Reducing HCAI through a paradigm shift in strategic thinking:

The Law of Multiple Small Positive Returns

Dr Mike Simmons

Introduction

Members of the Hywel Dda University Health Board (HDUHB) agreed at a Board Development Day on 19th December 2013 that management of infection is a priority. Members accepted the advice from the Infection Control Service and the executive who attended the Welsh Government Team Wales event that while the health board will continue to be judged alongside other health boards using the MRSA bacteraemia and C diff data sets, with Hywel Dda having low numbers of these specific organisms, