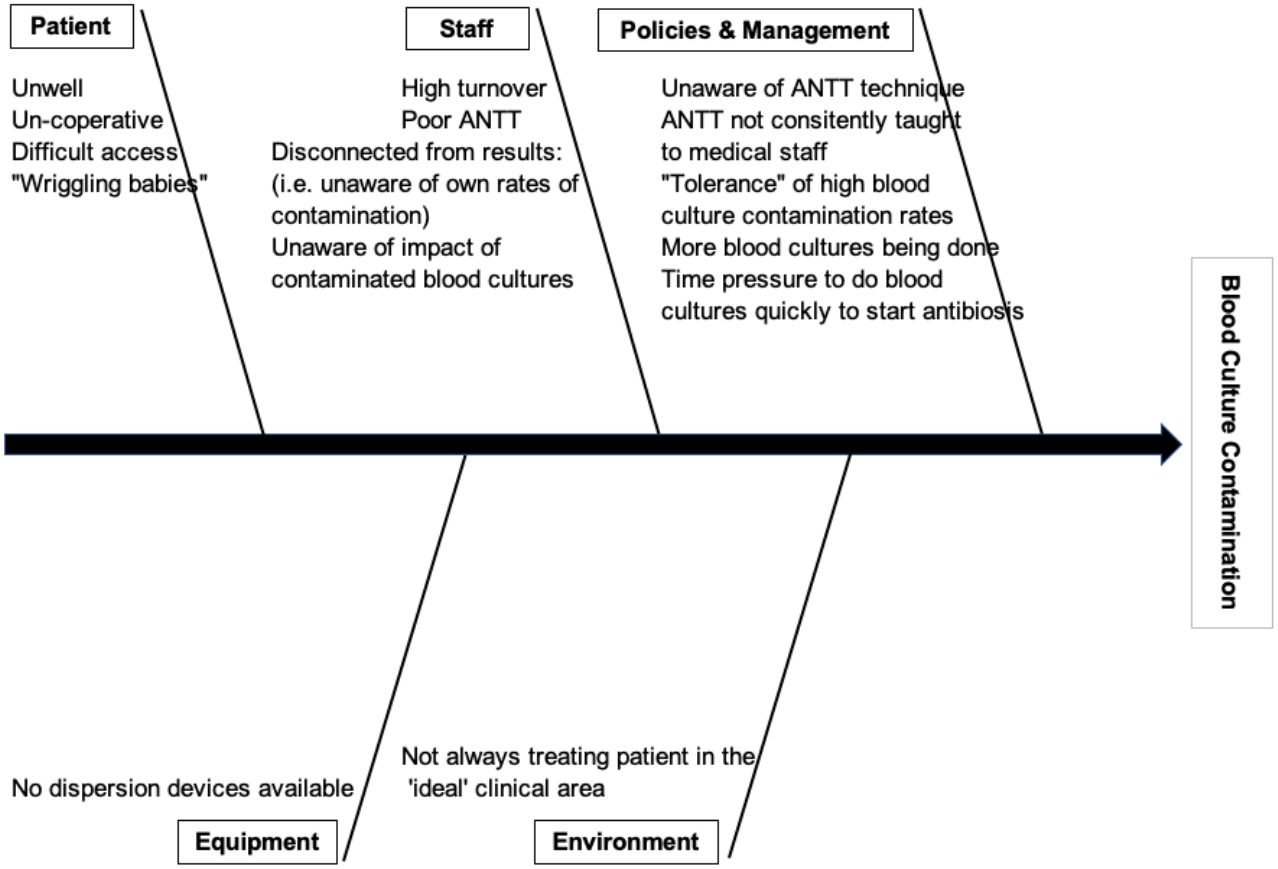


Figure 5: Ishikawa Diagram for Blood Culture Contamination

The Argyris and Schon model of double-loop learning was applied. Whilst designed specifically for education within organisations, I have used it because it is applicable to changing the mental models relating to BCC. Single-loop learning does not do this (19).

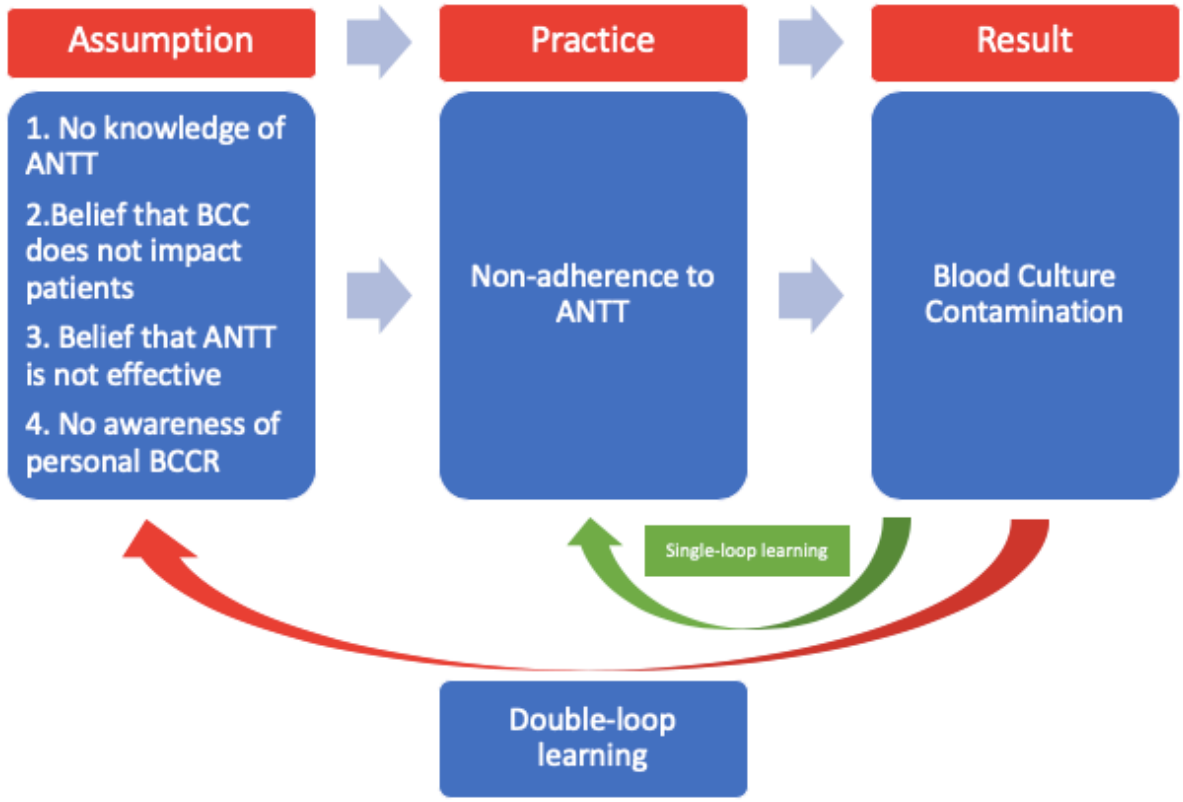


Figure 6: Graphic representation of double-loop learning applied to BCC

An alternative would have been to create a Pareto chart, applying the principle that 80% of the system outcomes are due to 20% of the causes. This was not used because the brainstorming sessions occurred on three different occasions, leading to difficulty assimilating the data.

The **third** stage was to identify where work might already have been done to reduce the BCCR:

1. **In this institution:**

Intervention	Year	Effect	Reasons for discontinuation
Provision of BC "kit" including dispersion devices (Trust-wide)	2012-2015	Not formally measured	Cost No evidence of effect

Inclusion of BC protocol on corporate induction (Trust-wide)	2010 - current	Not formally measured	Current
ANTT teaching on nursing mentor days and *ad hoc* sessions (not specific to BCs)	No record of when this started	Not formally measured	Current

Table 3: Summary of previous interventions at this institution

2. Published solutions:

A literature search was undertaken using PubMed from 1949 to *current*. The search strategy was limited to studies published in English. The key words {contamination} OR {false-positive} AND {blood culture} AND {emergency department} OR {emergency room} were used. Review articles were not included, or studies where BCs were drawn from indwelling vascular access devices. Grey literature was also searched.

The most significant results of this literature search, alongside a critique, are presented in Appendix 2. What is notable from this literature review, is that there is a significant amount from North America, where a 3% 'acceptable' BCCR is a quality assurance metric linked to re-imbursement from insurance companies (an example of values-based healthcare commissioning). Given this, it is surprising that few of the studies have included what they consider to be a list of contaminants.

3. Search for evidence outside of published solutions:

From personal communication with ED trainees within our region, only one hospital has focussed Trust-wide in a meaningful way on their BCCR. This Trust has a similar ED census to ours and identified a BCCR of nearly 8% at the start of the project (Appendix 1). They introduced

mandatory BC-ANTT training with sign-off for all new starters in their hospital, since 2017. In addition, they identified the problem of a disconnect between the results and the person who took the sample. They have 'connected' this by introducing a system of emails when individuals have a BCC. Their next step is to incorporate BC-ANTT re-training for people who are outliers in terms of their BCCR.

The **fourth** stage was to pragmatically analyse the resources available for this QIP (Appendix 6).

The **fifth** stage was to analyse the possible solutions from both those generated by the Core Team and those from the literature. The appraisal of these options is summarised in Appendix 7.

An Impact-Effort grid was also generated, with a keen eye on the motivational aspects of 'Quick Wins', though in fact, only one was agreed as a PDSA cycle with the Core Team.

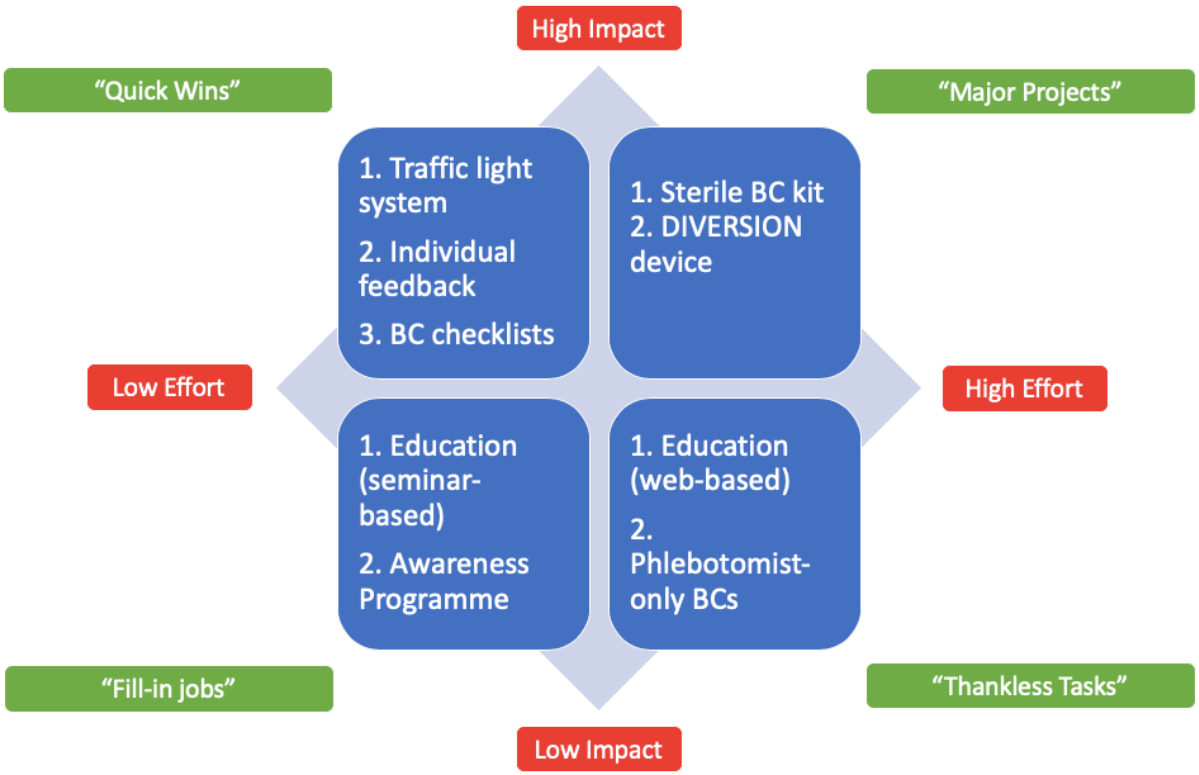


Figure 7: Impact-Effort Grid

Consideration was also given to how to bring the intervention as close to the source of the problem as possible. An example of how this was ultimately done, was placing laminated posters on the top of the blood trolleys.

The **penultimate** stage was to produce a Driver Diagram containing what would ultimately become the PDSA cycles.

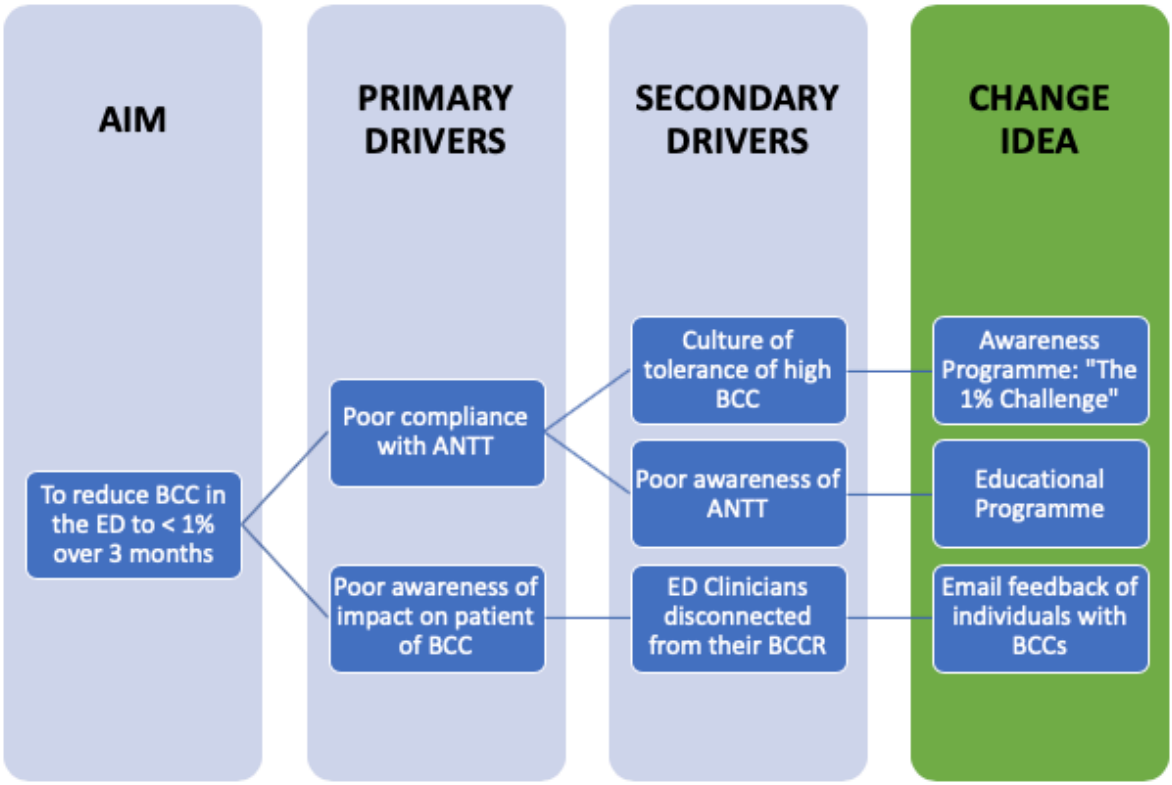


Figure 8: Driver Diagram

I was mindful of the Hierarchy of Effectiveness. The diagram below demonstrates where the PDSA cycles lie on this.

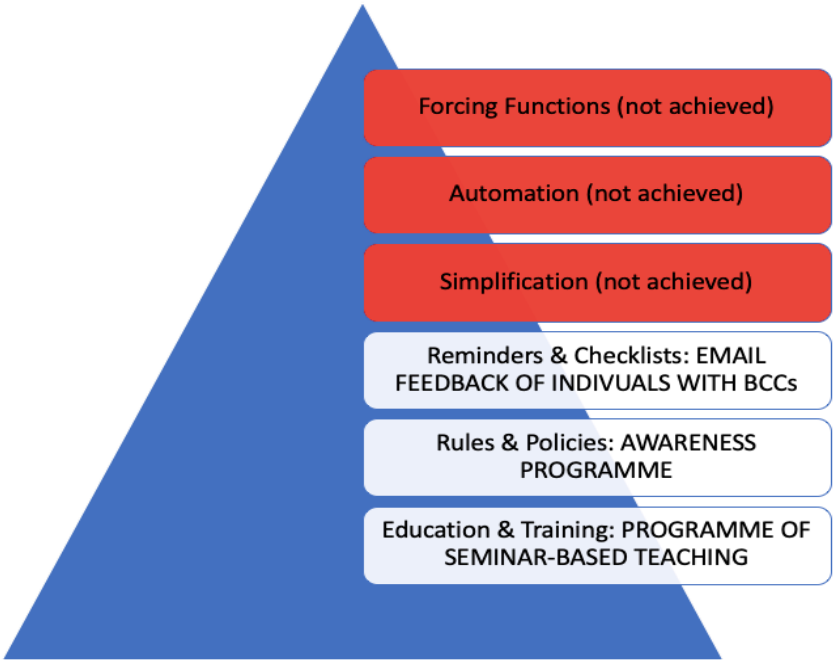


Figure 9: Planned Interventions plotted on the Hierarchy of Effectiveness.

Whilst they fall towards the bottom of the pyramid, the consensus from the Core Team was that education and linking BCC with the sampler was something that had not been tried before in our institution and was therefore a critical step. The concept of a *poka yoke*, essentially the apex of the pyramid, is discussed further in REFLECTIONS.

The **final** stage was to consider internal and external factors that might impact upon the project. Some of these forces are personal to me.

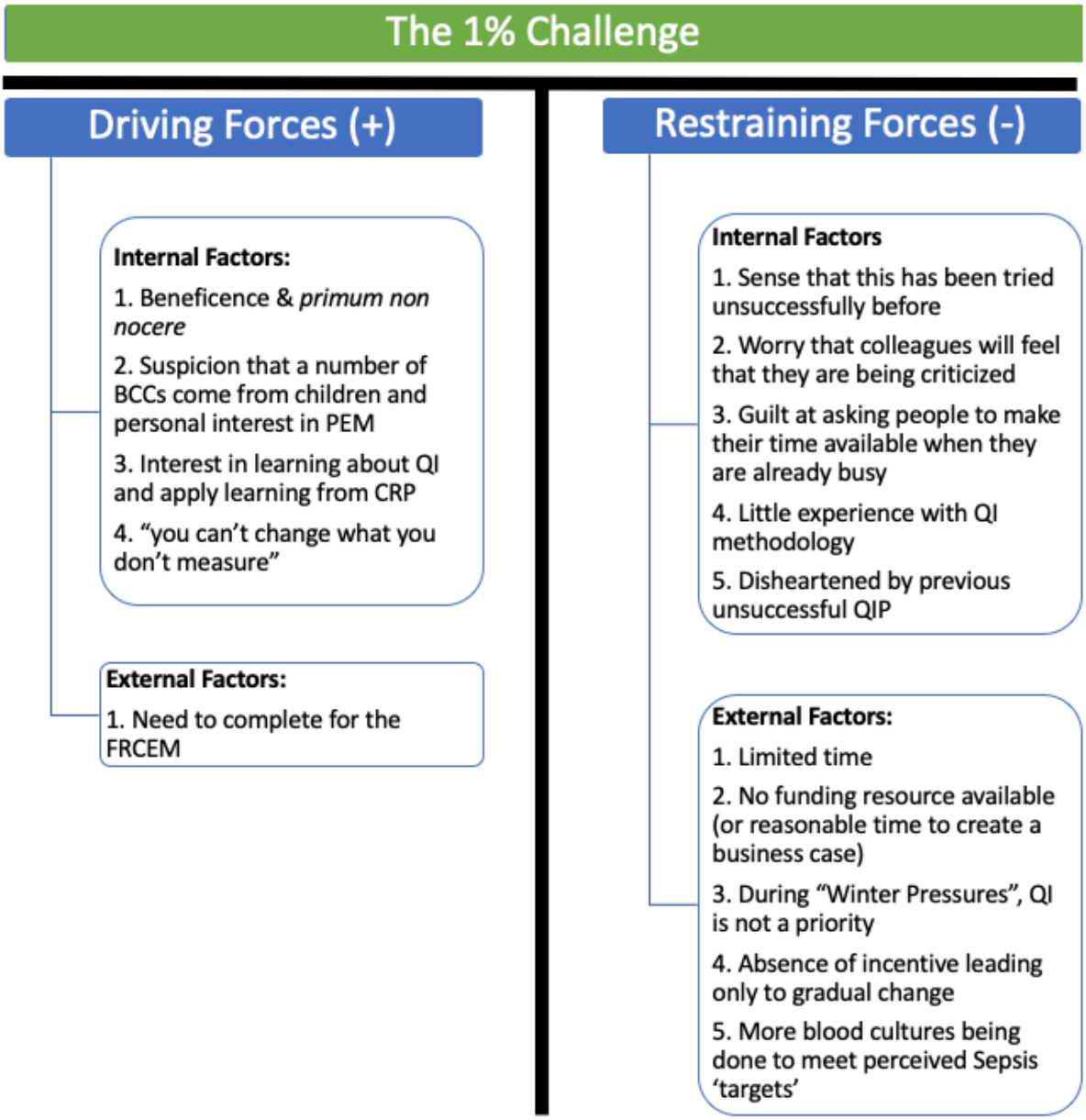


Figure 10: Modified Force Field Analysis

CHANGE MANAGEMENT

1. Changes

The overarching goal in this project is a fortuitous play on words: to change the *culture*. In addition to the PDSA cycles, the Core Team agreed that it was important to create a 'brand', so that Stakeholders would be immediately able to identify this project. This was a form of marketing and I designed a logo. The brand defined the goal without obvious negative connotations, whilst introducing an element of competition.

Figure 11: The QIP 'brand'

The goals I set for the Core Team were to consider PDSA cycles in terms of the sub-headings below. They are plotted in Table 4 with consideration as to whether the goal was met.

	PDSA Cycle One: Awareness Programme	**PDSA Cycle Two: Educational Programme**	**PDSA Cycle Three: Email Feedback of individuals with BCCs**
"Quick Win"			*
Incentive Provided			
High on Hierarchy of Effectiveness			
Pragmatic use of available resource	*	*	*
Creative/inspiring			
Novel to this ED	*	*	*
Involved all Stakeholders	*	*	*
'Easy' Metric	*	*	*

Table 4: Assessment of PDSA Cycles

There was a series of 'negotiation', largely by opportunistic meetings with the Core Team, or at 'Cake & Competency' sessions. No formal democratic process was necessary because there was unanimity.

I had 'red lines' largely based on what I thought was achievable, not least because of previous experience (see REFLECTIONS). These are marked above in red. There was no opposition to this.

There was difficulty in finding genuinely creative interventions by myself, or the Core Team or the literature, until the later stages. I had hoped that something novel might emerge sooner, but the consistent theme was changing the culture for BCCs through education. I challenged them to consider a *poka yoke* (see REFLECTIONS) (24).

The PDSA cycles follow a logical sequence: making people aware of the issue, educating them about how to deal with it and following-up. The first two PDSA cycles are essentially 'phases' designed to produce the ultimate goal, with each element making up a PDSA cycle in itself (given that data was collected around each element).

The detail of each PDSA cycle is outlined below.

	Purpose	Initial Idea	Metric	Hypothesis	When?
PDSA Cycle 1					
Email to all Stakeholders	• Awareness of BCC issues	• Introductory email composed by me to introduce the initiative, current rate of BCC, the impact on patients and re-enforce ANTT • Circulated by Support Team • Appendix 10	• BCCR	• Some ED staff would be genuinely unaware of the ANTT and impact of BCCs and would change behaviour accordingly • Some staff might be annoyed at this email	• 1st January • One off
Posters	• Awareness of BCC issues	• Poster containing the salient points to be displayed in areas where BCs are taken (e.g. blood trolleys) • Laminated • 14 around the ED • Appendix 11	• BCCR	• Staff using blood trolleys would be mindful of ANTT	• 14th January • One off

PDSA Cycle 2					
Education for nurses	• Education about ANTT	• Short presentation delivered by me at morning nurse handover over 4 day period • Baked goods offered as incentive	• BCCR	• Staff would be mindful of project and ANTT leading to reduced BCCR	• 29th January to 1st February
Education for ED juniors	• Education about ANTT	• Short presentation delivered by me at morning medical staff handover over 4 day period • 'Learning Bite' Also included ACPs	• BCCR	• As above	• 29th January to 1st February
Education for ACPs	• Education about ANTT	• As above plus presentation in monthly ACP teaching (incorporate into sepsis teaching in exchange for opportunity to talk to them)	• BCCR	• As above	• 30th January

PDSA Cycle 3					
Emails about individual BCCs	• Connect BCC result to sampler	• Interrogate the BCCs generated and email the requestor to inform them and remind them of the causes and consequences • Appendix 12	• BCCR	• Encourage revision and reflection on the ANTT	• From February 15th onwards

Table 5: Details of PDSA Cycles

2. Methodology

Multiple QI methods were considered concurrently, with the help of a QI expert. Aspects of several have been incorporated into this project and they are highlighted in green in Appendix 8.

Ultimately the Model for Improvement was selected, with the aim of making a number of small interventions and then scaling up the most effective. It is based on the original work of William E. Deming, who is credited with re-shaping Japan's heavy industry after World War II (20). The model is outlined below. Interestingly, it was also the model that I noted most frequently in the literature relating to BC QI methodology.

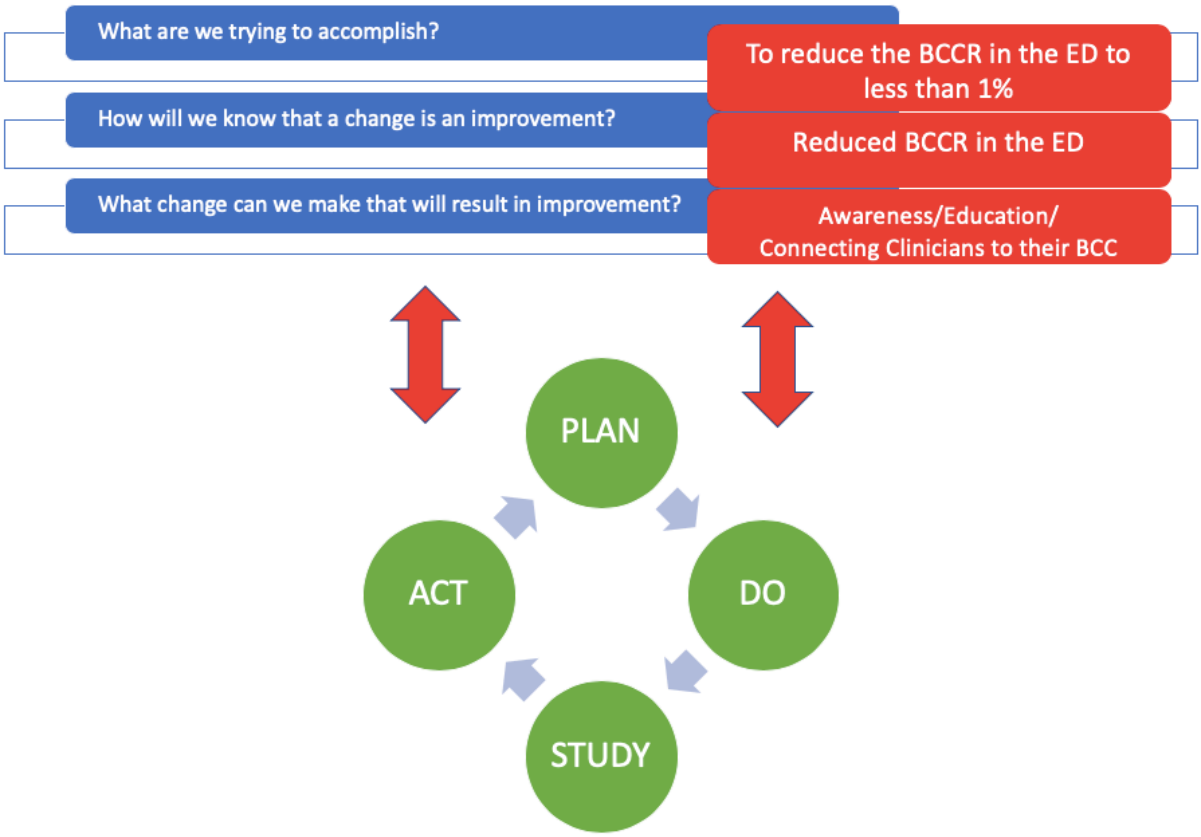


Figure 12: Model of Improvement

3. Metrics

In order to make improvements something must be counted. Various tools to assess outcome ('metrics') were considered and they are outlined in Appendix 9. These were discussed with the QI Expert and amongst the Core Team. As stated previously, an easily measurable and communicated metric was a 'red line' for me. There was no dispute within the Core Team.

4. Project planning and management

The process for change management is illustrated in the Gantt chart below and was communicated to the Core Team. An alternative would have been to use a Critical Path Breakdown, (which interestingly contributed to the success of the Manhattan Project (21)), but I felt that visually, it would be too complex and so did not meet my needs. I have modified the Gantt chart to make it most useful to me (e.g. including special events and highlighting key meetings).

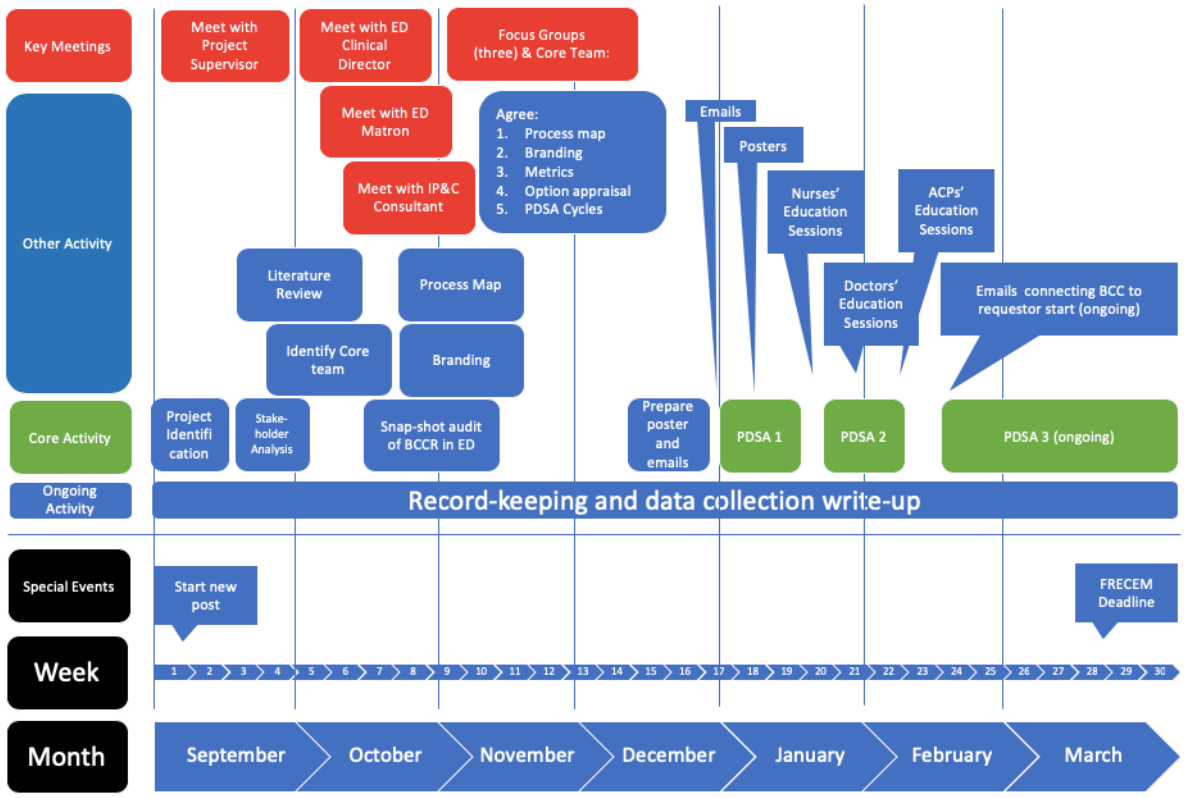


Figure 13: Gantt Chart

I used a project management computer programme (OmniFocus™, The Omni Group, Seattle, USA) to break down larger projects (such as a PDSA cycle) into a series of sequential or parallel tasks. At one time, the total number of tasks exceeded 200. The computer programme also linked to my electronic calendar, to help me to set and meet deadlines.

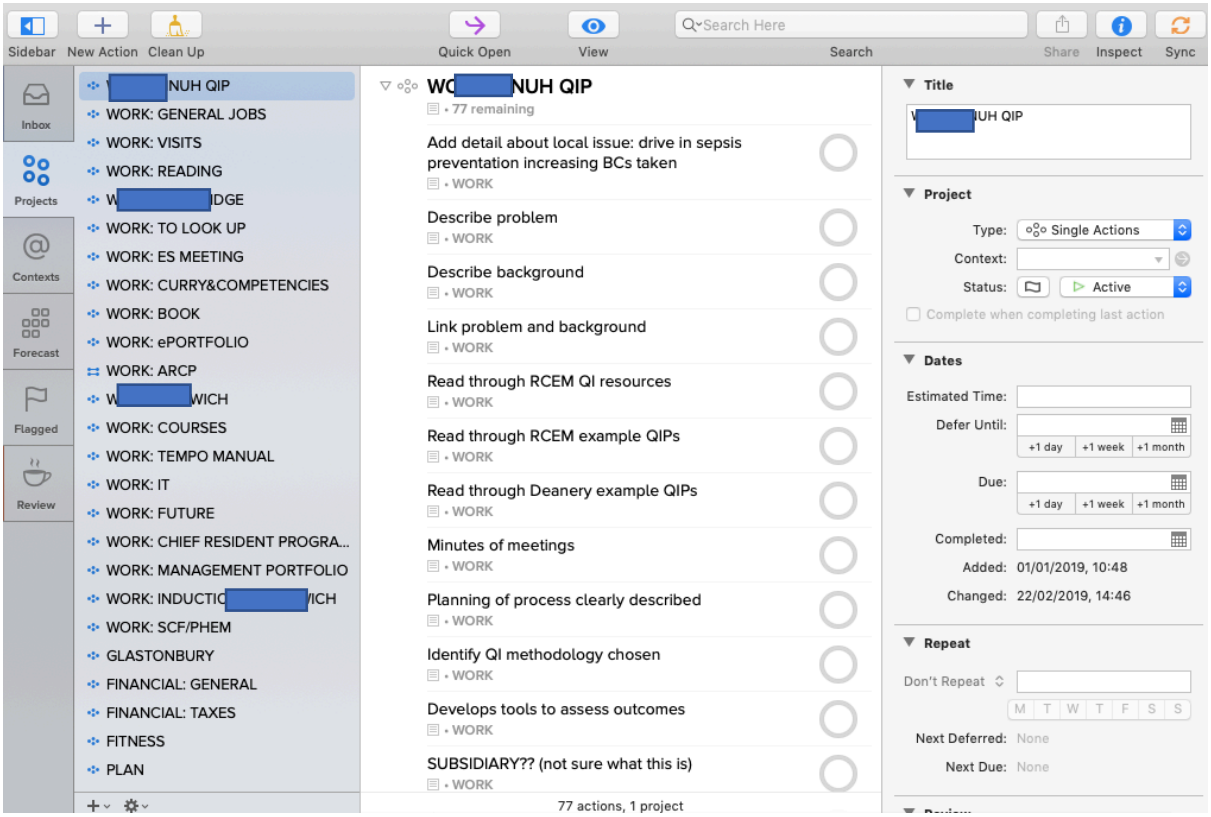


Figure 14: OmniFocus™ user interface

As the project progressed, I realised that I had underestimated the time needed for Core Team members to respond to emails and found that chasing people down in person became more effective. The disadvantage of this approach is that it does not leave a paper-trail. Optimum communication methods have been discussed previously. I also underestimated the pressures of undertaking such a project whilst working shifts. Though I was able to use this to my advantage during PDSA Cycle 2; I was working night shifts and therefore present in the ED for the nursing handover at 0700 and for the 0800 junior doctors' handover and 'Learning Bite'.

At the start of the project, I had intended to produce a weekly newsletter highlighting progress in the project each week. An example is in Appendix 13. The reason that I stopped was because there seemed to be insufficient interest in the contents, an imperative to avoid overloading people's email unless absolutely vital and because there was insufficient progress on a weekly basis to make it worthwhile. This is an example of how 'quick wins' may have been helpful in harnessing interest and generating momentum.

IMPLEMENTATION & RESULTS

The data collected was the blood culture contamination rate: expressed as a percentage of the total number of blood cultures done in a given time period:

$$\frac{\text{number of contaminated blood cultures in 24 hours *}}{\text{total number of blood cultures in 24 hours *}} \times 100 = \textbf{BCCR}$$

(*running from 0000 to 2359)

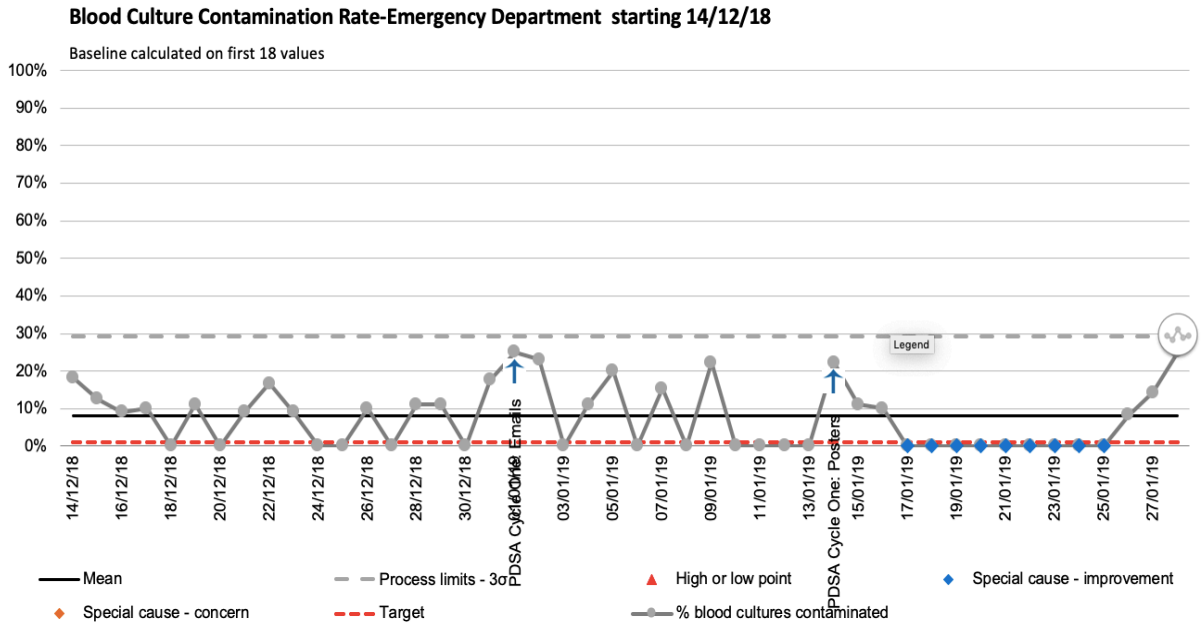
The data was collected by interrogating the hospital's electronic reporting system, using filters identifying all BCs sent from the ED, referring back to the agreed list of what constituted a BCC and identifying the requesting clinician and date. These were recorded on an anonymised spreadsheet kept confidentially (Appendix 14). Data was rounded to the nearest whole number and entered into a Statistical Process Control tool (22), made publicly available by NHSI, which stored, processed and analysed it (Appendix 15).

Responsibility for this data collection lay with me and, given shift working and other commitments, this meant that data collection did not always occur at the same time each day and, in fact, several days' worth of data were often collected in one go (see REFLECTIONS).

The original data collected in October was used to firstly test how the data could be collected and secondly as a baseline to make a case to Stakeholders. For the interventional side of the project, continuous data collection began two weeks prior to the first PDSA cycle. The BCCR% was 5.8% in the 'snap-shot' but was 8% for the duration of the project. Both of these data points fall within the 3 σ range, suggesting internal validity.

The PDSA cycles proceeded as demonstrated in the Gantt Chart and are analysed in the tables below.

The 1% Challenge:

PLAN	1. Engage with ED staff who take blood cultures by introducing the problem and reinforcing the ANTT 2. 'Market' the project
DO	1. Email sent to all ED staff (Appendix 10) from EM Trainee via Support Team [1st January] 2. Posters placed in prominent areas highlighting the key points (Appendix 11) by EM Trainee [14thJanuary]
STUDY	 • Emailing staff did not appear to have any effect on the BCCR. It was noted by the group that agency and locum staff were not included in the email and this will be corrected in a further PDSA Cycle in April (which is designed to coincide with the arrival of the next intake of GP trainees into the ED). It was felt that it was still appropriate to send the emails because they complement the introduction of PDSA Cycle 2. It would be unfair on Stakeholders to commence PDSA Cycle 3 if they had no knowledge that there was, in fact, a problem. • Special cause variation (indicated by the blue dots) **is** noted within 3 days of posters being put up around the ED. The majority of these were on blood trolleys. It is also noted that samples may take up to 12 hours to reach the laboratory and that initial results will not

	appear for 48 hours; i.e. there is temporal plausibility to this finding. Unfortunately, this is not sustained. • The purpose of PDSA Cycle 1 was to make Stakeholders aware of the problem and simply collecting the BCCR% may not have been an appropriate way of demonstrating that awareness of the problem had increased.
ACT	• The special cause variation generated some excitement! It may be an effect of subsidiarity. Essentially something **did** happen after PDSA Cycle 1, even though it was not sustained. The key element may be to do with the posters on the blood trolleys. Combining the idea of proximity with interventions further up the Hierarchy of Effectiveness (**checklists** then **standardisation and simplification),** the following idea is now being considered, albeit at an early stage. It combines experience of pre-hospital emergency medicine and advent calendars. • From the Process Map, a sequence in which equipment and disposables are required is generated. This achieves some elements of **standardisation**. • The actual disposables can be organised in a cardboard tray; like a “kit dump” for rapid sequence induction. This too achieves **standardisation**.  **Figure 15: Intubation “Kit Dump”**

- The tray can be sealed with a foil cover, on which is printed the checklist, so there is little way to access the disposables without first accessing the checklist.
- To achieve both a **checklist** and a **simplification** function, in sequence, the disposables necessary at each stage could be pushed through a foil "door" when they are needed, like the chocolates in an advent calendar. A mock-up of this has been generated:

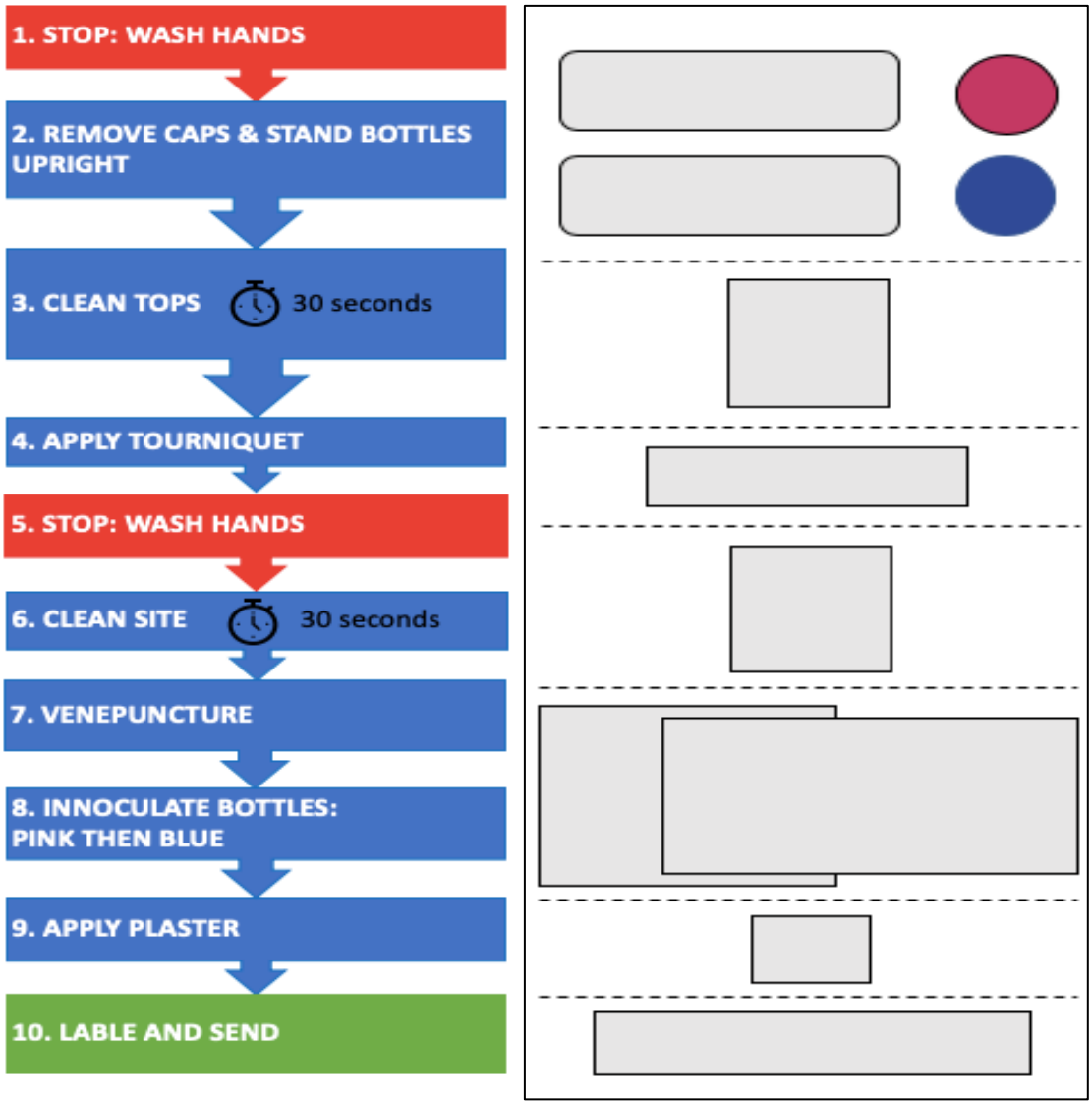


Figure 16: Blood Culture "Kit Dump"

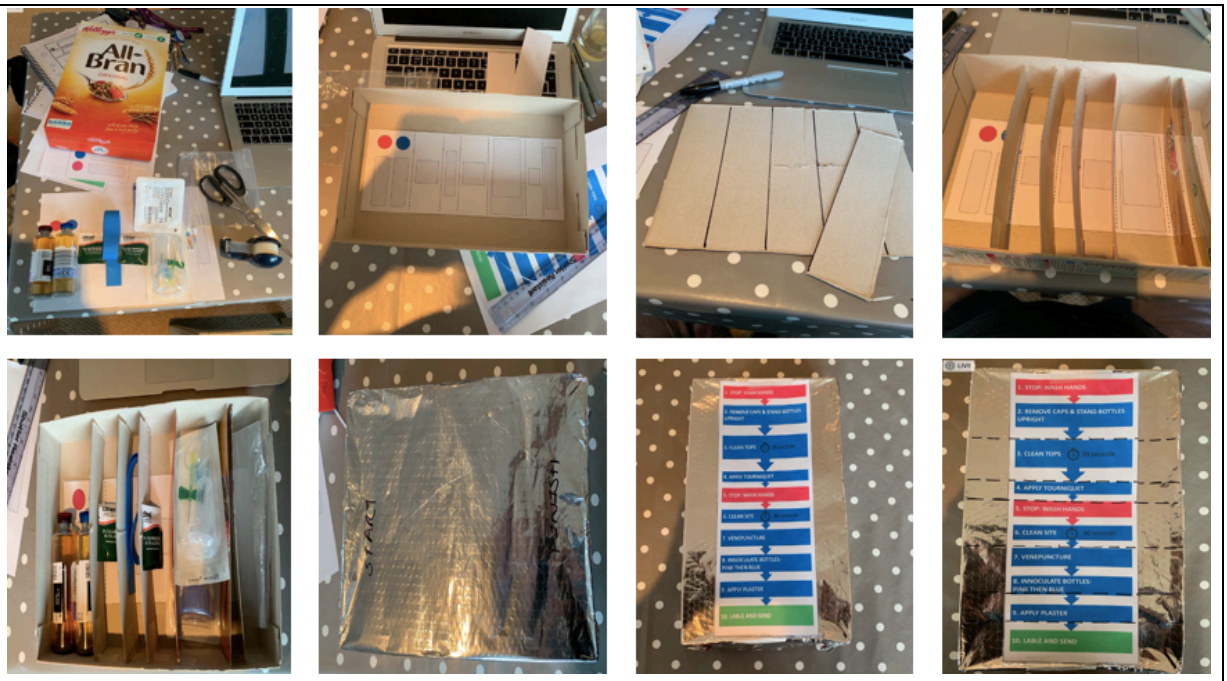
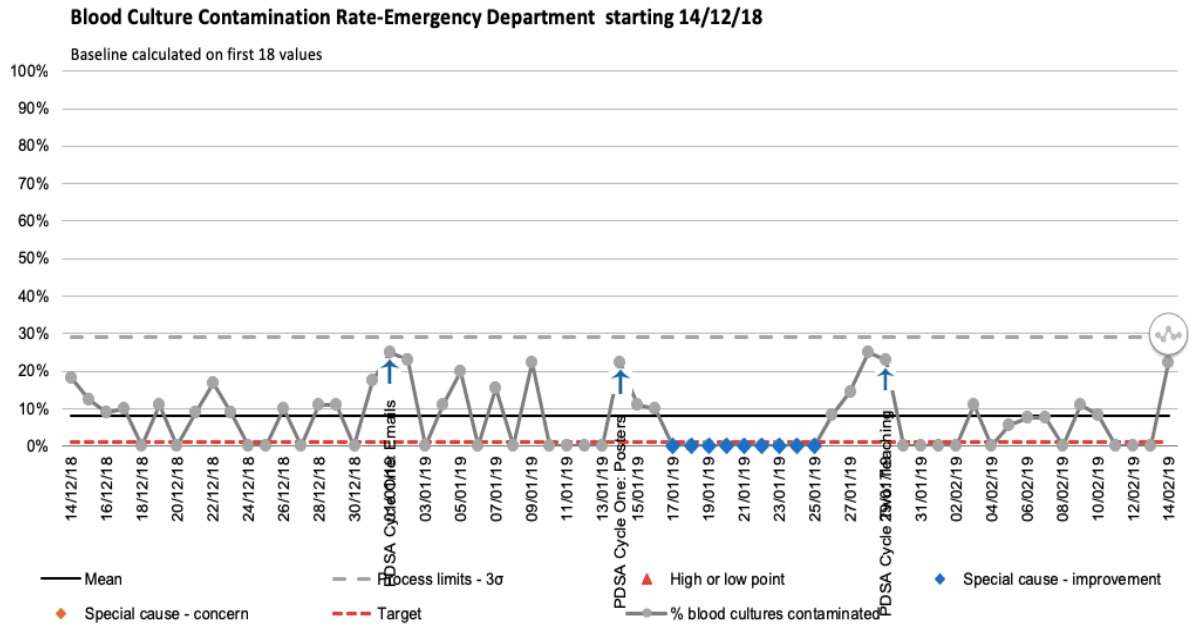


Figure 17: Blood Culture 'Advent Calendar' prototype

- To my knowledge, this is a genuinely novel approach to the issue of BCCR and is going to be a big project, likely involving external Stakeholders and a business case.
- This idea was originated because of deeper consideration of why the results of PDSA Cycle 1 appears to be effective but not sustained.

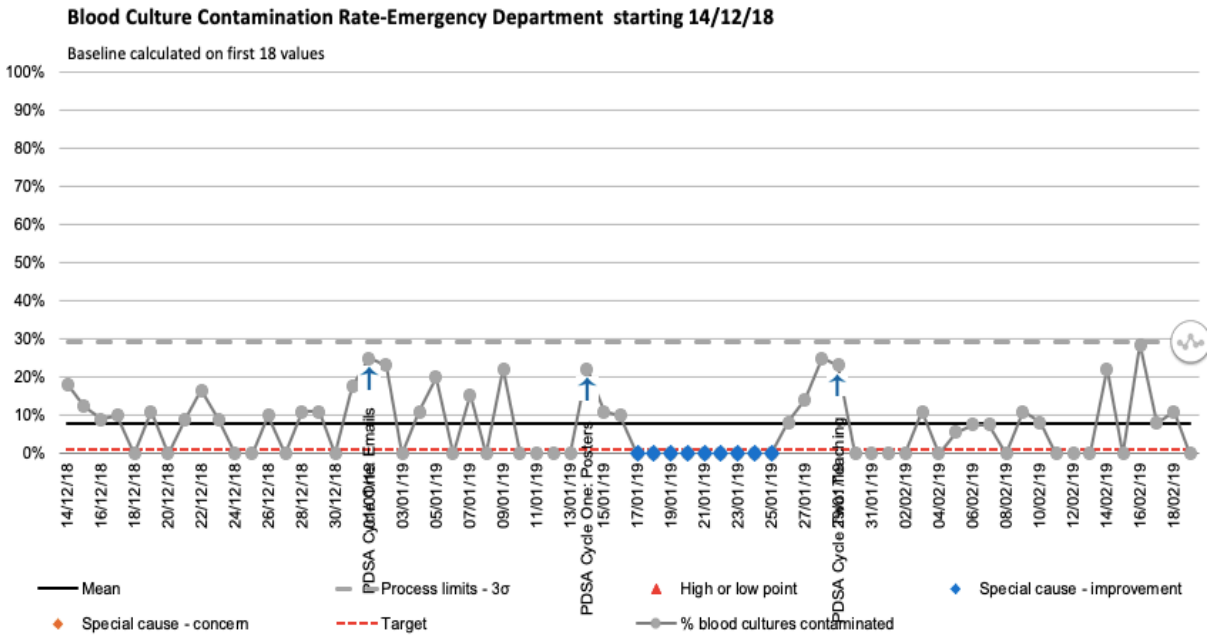
Table 6: PDSA Cycle One - Awareness

PLAN	1. To educate Stakeholders about BCC 2. To build an emotional investment in the project by including the clinical vignette 3. To re-enforce Trust policy regarding ANTT
DO	1. Attend nursing handover at 0700 and deliver a short presentation about BCC and ANTT (baked goods provided) (EM Trainee) [29th January – 1st February] 2. Attend junior doctors' handover at 0800 and deliver a 'Learning Bite' as above (EM Trainee) [29th January – 1st February]

	3. Speak at an ACP Study Day on a subject they requested ("What's New in Sepsis?") in exchange for delivering a short presentation at the end (EM Trainee) [30th January]
STUDY	 • The SPC suggests that teaching, whilst warmly received, did not have any effect on the BCCR.
ACT	• No record was made at the nursing or medical teaching sessions of who was present and whilst efforts were made to include as many as possible, what is not known is what percentage of staff were finally 'targeted'. • Nursing staff suggested that some kind of hand-out would have been appreciated and this will be developed. An example they gave was a credit-card sized laminate with the ANTT details on them that could be hung from a lanyard. • An alternative to this form of teaching session would be to create some kind of mandatory aspect, repeated in a cyclical fashion (like basic life support training). This idea needs to be considered in terms of both the current mandatory-training 'burden' and the resource implication, though this might address the issue of sustained improvements in the BCCR. • Targeting new staff at Departmental induction is an alternative and this will be raised at an ED Divisional Meeting.

	• However, given the results presented there are no immediate plans for further PDSA teaching cycles.

Table 7: PDSA Cycle Two - Education

PLAN	1. To connect Stakeholders with their own BCCs
DO	1. Interrogate each BCC and identify requestor (EM Trainee) [15th February onwards] 2. Send email to requestor to inform them of BCC and remind them of ANTT (see Appendix 12) (EM Trainee) [15th February onwards]
STUDY	 • The SPC has not demonstrated any change with this intervention. However, caution should be used inferring absence of effect (yet). There is a latent period between one BCC leading to an email and reflection upon this by the recipient and the next occasion they take a BC. It is possible that ongoing data collection will trend towards improvement. Informally, I discussed this with a colleague at another institution, who said that their experience of a similar intervention had been the same at the start, but improvement had been demonstrated. This took approximately 6 months.

ACT	• Issues highlighted in response to this cycle were: • The requestor of the sample may not always be the person that ends up taking the sample and the computer system does not record who did so. The original email that was sent out was modified to reflect this: ○ *If you are not the person who took this blood culture, please could you respond to this email with the relevant information. Thank you*. • Some of the BCCs were taken by non-ED staff, including Paediatricians, working in the ED. They were not recipients of this email because they had not been considered as part of the Stakeholder Analysis. This will be discussed with the paediatric lead in ED, as the aim would be to include them in this process in further cycles. • Whilst the email did request acknowledgement of response, there was no sanction for non-response. This will be discussed at an ED Divisional meeting. A separate PDSA cycle is being considered for July, where both non-response or 'outliers' in terms of BCCR will be required to attend formal training in ANTT. This needs agreement from line managers/educational supervisors. I anticipate that this would be controversial. • For 'outliers' to be identified, an agreement of what an 'outlier' is needs to be reached with the Core Team (e.g. BCC > 3 in 12 months) and a record needs to be kept. This also introduces the idea of a 'league table' and competition that could be incentivised. A further PDSA Cycle could include a competition with an incentive to have the lowest BCCR. • When PDSA Cycle 3 started, it was discreetly suggested to me that calling them, albeit 'unofficially', "Offender Emails" was not useful. I have stopped this practice.

Table 8: PDSA Cycle Three - Individual BCCs

The most contemporaneous run chart is included in Appendix 15.

In addition to the BCCR data, no further patient safety incidents or complaints relating to BCCs were received by the Trust during this time.

The results of this project were presented to the Care Quality Commission (CQC) and at an ED Divisional Board meeting (Appendix 16).

CONCLUSION

The implementation of these three interventions has not (yet) led to a sustained improvement in the BCCR in this ED. However, the resulting data has led to an exciting and innovative idea: (Working Title) Blood Culture Advent Calendar. Additionally, there may be a longer than expected latent period between the introduction of PDSA Cycle Three and positive results.

As a future ED consultant, passionate about the specialty, I wanted to convey that making the ED as a whole an "early adopter" of good practice routinely would set an example for the rest of the hospital. Unfortunately, I have not yet found a way of conveying this message outside of the Department. Nor have the results of this QIP been able (yet) to justify doing so, which is disheartening.

Nevertheless, I am proud of this project and presented it to the CQC during an inspection visit.

Finally, in submitting this QIP, I am mindful of one of the findings of Lord Francis into the failings at Mid-Staffordshire Hospital (23):

"A shared positive safety culture requires: shared values in which the patient is the priority of everything done; zero tolerance of substandard care; empowering front-line staff with the responsibility and freedom to deliver safe care; recognising them for their contribution; and that professional responsibility is accepted and pursued."

REFLECTIONS & LIMITATIONS

Personal Learning

Reducing blood culture contamination was not my first QIP. I was seven months in to a much more complex project that aimed to reduce the admission rate in paediatric patients with 'low-risk' right iliac fossa pain. The reasons this project was not completed were two-fold: poor Stakeholder Analysis and over-estimating the resources available.

The first problem essentially stemmed from incorrectly identifying “Resistors”. Key people said one thing in meetings with me and then the opposite to others afterwards. The second was being unable to find physical space within a hospital already at full capacity. Time-constraints and changing hospitals meant that I had to reluctantly accept defeat in view of long-lead times and looming deadlines.

Learning from this, I applied the SMART goals from inception: in an organisation similarly short of space and money, these were unlikely to be available in significant quantities to a novice ‘QIPer’.

I also felt it important to approach a subject that was both non-controversial, hence avoiding both expected and unexpected Resistors, and unique to my own experience as a PEM trainee. This helped me ‘sell’ “The 1% Challenge” in the ED. The initial patient story is used as an **emotional** appeal to colleagues, which I then coupled with **evidence**, with the aim of inducing a **behavioural** change.

Part of this QIP experience coincided with a regional Chief Resident Programme, designed for future healthcare leaders, through the Judge Business School at the University of Cambridge. There were formal taught courses on operations and change management, some of which I have incorporated. For example, using the Argyris and Schon double-loop learning model as a mechanism of formalising the outcome of brainstorming sessions.

Something that I struggled with during this project was building and maintaining a Core Team. The ‘Cake & Competency’ sessions were a creative way of improving this. I particularly wanted someone to take on the data collection. I approached various colleagues but, in the absence of allocated time in many people’s job plans and competing demands (not least other colleagues undertaking their own QIPs), I had to do it myself. The problem with this is that it makes the project difficult to scale-up or survive beyond my next rotation. In hindsight, medical students may have been a valuable resource that I did not consider at the time.

Finally, and most importantly, I am now much more scrupulous about ANTT myself!

Institutional Learning

I was very aware throughout the process that this was happening in an operationally-challenged ED, already coming under significant external scrutiny from NHSI. The impact of this was two-fold: this project operated largely under-the-radar of management at both an operational (i.e. Departmental) and strategic (i.e. Hospital-wide) level, which was both a blessing and a hinderance.

In terms of blessing, it meant that 'Players' who may have been potential 'Resistors', whilst included, did not divert a great deal of their attention to what was going on. In terms of hinderance, it meant that what attention there was, had to be used wisely. Email communication, rather than face-to-face, became the norm and sometimes was limited to single word answers.

Formal face-to-face interaction had to be prefaced with a short agenda so that key items were dealt with efficiently and on my terms. Eventually these meetings took the form of an ED-style 'consultation': one open-ended statement followed by several closed questions, followed by a plan.

Of the metrics reported to the Trust board monthly, on a patient safety dashboard and annually in the IP&C report, the BCCR is never mentioned. I find this surprising given the patient safety and potential financial implications discussed in the BACKGROUND. Perhaps this absence of Board level oversight has allowed the BCCR to persist at the rate that it has.

It was important to communicate that even in an ED where there is lots of great care, this aspect is not done well, but it could be and with little effort. Essentially, the purpose of this QIP was to shift the 'best-practice curve' to the right. In the complexity of hospital medicine, particularly at the front-door, it is important to be mindful that this QIP is just one of numerous initiatives designed for patient benefit and it is possible to overload staff with not only new initiatives, but a sense that nothing they are doing is good enough.

Limitations

The ideal pathway would be to find a *poka yoke*: which is Japanese meaning essentially to 'mistake-proof' the process (24). Whilst considered, no such solution was found in practice, or in the literature. The PDSA cycles, whilst justified, sacrificed creativity for pragmatism.

The QIP ideally, would have been started much earlier, to enable longer and more frequent PDSA cycles. It was time-limited by changing rotations and the FRCEM submission date. Ideally, I think 18 months would be necessary. Further planned iterations of the PDSA cycles have already been described.

The aim is to continue this project for at least a further 8 months beyond the FRCEM submission date. In this time, it is hoped that it can be 'handed over' to the trainee ACP, who by then should be credentialed.

Consideration was given to PROMS, however no metric relating to BCCR was found.

No balancing measures were used. The opportunity cost of not doing a blood culture might be a missed treatable infection leading to an adverse event. However, in the absence of any such event ever being recorded by the Trust, this was not explored further.

The data from PDSA Cycle One has led over recent weeks to the development of the Blood Culture Advent Calendar. This is a genuinely novel and exciting development that I hope to put before an NHS Innovations committee, to see if a trial can be funded.

Plans for a further study

This QIP was never about the diagnostic utility of BCs. However, it was frequently commented that the ED reflexively does "too many" BCs, where they are not indicated. A further QIP to reduce this could be modelled, using largely the same team and methods.

This QIP **inferred,** albeit based on scientific evidence, that reducing the BCCR actually reduces patient harm. However, this QIP did not specifically measure aspects of patient care such as admission for IV antibiotics or length-of-stay. These could be included in a much longer future QIP.

FUNDING

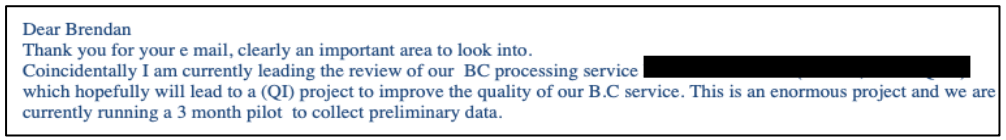
No external funding was required for this project.

APPENDIX 1: SUMMARY OF KEY COMMUNICATIONS

(Communications that were not significant in terms of key personnel or leading to iterative changes have been omitted. In practice, some kind of discussion or communication about this QIP occurred daily on the shop-floor.)

Date	Stake-holder	Type of Communi-cation	Key Points	Outcomes
September	ED Clinical Lead	Meeting	• QIP proposal reviewed • Advised that subject material "not very exciting" - embed the email feedback system into ED processes (unclear how yet) - include ANTT DOPS as routine part of ED induction **Signed by Project Lead** Dr Brendan Fletcher, ST6 Emergency Medicine **Date** 8th October, 2018 **Signed by Project Champion** [redacted], Clinical Lead for Emergency Medicine **Date** 30th September, 2018 *1. Did they believe there was a problem with BCCR in this institution?* ***Yes*** *2. Did they already have data about BCCR?* ***No***	• 'Permission' given • Consideration of creative PDSA cycles • Consented to be SYSTEMS expertise

			3. Did they have information about any previous attempts to reduce the BCCR? ***No*** *4. Did they have any suggestions to reduce the BCCR if they felt it was a problem?* ***No*** *5. Did they feel there were any unique factors in this institution contributing to the BCCR?* ***More blood cultures being done than was necessary*** *6. Did they have any suggestions as to who the stakeholders might be?* ***ED Nurses & junior doctors*** *7. Did they have any ideas about how to involve patients the process?* ***No***	
	ED Consultant (Education-al Supervisor)	Meeting	• QIP proposal reviewed • Advised that met SMART objectives and would be "non-controversial" (i.e. did not expect "Resistors")	• SMART objectives reviewed

	ED JDs	Opportunistic Meeting	• Advised to keep QIP within SMART objectives as this is likely to be the rate-limiting step • No specific ideas about how to involve patients or PROMS	• SMART objectives reviewed • Reminded of burden of induction-related learning • Reminded that QIP would be occurring in an ED where there are going to be many QIPs occurring at once
October	IP&C Director	Email	• QIP proposal reviewed • Advised that this is an "important area"  Dear Brendan Thank you for your e mail, clearly an important area to look into. Coincidentally I am currently leading the review of our BC processing service [redacted] which hopefully will lead to a (QI) project to improve the quality of our B.C service. This is an enormous project and we are currently running a 3 month pilot to collect preliminary data.	• 'Permission' given • Meeting organised

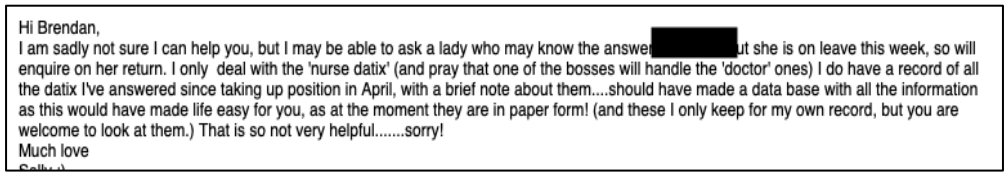
	IP&C
	
	Director
		Meeting	• Discussion:
			  • about the current BCCR
			  • around patient-level and systems-level impact of BCCR
			  • historical context of ways to reduced BCCR in this institution
			  • referral made to microbiology user guide
			
			1. Did they believe there was a problem with BCCR in this institution? ***Yes***
			
			2. Did they already have data about BCCR? ***Yes (and shared)***
			
			3. Did they have information about any previous attempts to reduce the BCCR? ***Yes, but not specific to ED***
			
			4. Did they have any suggestions to reduce the BCCR if they felt it was a problem? ***Yes. Considering new kit.***
			
			5. Did they feel there were any unique factors in this institution contributing to the BCCR? ***Too many BCs being taken. Elderly population.***
				• Confirmation of what constitutes a BCCR
				• Referred to Microbiology 'handbook'
				• Hospital ANTT protocol obtained
				• Consented to be SUBJECT expertise

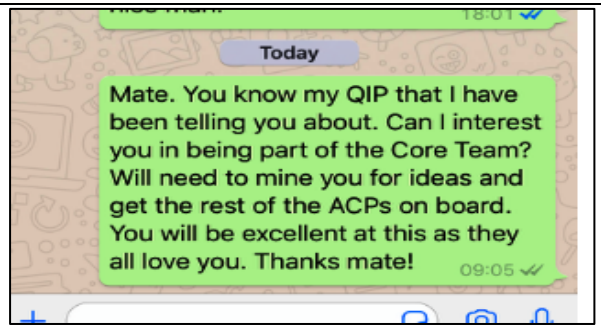
			6. Did they have any suggestions as to who the stakeholders might be? ***Already identified.*** *7. Did they have any ideas about how to involve patients the process?* ***No*** **19.3 Blood Cultures** **19.3.1 General Principles** These are important specimens for the detection and diagnosis of bacteraemia. The number of organisms present in 5mL of blood is very small even in severely ill patients. There is therefore no immediate microscopic examination of blood. An interim negative result is sent out in real time at 48 hours, and 36 hours for NICU samples. Please note this period starts when the blood culture bottle is loaded on to the analyser. As soon as a **positive** blood culture is **detected** the results are communicated to clinical staff immediately. It is therefore helpful to have a bleep number, if possible that of the doctor who is actually looking after the patient. Clinical details, especially details of antibiotic therapy, previous, current and planned are helpful in the interpretation of results. **19.3.2 Taking Blood Cultures** Please refer to LOCAL TRUST GUIDELINES for procedures relating to the taking of blood cultures.	
	ED Matron	Email	Hello Brendan, Would love to discuss this with you. I was the previous ANTT lead so will be able to fill you in on what has been done before and other key points. Let me know some good times/dates. See you soon,	• Meeting organised
	ED Matron	Meeting	• QIP proposal reviewed • Previous attempts at reducing the BCCR discussed to gain historical context	• ‘Permission’ given

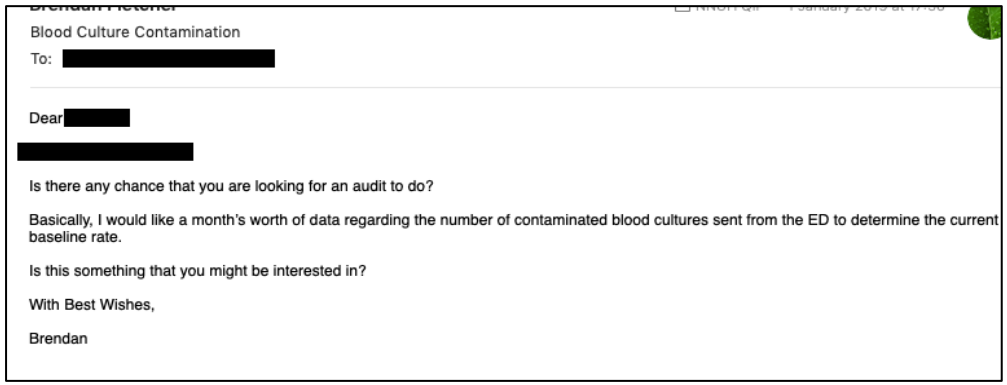
			• No data obtained as to whether or not these worked *1. Did they believe there was a problem with BCCR in this institution?* ***Yes*** *2. Did they already have data about BCCR?* ***No*** *3. Did they have information about any previous attempts to reduce the BCCR?* ***Yes (see Table 3)*** *4. Did they have any suggestions to reduce the BCCR if they felt it was a problem?* ***Yes (see IDENTIFICATION OF ACTIONS)*** *5. Did they feel there were any unique factors in this institution contributing to the BCCR?* ***Very busy department and many new starters from diverse backgrounds*** *6. Did they have any suggestions as to who the stakeholders might be?* ***Junior doctors and ED nurses (and suggestion as to who might be go-to people amongst the nursing staff)*** *7. Did they have any ideas about how to involve patients the process?* ***No***	• Table of previous attempts to reduce BCCR generated • ED Nurse Champion for Core Team identified and approached • Consented to be SYSTEMS expertise

	QI Expertise	Email	• QIP proposal reviewed • Suggested the use of a 'negative design process' to create a driver diagram Hi Brendan This looks good! Would be happy to chat over the phone if that'd help. [redacted] is our contact in micro, incredibly helpful and gets things done when you meet up- but rarely responds to emails and does not have a phone so the main challenge is getting hold [redacted] We could use some QI tools if you can make a weds afternoon meeting or else I can talk you through them over the telephone. One of them is to do a negative design I.e. design the worst possible process- this helps you find where all the flaws are. These tools work best doing them with a few people. Many heads are better than one etc. Best wishes [redacted]	• Consideration given to a "negative" process: ultimately not undertaken to due to careful use of time with Core Team
	PALS	Email	• No patient complaints recorded relating to BCC in the ED • No suggestions about how to involve patients in the process Dear Brendan Thank you for your email received in PALS. The database you are referring to is probably Datix, where complaints, PALS issues and incidents are recorded. I deal with PALS enquiries but I do not recollect any PALS enquiries relating to blood cultures contaminated in ED raised by patients. A summary of all PALS enquiries are placed in the Governance folder each month in the S drive under Corporate Departments/Trust Management Shared/Governance Leads and you may wish to access this and review these. You will need to speak to the Complaints Team/Incident Reporting if you wish to access their data. With kind regards Sarah *Did they have any ideas about how to involve patients the process?* ***No***	• Summary of PALS enquiries interrogated as suggested. No relevant complaints noted

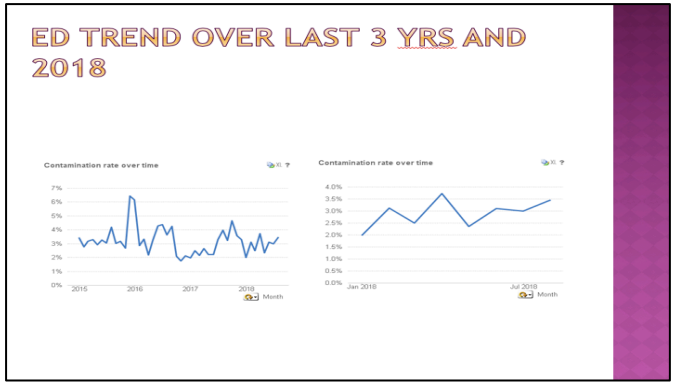
The 1% Challenge:

	ED incident reporting contact	Email	• No patient safety incidents recorded relating to BCC in the ED  Hi Brendan, I am sadly not sure I can help you, but I may be able to ask a lady who may know the answe[redacted]ut she is on leave this week, so will enquire on her return. I only deal with the 'nurse datix' (and pray that one of the bosses will handle the 'doctor' ones) I do have a record of all the datix I've answered since taking up position in April, with a brief note about them....should have made a data base with all the information as this would have made life easy for you, as at the moment they are in paper form! (and these I only keep for my own record, but you are welcome to look at them.) That is so not very helpful.....sorry! Much love	• See below
	ED incident reporting contact	Opportunistic meeting	• Has checked with colleagues. No patient safety incidents recorded relating to BCC in the ED	• Consideration now being given to categorising patient safety incident reports in the ED (i.e. the creation of a database that will be searchable)
	ED Nurse	Opportunistic meeting	• QIP presented • Invited to be part of the Core Team • Mined for ideas	• Core Team member recruited

	Trainee ACP	Telephone Message	 **Figure 18: Invitation to be part of the Core Team**	• Core Team member approached
	Trainee ACP	Meeting	• Issues of BCC presented (trainee ACP is from a paramedic background and so BCs generally are a new concept) • QIP presented • Invited to be part of the Core Team	• Core Team member recruited

	ED Junior Doctor	Email	• GP trainee working in ED approached (on the grounds of reliability and knowing that they have to complete and audit project for their ARCP) • Unfortunately this trainee already had an audit project and personal commitments.  Blood Culture Contamination To: [redacted] Dear [redacted] Is there any chance that you are looking for an audit to do? Basically, I would like a month's worth of data regarding the number of contaminated blood cultures sent from the ED to determine the current baseline rate. Is this something that you might be interested in? With Best Wishes, Brendan	• Core Team member approached • Decision made to do the snap-shot audit myself
	Paediatric Junior Doctor (with experience of working in ED)	Opportunistic Meeting	• BCC problem discussed (with reference to the patient story presented in BACKGROUND) • She confirmed that this was an increasing issue in paediatrics • Explained that similar work had been undertaken in paediatrics and she had a contact in the MICROBIOLOGY department (this consultant already involved with this QIP)	• She would explain to the paediatric team that this work is being undertaken in the ED for her team to be aware

			• "You almost certainly know it is a contaminate when the CSF **AND** BCs grow a CNS – it makes you wonder if they even washed their hands!"	
	ED Resus Lead Nurse	Opportunistic Meeting	• BCCs discussed • Historical context of attempts to reduce the BCCR discussed • "It always feels like we are being criticised but no one really gives us the time or the [tools] to do the job better" • Explained the goal was to shift the best-practice curve to the right • Told the story about the patient in PICU and the consequences for her (this seemed to be the most effective argument)	• Consideration given to incentives and "Quick Wins" • Consideration given to using the EMOTIVE aspect of the story to change BEHAVIOUR • Consideration given to the 'balancing' effect of QI is perceived criticism of current practice

November	External hospital consultant (as part of search of 'Grey Literature'	Email	• Kindly shared some of their BCCR data • Suggests that our ED's BCCR is much higher than their baseline of around 3% (with a similar ED Census) • Agrees with a less than 1% target but suggests that this will be very difficult to reach • No suggestion about how to involve patients in the process 	
	ED Consultants and	Departmental Meeting	• BCCR discussed • Issue of "psychological safety" discussed: essentially that if the target is too ambitious and the 'sanction' too great, this may have the effect of putting clinicians off doing BCs, even when they are necessary	• Reassurance provided to group that there are no

<table>
<tr>
<td></td>
<td>manageme
nt team</td>
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<table>
<tr><td>Brendan Fletcher</td><td>Will tackle each areas for training and education</td><td></td><td></td><td></td></tr>
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</td>
<td>‘sanctions’ built into this project</td>
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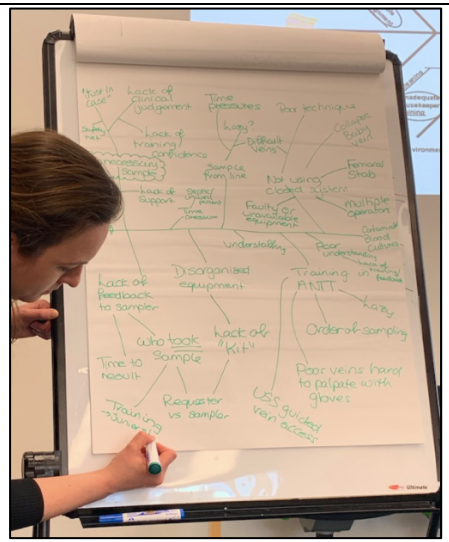
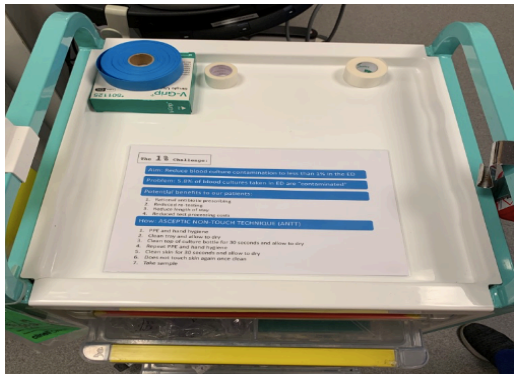
<tr>
<td>December</td>
<td>Core
Group: NS,
tACP, JD</td>
<td>Brainstorming
Sessions</td>
<td> 

Figure 19: Photo of Focus Group brain-storming session in progress</td>
<td>• (Kitchen) table-top exercise completed to design process-map
• Ishikawa diagram generated
• Resources considered
• Options appraised
• Driver diagram agreed</td>
</tr>
<tr>
<td></td>
<td>Core
Group: NS,
ACP, JD</td>
<td>Opportunistic
Meeting</td>
<td>• “Red Lines” discussed and agreed
• Discussion around PDSA cycles and negotiation</td>
<td>• PDSA cycles agreed</td>
</tr>
</table>

			• Explained that there has been a sacrifice of imagination in favour of pragmaticism	
	Core Group: NS	Email	RE: The 1% Challenge To: Brendan Fletcher Hi Looks good – send away. I like the graphic too. Best Wishes	• 'Branding' agreed
	Support Team	Informal email	Blood Culture Contamination: The 1% Challenge Details To: [redacted] Cc: Brendan Fletcher Deares[redacted] [redacted] Is there any chance that you could circulate the email below to the Consultants, Juniors and ACPs in the ED please? Big Love, BF	• PDSA cycle one started
January	ED Consultant	Opportunistic Meeting	In response to poster he had seen: • Pleased it had been laminated (!) • Observed that there was already much laminated signage in this clinical area (resus), and it is possible to get "laminated signage fatigue"	• Example of subsidiarity: keeping the problem and the solution is close proximity.

			• Reassured that these signs were the only ones on the blood trolleys where the blood culture bottles are kept  **Figure 20: Poster on blood trolley**	• White board in handover area 're-claimed' for use for morning "Learning Bite' (with one of the posters)
	IP&C Nurses	Opportunistic Meeting (whilst they were in ED performing hand hygiene audit)	• Poster highlighted • Used the opportunity to 'market' the project to a wider audience **within** the hospital • Explained was proud of this work being done	• Asked her to spread word of the good work being done in the ED to reduce the BCCR

	Inspector from the Care Quality Commission	Opportunistic Meeting (whilst they were in the ED performing a planned inspection)	• Poster highlighted and project discussed • Used the opportunity to 'market' the project to a wider audience **outside** the hospital • Explained was proud of this work being done	• Asked him to spread the word of the good work being done in the ED to reduce the BCCR (report awaited)
February	ED Nurse	Opportunistic Meeting	In response to email about a BCC: • Discussion about BCC and why it matters to patients • Explained no sanction attached	• Identified that he had not been at the handover sessions • Identified need to keep a record
	ED Junior Doctor	Opportunistic Meeting	In response to email about a BCC: • Discussion about BCC and why • Explained no sanction attached	• Identified that she had not been at the 'Learning Bite'

			• Explained about ANTT (context is that doctor is an IMG and not familiar with local ANTT)	• Identified need to keep a record
	ED Senior Nurse	Opportunistic Meeting	In response to email about a BCC: • Explained had made the request on computer system but did not take the sample herself	• Modification made to original email to acknowledge that requestor and sampler might not be the same person
	ED Consultant	Email	I love a run chart…. Can I ask a favour- wer are being pressed to show we have completed audits are responded to the issues raised by RCEM audits- your blood culture QIP could be squeezed into a box that says we are looking at sepsis management. Could you put some of your culture contamination rate data and your laminates into the audit response flow chart attached and I can include it at the next governance meeting. Thanks	• Presentation for ED Divisional Board Meeting (Appendix 16)

	Recipient of 'responsive email'	Email	Hi Brendan, Thank you for bringing this to my attention. I am quite passionate about blood cultures and following the right procedure so I appreciate being made aware of this. As a new member of ED from AMU I have had to print requests off for other members of staff. I will be more aware of this for the future. Thank you Kind regards	• 'Responsive email' changed to reflect that requestor and sampler may not be the same person
March	QI Expert	Email	Wow Brendan, that is an amazing piece of work which you have put an awful lot of work into. It is very thorough and I am sure it is frustrating that you haven't been able to get the results you desired. I know they ran a similar piece of work in paeds medical in [redacted] would it be helpful if I got the main learning points from their project to see if there is anything else transferrable?	• Results shared

Table 9: Summary of key communications

APPENDIX 2: SUMMARY OF KEY LITERATURE

Intervention(s)	Setting (Country)	Year	Effect	Metric	Time Period	Critique	Ref.
1.Venepuncture sterility checklist 2.Feedback of individual BCCR	Paediatric ED (USA) Census: 90,000	2015-2017	3.02% to 1.17% BCCR	1.BCCR% 2.Clinical ordering rate	24 months	1. Included balancing measure of bacteraemia in returning patients when BC not done (3.6%) 2. PDSA cycle to reduce physician ordering 3. Also changed equipment provision but this was not an additional PDSA cycle and could have contributed to the improvement 3. Measured financial impact (> $300,000 cost saving) Estimated not calculated 4. Limited to paediatric patients 5. Did not define contamination	25

The 1% Challenge:

1.DIVERSION device *(essentially discard of first 2ml of blood)*	Adult ED (USA) Census: not recorded	2014-2015	1.78% BCCR reduced to 0.22%	1. BCCR 2. User satisfaction	12 months	1. Convenience sample (missing 64% of patients) 2. Limited to adult patients 3. Phlebotomists only in the trial – possibly likely to have a lower BCCR 4. Dedicated phlebotomists not likely to be available in most UK EDs limiting generalisability 5. User satisfaction recorded 6. Limited to adult patients 7. Did not define contamination	26
1. Seminar educational intervention 2. Monthly monitoring	Adult ED (USA) Census: not recorded	2015-2016	5.37% to 1.75%	1. BCCR%	12 months	1. Limited to adult patients 2. Did not define contamination 3. Did not specify what the monthly monitoring actually did	27

3. Feedback of individual BCCR 4. Peer review of BC technique							
1. Sterile BC kit introduced 2. Limited BCs to phlebotomists only	Adult ED (USA) Census: not recorded	Not defined	4.34% to 1.168% with kit and 1.10% with phlebotomist	1. BCCR% 2. Costs	12 months	1. Dedicated phlebotomists not likely to be available in most UK EDs limiting generalisability 2. Limited to adult patients 3. Modelling to suggest that dedicated phlebotomists and kits would be cheaper long-term (but not actually demonstrated) 4. Did not define contamination	28
1. Sterile BC kit introduced	Academic Adult ED (USA)	2009-2010	4.3% to 1.7%	1. BCCR %	48 weeks	1. Also developed a checklist and 'ANTT' policy but it is not clear from the published data whether what intervention out of the THREE actually worked	29

	ED Census: 55,000					2. Limited to adult patients 3. Did not define contamination	
1. New "ANTT" policy 2. Web-based educational intervention	Paediatric ED (USA) Census: not recorded	2011	3.9% to 1.6% Cost savings	1. BCCR% 2. Cost savings	10 months	1. Cost savings were estimated 2. Also introduced a checklist at the same time and it is not possible to separate this out from the new policy as the run chart was all interventions together 3. DID define contamination 4. Limited to paediatric patients	30
1. Checklist 2. Traffic-light system for BC sampling technique:	Mixed ED (UK) Census: 50,000	2014-2015	4.74% to 2%	1. BCCR%	12 months	1. Excellent run chart with PDSA interventions marked 2. Did not include children 3. The traffic light system is novel and evidence-based 4. Liked the staff display area	13

- Green (closed system) - Amber (needle and syringe) - Cannula (red) 3. Seminar educational intervention 4. Email feedback of BCCs 5. Display area in ED of							

department progress							
1. Awareness 2. Training (essentially seminar-based educational intervention)	Mixed ED (UK) Census: not recorded	2017-2018	4.2% to 3.5%	1. Number of staff trained 2. BCCR%	7 months	1. Limited to adults 2. Data unpublished with PDSA cycles outstanding	14

Table 10: Summary of key evidence

APPENDIX 3: TEAM ASSESSMENT TOOL

Role (Belbin Role)	Team Sponsor	Technical Expert	Day-to-Day Leadership	Assets
EM Trainee **("Co-ordinator")** **("Complete Finisher")**			X	• **Personal investment in success of project**
ED Consultant **("Team worker")**	X			• Awareness of QIP process and local processes • Popular with colleagues • **Professional gravitas** • Contacts throughout the hospital
Microbiology Consultant & Trust IP & C Lead **("Specialist")**		X		• **Subject matter expert** and systems expert
ED Matron **("Plant")**				• **Awareness of previous attempts** • Professional gravitas in the ED • Popular with colleagues

ED Nurse (“Resource Investigator”)				• **Project “champion” amongst nursing colleagues** • Popular with colleagues
Trainee ACP				• **Project “champion” amongst ACP colleagues** • Popular with colleagues
ED Junior Doctor (“Implementer”)				• Project “champion amongst medical colleagues
QI Methodology Expert* (“Monitor Evaluator”)	X	X		• **QI methodology expertise**
Data Collection				• Data collection
Support Team				• **Disseminating emails** • **‘Covert’ information (minute-taker in meetings)**

Table 11: Team Assessment Tool

(* = support provided by a consultant from another hospital with expertise in QI methodology)

The roles highlighted in orange were ones that were never filled. I was able to assume both these roles (see REFLECTIONS).

APPENDIX 4: CORE TEAM ROLES

Role	Agenda/ Competing Factors	Preferred Communication	Specific Role	Specific Action
EM Trainee	• Working towards a submission deadline	• N/A	• See below	• See below
ED Consultant	• Multiple competing demands on time • "Winter pressures"	• Email • Opportunistic Meetings	• Departmental project supervision • Senior Support	• Consent to actions being undertaken in the ED • Review of write-up
Microbiology Consultant & Trust IP & C Lead	• Multiple competing demands on time	• Email • Opportunistic Meetings	• Expert advice on issues relating to BCCR	• Confirm what constitutes as BCCR • Confirm locally and nationally available data
ED Matron	• Multiple competing demands on time • New to post	• Opportunistic Meetings	• Senior Support	• Consent to actions being undertaken in the ED

	• "Winter pressures"			• Provide historical context to previous attempts
ED Nurse	• Less easy access to email communications • 'Subject' to other projects/priorities	• Opportunistic Meetings	• Entry point into the nursing cohort	• Disseminate PDSA cycles and data collection at handovers
Trainee ACP	• Less understanding of the issues around BCCR • New to hospital practice	• Opportunistic Meetings • Text message	• Entry point into the ACP cohort	• Disseminate PDSA cycles and data collection
ED Junior Doctor	• NEVER FILLED	•	• Entry point into the Junior Doctor Cohort	• Disseminate PDSA cycles and data collection
QI Methodology Expert	• Works in a different hospital and specialty	• Email • Formal face-to-face	• Senior Support	• Advice on QI methodology Review write-up

Data Collection	• NEVER FILLED	•	•	• One month 'snap-shot' data collection • Collect data after each PDSA cycle
Support Team	• Non-clinical. Limited understanding of BCCR	• Opportunistic Meetings • Text message	• Disseminate emails • Book face-to-face appointments	• Additionally, to provide informal comment on what is said about project by others (identify any 'covert' Resistors)

Table 12: Core Team Roles

The roles highlighted in orange were ones that were never filled. I was able to assume both these roles (see REFLECTIONS).

APPENDIX 5: "WHAT'S IN IT FOR ME?" ANALYSIS

Stakeholder	The "What's in it for me?"	The "Offer"
EM Trainee	• Completion of QIP for FRCEM • Career advancement	• Not applicable
ED Consultant	• Professional obligation to supervise a trainee QIP • Needs to demonstrate that the ED supports educational activity to the Deanery	• Be point of contact for trainees thinking about QIPs • Provision of data (Appendix 16)
Microbiology Consultant & Trust IP & C Lead	• Needs to support on projects that ultimately improve antimicrobial stewardship	• Be point of contact in the ED for future QIPs involving antimicrobial stewardship
ED Matron	• New to role and building reputation	• Social integration • Point of contact into ED Junior Doctor Body
ED Nurse	• Career advancement • Wanting to learn about QI methodology	• Sepsis teaching session on mentor day

The 1% Challenge:

Trainee ACP	• Paramedic new to hospital practice • Needs to build knowledge and contact base	• Teaching session on sepsis at ACP training day
ED Junior Doctor	• Not applicable	• Not applicable
QI Methodology Expert	• Professional obligation to supervise a trainee QIP	• Knowledge of working processes in ED
Data Collection	• Not applicable	• Not applicable
Support Team	• A helpful person that wants to do the right thing for the ED	• Flowers
Patients & Families	• See BACKGROUND	• See BACKGROUND
Infection, Prevention and Control Team	• Point of contact into the ED medical team	• Point of contact in the ED for new initiatives
ED Junior Doctors	• General sense of wanting to do what is best	• Sepsis teaching at JD teaching sessions. Bedside teaching
ACPs	• General sense of wanting to do what is best • Specific educational needs relating to sepsis	• Sepsis teaching session at ACP training days

The 1% Challenge:

ED Nursing Staff	• General sense of wanting to do what is best	• Snacks provided at handover • Sepsis teaching at mentor days
ED Clinical Director	• Need to demonstrate at Board level that the ED is engaged with both FRCEM activity and quality improvement • Needs to manage the reputation of the ED internally and externally	• Positive comment on GMC training survey
ED Consultant Body	• Need a trainee to pass the FRCEM to join the Consultant body in the future	• 'Learning Bite' at morning handovers

Table 13: "What's in it for me?" Analysis

APPENDIX 6: SUMMARY OF RESOURCES

Resource	Notes	Efforts to Maximise
Time	• 7 months (with option to extend): time-bound by start date in new hospital and FRCEM submission date • SPA time and free-time available	• PDSA cycles can run past the FRCEM submission date (demonstrating succession)
Space	• Office space available at work and at home	• Not needed
Materials	• Office materials and presentation materials	• Not needed
Equipment	• Unlikely to be new 'kit' available in the absence of business case approval (Business case unlikely to be approved in the time available)	• Not needed at initiation
Funding	• Business case unlikely to be approved in time available. May have to meet any out-of-pocket expenses personally	• Not needed at initiation
People	• Nursing staff • ACPs • Junior doctors • Issue with staff changing rotations	• See REFLECTIONS
Expertise	• QI Methodology via CRP • Microbiology Consultant • ED Consultant body	• QI methodology input particularly helpful

Goodwill	• Intangible asset • Aware that the ED is operating in 'winter pressures' and external scrutiny from NHSI	• Offer to do teaching sessions in exchange for 'access' • Baked goods to handovers • Avoid overloading staff with emails and requests • "Cake & Competencies"
Reputation & Experience	• Intangible asset • Being a senior EM Trainee may carry some professional gravitas	• Use experience of undertaking a QIP

Table 14: Summary of available resources

APPENDIX 7: OPTION APPRAISAL

Option	Match to Ishikawa Chart	Previous effectiveness (Appendix 2)	Anticipated resource implication*	Position on hierarchy of interventions	SMART¶
BC Checklist	Yes	Not clear from evidence	Low	MEDIUM	Difficult to measure compliance
Individual feedback of BCC	Yes	Yes	Low	MEDIUM	Yes
DIVERSION device	Yes	Yes	Moderate - high	MEDIUM	Not achievable in time-frame
Seminar educational intervention	Yes	Yes	Low	LOW	Yes
Peer review of BC technique	Yes	Not clear from evidence	Moderate	LOW - MEDIUM	Yes
Sterile kit	Yes	Yes	Moderate - high	MEDIUM	Not achievable

					in time-frame
Limiting BCs to phlebotomists only	No	Yes	High	MEDIUM - HIGH	Not achievable in time-frame
Web-based educational intervention	Yes	Yes	Moderate	LOW	Yes
Traffic-light system	No	Yes	Low	LOW	Yes
Awareness Programme	Yes	Not clear from evidence	Low	LOW	Yes

* = i.e. a business care would be needed

¶ = Specific, Measurable, Achievable, Relevant, Time-bound

Table 15: Option Appraisal

APPENDIX 8: QUALITY IMPROVEMENT METHODOLOGIES (31)

QI Method	Description	Why suitable for this project	Why not suitable for this project
Clinical Audit	• Comparison of current practice against agreed standard	• To obtain a 'baseline' current BCCR	• Collects more than 'just enough' data Time-consuming 'Unimaginative'
Plan-Do-Study-Act	• Rapid cycles of change introduction, data collection about the impact of that change, allowing for more rapid refinement in further cycles.	• Collects "just enough" data rapidly • More imaginative than clinical audit	• May be perceived as less robust by external regulators

Model for Improvement	• Two phased approach. • Firstly: • Defines goal • Defines outcome • Defines metric • Secondly, applies PDSA cycles	• As above. • Increasing experience with this tool in QI internationally	• As above
Six Sigma	• Applies DMAIC to ascertain root causes of variation. • Defining • Measuring • Analysing • Improving • 5. Control	• If a checklist or a new piece of kit was introduced, this may be an effective tool	• Needs a lot of data • Accepted practice in industrial change
Lean	• Essentially it is used to eliminate variation and waste in processes • Can be combined with Six Sigma	• Might be applicable if a 'high-level' metric such as LOS associated with BCC was being applied	• Needs a lot of data • Accepted practice in industrial change

Performance Benchmarking	• Identifies key performance indicators and manages change at a strategic level	• Could have been used if there were agreed benchmarks already or if the data were to be compared between hospital departments or between hospitals	• "Targets" is a word used a lot in the ED already, with negative connotations • Needs a lot of data • Likely needs agreement at strategic and operational levels
Healthcare failure modes and effects analysis	• Reviews processes prospectively to prevent harm by applying 'failure models' and a 'risk priority number'	• The Argyris & Schon consideration discussed has relation to the first part of this process (19)	• Time-consuming • Requires significant staff input
Process Mapping	• Defines the patient journey through a system and uses "touch points" as QI opportunities	• Used to break down the process of BCs in the ED	• See PLANNING

Statistical process control	• Monitors how a process operates compared to its full potential	• Aspects of this are used in the project (the Run Charts)	• Needs a lot of data
Experience-based co-design	• Reviews systems from the patient's own 'touchpoints' with them		• Patient involvement considered in this project, but no PROM identified that was relevant
Root-cause analysis	• Investigative process to examine people and systems involved in adverse events	• Double-loop learning theory (19) was applied to this project to consider the change in culture needed to reduce BCCR • An Ishikawa diagram was generated	• Does not examine the impact of a change

Table 16: Analysis of Quality Improvement Methodologies

Methods used in this project are highlighted in green.

APPENDIX 9: ANALYSIS OF METRICS

	ADVANTAGES	DISADVANTAGES
OUTCOME MEASURES	**(i.e. patient-related)**	
Number of patient safety incidents relating to BCCs	• Reducing these may directly demonstrate better patient care and safety	• Not all may be reported • (None were actually reported)
Number of patient complaints relating to BCCs	• Introduces 'patient voice'	• Small numbers • (None were actually reported)
Patient satisfaction with ANTT adherence	• PROM • Introduces 'patient voice'	• Patient unlikely to know about ANTT and therefore cannot be consistently applied
Length-of-stay	• Measure of patient care	• Too many variables to link directly to BCC in this QIP
Inappropriate antibiotic usage	• Measure of patient care	• Too many variables to link directly to BCC in this QIP
PROCESS MEASURES	**(i.e. system-related)**	
BCCR % (i.e. BCCs/total number of BCs in given time period)	• Consistent in the literature • Easily derivable metric • Easily communicated metric	• Indirect measure of patient care and safety (but consistently used in the literature to reflect this)

Adherence to ANTT	• Specific to what one of the underlying problems is thought to be	• Labour intensive • Indirect measure of patient care and safety
Staff understanding of ANTT before and after teaching	• Specific to what one of the underlying problems is thought to be	• *Only considered retrospectively*
BALANCING MEASURES	**(i.e. "unintended" consequences)**	
Time spent obtaining blood cultures	• Increased time may be a side effect of better ANTT	• Labour intensive
Use of disposables	• Increased disposable costs may be a side effect of better ANTT	• Difficult to define what kit has been used where and why
FINANCIAL MEASURES	• Could be used to drive investment and buy in from NHS management	• Complex and beyond the scope of this QIP

Table 17: Analysis of metrics

Metrics used in this project are highlighted in green.

APPENDIX 10: PDSA CYCLE 1 - EMAIL TO STAKEHOLDERS

The 1% Challenge:

Dear Team,

Your help is needed please.

Summary:

1. The current rate of blood culture contamination from the ED is 5.8%
2. The consequence of contaminated blood culture samples may be increased length-of-stay and inappropriate prescription of antibiotics
3. Other departments have been able to reduce their blood culture contamination rate to less than 1 %
4. Adherence to the Aseptic Non-touch Technique (ANTT) is proven to reduce blood culture contamination

Detail:

1 [redacted] Trust-wide has a problem with blood culture contamination
2. It is accepted that 0% is not an achievable goal given blood cultures may be taken during resuscitation, where time-critical interventions may lead to sub-optimal ANTT
3. The majority of contamination occurs in samples taken from children by medical staff
4. Doctors may not realise that they have a contaminated sample because the results do not appear for some days
5. As part of a Quality Improvement Project to reduce contamination to below 1%, the following are offered:
   - An email updating you if you have taken a sample that is subsequently shown to be contaminated (bridging the disconnect between samples taken in the ED and not resulted until days later)

Further good things are coming!

Thank you for your help and for any advice about how to make this happen!

Brendan Fletcher, ED Registrar

APPENDIX 11: PDSA CYCLE 1 - POSTERS TO RAISE AWARENESS OF BCC

The 1% Challenge:

Aim: Reduce blood culture contamination to less than 1% in the ED

Problem: 5.8% of blood cultures taken in ED are "contaminated"

Potential benefits to our patients:

1. Rational antibiotic prescribing
2. Reduced re-testing
3. Reduce length of stay
4. Reduced test processing costs

How: ASCEPTIC NON-TOUCH TECHNIQUE (ANTT)

1. PPE and hand hygiene
2. Clean tray and allow to dry
3. Clean top of culture bottle for 30 seconds and allow to dry
4. Repeat PPE and hand hygiene
5. Clean skin for 30 seconds and allow to dry
6. Do not touch skin again once clean
7. Take sample

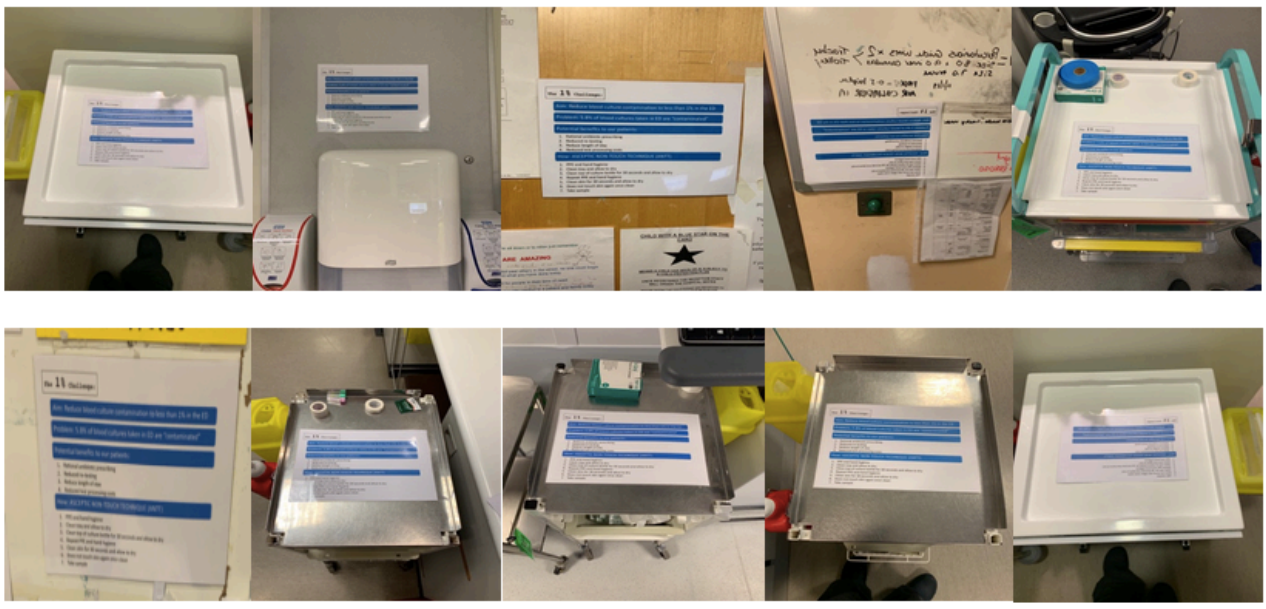


Figure 21: Posters placed in strategic locations around the ED (especially blood trolleys)

APPENDIX 12: PDSA CYCLE THREE - EMAIL TO STAFF WITH A BCC

The 1% Challenge:

Dear **INSERT NAME**,

I hope that this email finds you well.

On **INSERT DATE**, a blood culture was performed on a patient with hospital number **INSERT NUMBER**. You are listed as the requestor for this sample.

You may not or may not know already, but this blood culture has grown an organism likely to be a contaminant.

This might affect their ongoing care, if they were admitted; particularly with reference to continuing or stopping a course of antibiotics.

We know that around 5.8% of blood cultures sent from the ED are similarly contaminated and that there are many factors that might contribute to this.

In order to improve care and safety for **our** patients, we aim to reduce this number to less than 1%.

The science suggests that the best way to avoid inadvertent contamination of blood cultures is rigid adherence to the [redacted] Aseptic non-touch technique (please find attached).

I would be grateful if you could please kindly acknowledge receipt of this email.

Thank you for taking the time to read this.

With Best Wishes,

Brendan Fletcher
Emergency Medicine Registrar

APPENDIX 13: THE 1% CHALLENGE WEEKLY TEAM BRIEF

The 1% Challenge:

AIM: To reduce blood culture contamination rates to below 1% from samples taken by Emergency Department doctors by December 2018

WEEKLY TEAM BRIEF: Monday September 24th – Sunday 30th

Achievements so far:

1. Initial meeting with [redacted]
2. Potential goal decided (SMART boxes ticked!)
3. Potential logo decided
4. Background reading
5. Consideration to timeline
6. Consideration to PDSA cycles:

Cycle One (broadly "Awareness"): Build a brand: logo + laminated posters (detailing the problem and the goal) and circulating by email Best Practice guidance.
Cycle Two (broadly "Education"): Engage personally with nurses, ACPs and doctors who take blood cultures to explain the problem and the solution to it
Cycle Three (broadly "Challenging the Culture"): emailing individuals when they have their name against a contaminated sample to remind them of good practice.

Specific Actions for this week:

1. Agree goal as worded above [redacted]
2. Agree logo [redacted]
3. Stakeholder Analysis (BF)
4. Timeline (BF)
5. Seek opinion about potential PDSA cycles [redacted]

General Actions:

1. Build the team! (BF)
2. Continue background reading (BF)

Advice/Help Please:

1. Do you have a contact in microbiology that you think might be helpful?
2. Do you have a QI "tool" you might recommend for stakeholder analysis?
3. What QI tools might you recommend for INTERNAL and EXTERNAL analysis?

APPENDIX 14: RAW DATA COLLECTION

Date	Total	BCC	BCCR(%)	Date	Total	BCC	BCCR(%)	Date	Total	BCC	BCCR(%)	Date	Total	BCC	BCCR(%)
DECEMBER				JANUARY				FEBRUARY				MARCH			
14	11	2	18.2	1	8	2	25	1	7	0	0	1	4	0	0
15	8	1	12.5	2	13	3	23.1	2	14	0	0				
16	11	1	9.1	3	12	0	0	3	9	1	11.1				
17	10	1	10	4	9	1	11.1	4	12	0	0				
18	7	0	0	5	10	2	20	5	18	1	5.6				
19	9	1	11.1	6	8	0	0	6	13	1	7.7				
20	9	0	0	7	13	2	15.4	7	13	1	7.7				
21	11	1	9.1	8	7	0	0	8	8	0	0				
22	6	1	16.7	9	9	2	22.2	9	9	1	11.1				
23	11	1	9.1	10	8	0	0	10	12	1	8.3				
24	9	0	0	11	5	0	0	11	9	0	0				
25	13	0	0	12	5	0	0	12	10	0	0				
26	10	1	10	13	7	0	0	13	9	0	0				
27	18	0	0	14	9	2	22.2	14	10	3	30				
28	9	1	11.1	15	18	2	11.1	15	14	0	0				
29	9	1	11.1	16	10	1	10	16	7	2	28.6				
30	5	0	0	17	7	0	0	17	12	1	8.3				
31	17	3	17.6	18	13	0	0	18	9	1	11.1				
				19	9	0	0	19	10	0	0				
				20	10	0	0	20	10	0	0				
				21	10	0	0	21	11	1	9				
				22	13	0	0	22	8	2	25				
				23	11	0	0	23	13	2	15.3				
				24	7	0	0	24	10	2	20				
				25	9	0	0	25	10	0	0				
				26	12	1	8.3	26	5	0	0				
				27	7	1	14.3	27	16	0	0				
				28	8	2	25	28	8	0	0				
				29	13	3	23.1								
				30	8	0	0								
				31	16	0	0								

Table 18: Raw Data Collection

APPENDIX 15: "LIVE" STATISTICAL PROCESS CHART TO MARCH 2019 (22)

SPC (XmR) tool

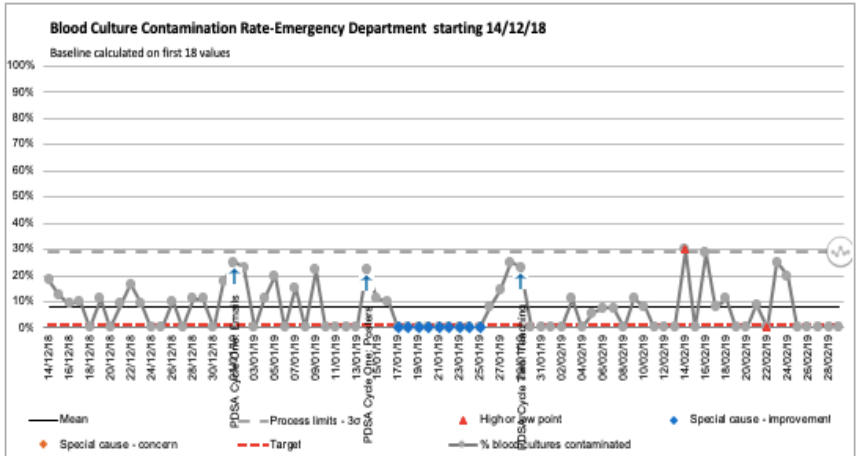
Chart title	Blood Culture Contamination Rate
Team/unit name	Emergency Department
Your measure	% blood cultures contaminated
What does improvement look like?	Low is good

Target	1%		
Maximum number	100%	Include weekends?	Yes
Start date	14/12/18		
Planned duration (days, weeks, months)	78 Days	Set baseline (choose baseline period 12 - 20*)	18 Days

NHS Improvement

Export chart to power point

Date	% blood cultures contaminated	Date	% blood cultures contaminated	Date	% blood cultures contaminated	Date	% blood cultures contaminated
Fri 14 Dec	18%	Fri 11 Jan	0%	Fri 08 Feb	0%		
Sat 15 Dec	13%	Sat 12 Jan	0%	Sat 09 Feb	11%		
Sun 16 Dec	9%	Sun 13 Jan	0%	Sun 10 Feb	8%		
Mon 17 Dec	10%	Mon 14 Jan	22%	Mon 11 Feb	0%		
Tue 18 Dec	0%	Tue 15 Jan	11%	Tue 12 Feb	0%		
Wed 19 Dec	11%	Wed 16 Jan	10%	Wed 13 Feb	0%		
Thu 20 Dec	0%	Thu 17 Jan	0%	Thu 14 Feb	30%		
Fri 21 Dec	9%	Fri 18 Jan	0%	Fri 15 Feb	0%		
Sat 22 Dec	17%	Sat 19 Jan	0%	Sat 16 Feb	29%		
Sun 23 Dec	9%	Sun 20 Jan	0%	Sun 17 Feb	8%		
Mon 24 Dec	0%	Mon 21 Jan	0%	Mon 18 Feb	11%		
Tue 25 Dec	0%	Tue 22 Jan	0%	Tue 19 Feb	0%		
Wed 26 Dec	10%	Wed 23 Jan	0%	Wed 20 Feb	0%		
Thu 27 Dec	0%	Thu 24 Jan	0%	Thu 21 Feb	9%		
Fri 28 Dec	11%	Fri 25 Jan	0%	Fri 22 Feb	25%		
Sat 29 Dec	11%	Sat 26 Jan	8%	Sat 23 Feb	15%		
Sun 30 Dec	0%	Sun 27 Jan	14%	Sun 24 Feb	20%		
Mon 31 Dec	18%	Mon 28 Jan	25%	Mon 25 Feb	0%		
Tue 01 Jan	25%	Tue 29 Jan	23%	Tue 26 Feb	0%		
Wed 02 Jan	23%	Wed 30 Jan	0%	Wed 27 Feb	0%		
Thu 03 Jan	0%	Thu 31 Jan	0%	Thu 28 Feb	0%		
Fri 04 Jan	11%	Fri 01 Feb	0%	Fri 01 Mar	0%		
Sat 05 Jan	20%	Sat 02 Feb	0%				
Sun 06 Jan	0%	Sun 03 Feb	11%				
Mon 07 Jan	15%	Mon 04 Feb	0%				
Tue 08 Jan	0%	Tue 05 Feb	6%				
Wed 09 Jan	22%	Wed 06 Feb	8%				
Thu 10 Jan	0%	Thu 07 Feb	8%				



Instruction sheet | Clear data

Print | Save | Clear interventions

Interventions

01/01/20	PDSA Cycle One: Emails
14/01/201	PDSA Cycle One: Posters
29/01/201	PDSA Cycle Two: Teaching
15/02/201	PDSA Cycle Three: Responsive Emails
04/01/201	

Please enter a date and select comment for recalculating the process limits

28/12/20	
20/12/201	
Turn off annotation	No

*You can choose a period for your baseline but if you want to introduce a step change and a baseline, please clear the baseline and use the recalculation buttons instead.

Set vertical axis: Change axis

* see instruction sheet point 9

min value	0%
max value	100%
Integer	Percentage
dd/mm/yy	dd/mm/yy

Summary statistics

Mean observation -	$\bar{X}$	8%
Average moving range -	$\overline{mR}$	8%
Three sigma - 3σ		21%
Upper process limit		29.3%FAL SE
Upper moving range Limit		26%

Data observations

This type of chart (SPC) allows you to identify statistically significant changes in data. The dotted lines (process limits) represent the expected range for data points if variation is within expected limits - that is, normal. You can aply a number of rules to identify when the process is not in control - that is, special variation.

Rule 1	Points which fall outside the grey dotted lines (process limits) are unusual and should be investigated. They represent a system which may be out of control. There is 1 data point which is above the line.
Rule 2	When more than 7 sequential points fall above or below the mean that is unusual and may indicate a sigificant change in process. This process is not in control. There is a run of points below the mean.
	On the moving range chart points which fall above the moving range process limit - grey dotted line - are unusual and suggest that the system is out of control. This should be investigated. There are 3 data points which are above the line.

APPENDIX 16: PRESENTATION FOR ED DIVISIONAL BOARD MEETING

Blood Culture Contamination in the Emergency Department

Background

Contaminated blood cultures are associated with:

Patient Level	Systems Level
Adverse drug reactions to unnecessary antibiotic use (including anaphylaxis)	Increased cost
Increased risk of hospital-acquired infections (e.g. *Clostridium difficile*)	Inefficient use of laboratory resources
Lead to unnecessary further investigations with associated morbidity (including ionising radiation and lumbar puncture)	Contribution to global antibiotic resistance
Increased length-of-stay	

Objectives

To reduce the rate of contaminated blood cultures from the ED to less than 1%

Standards and Exceptions

As above.

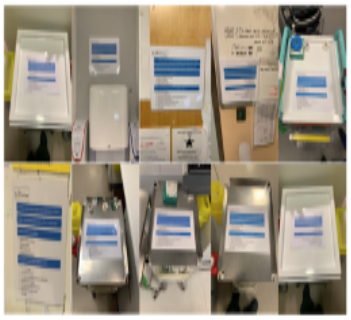
It is accepted that a rate of zero % may be unachievable (for example, samples taken during resuscitation) and attempts to achieve this may result in reticence in taking samples

Methodology

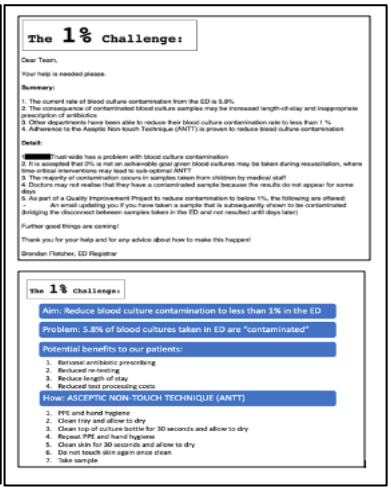
Quality Improvement Project submitted in part fulfilment of the FRCEM: "The 1% Challenge"

Using the Model for Improvement and PDSA cycles starting with:

- PDSA 1 – Awareness: Emails to staff and posters on around the ED (especially on blood trolleys).



- PDSA 2 – Education. Sessions provided for ACPs, nursing staff and medical staff. Essentially reminded staff of the hospital ANTT protocol.
- PDSA 3 – Emailing individuals who have had a contaminated sample.



The 1% Challenge:

Dear Team,

Your help is needed please.

Summary:

1. The current rate of blood culture contamination from the ED is 5.8%.
2. The consequence of contaminated blood culture samples may be increased length-of-stay and inappropriate prescription of antibiotics
3. Other departments have been able to reduce their blood culture contamination rate to less than 1 %
4. Adherence to the Aseptic Non-touch Technique (ANTT) is proven to reduce blood culture contamination

Detail:

1. [redacted] Trust-wide has a problem with blood culture contamination
2. It is accepted that 0% is not an achievable goal given blood cultures may be taken during resuscitation, where time-critical interventions may lead to sub-optimal ANTT
3. The majority of contamination occurs in samples taken from children by medical staff
4. Doctors may not realise that they have a contaminated sample because the results do not appear for some days
5. As part of a Quality Improvement Project to reduce contamination to below 1%, the following are offered:
   - An email updating you if you have taken a sample that is subsequently shown to be contaminated (bridging the disconnect between samples taken in the ED and not resulted until days later)

Further good things are coming!

Thank you for your help and for any advice about how to make this happen!

Brendan Fletcher, ED Registrar

The 1% Challenge:

Aim: Reduce blood culture contamination to less than 1% in the ED

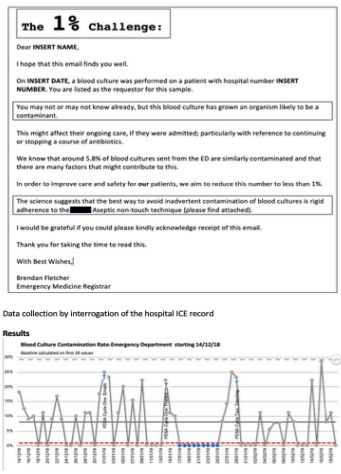
Problem: 5.8% of blood cultures taken in ED are "contaminated"

Potential benefits to our patients:

1. Rational antibiotic prescribing
2. Reduced re-nesting
3. Reduce length of stay
4. Reduced test processing costs

How: ASCEPTIC NON-TOUCH TECHNIQUE (ANTT)

1. PPE and hand hygiene
2. Clean tray and allow to dry
3. Clean top of culture bottle for 30 seconds and allow to dry
4. Repeat PPE and hand hygiene
5. Clean skin for 30 seconds and allow to dry
6. Do not touch skin again once clean
7. Take sample



The 1% Challenge:

Dear **INSERT NAME**,

I hope that this email finds you well.

On **INSERT DATE,** a blood culture was performed on a patient with hospital number **INSERT NUMBER**. You are listed as the requestor for this sample.

You may not or may not know already, but this blood culture has grown an organism likely to be a contaminant.

This might affect their ongoing care, if they were admitted; particularly with reference to continuing or stopping a course of antibiotics.

We know that around 5.8% of blood cultures sent from the ED are similarly contaminated and that there are many factors that might contribute to this.

In order to improve care and safety for our patients, we aim to reduce this number to less than 1%.

The science suggests that the best way to avoid inadvertent contamination of blood cultures is rigid adherence to the [redacted] Aseptic non-touch technique (please find attached).

I would be grateful if you could please kindly acknowledge receipt of this email.

Thank you for taking the time to read this.

With Best Wishes,

Brendan Fletcher
Emergency Medicine Registrar

Data collection by interrogation of the hospital ICE record

Results

Conclusions

Current ED blood culture contamination rate is 8% and this has remained static despite the current PDSA cycles.

It appears that there was a statistically significant response to placing posters around the ED but this was not sustained (blue dots).

Recommendations

Continue PDSA Cycle 3 as anticipated long latent period between intervention and improvement

Explore PDSA Cycle 2 result with further iteration: consider development of blood culture "kit dump" on blood trolleys or creating a blood culture "kit dump" packaged like an advent calendar.

Plans for re-audit

Not applicable. This is ONGOING quality improvement work.

GLOSSARY OF ABBREVIATIONS

ACP(s) Advanced Clinical Practitioner(s)

ANTT Aseptic non-touch technique

BC(s) Blood culture(s)

BCC Blood culture contamination

BCCR Blood culture contamination rate

BLS Basic Life Support

CNS Coagulase negative *Staphylococcus*

CQC Care Quality Commission

CQUIN Commissioning for Quality and Innovation

CRP Chief Resident Programme

DoH Department of Health

ED Emergency Department

GP General Practitioner

HAI(s) Hospital Acquired Infection

HCA Healthcare Assistant

IPCT Infection Prevention and Control Team

IV Intravenous

JD(s) Junior Doctor

MRSA Methicillin-resistant *Staphylococcus aureus*

MSSA Methicillin-sensitive *Staphylococcus aureus*

NHSI National Health Service Improvement

NS Nursing Staff

PALS Patient Advice and Liaison Service

PDSA Plan-Do-Study-Act

PEM Paediatric Emergency Medicine

PICU Paediatric Intensive Care Unit

PROM(s) Patient Reported Outcome Measure(s)

QI Quality Improvement

QIP Quality Improvement Project

SMART Specific, Measurable, Attainable, Relevant, Time-bound

SPA Supporting professional activity

SPC Statistical Process Chart

UK United Kingdom

WHO World Health Organisation

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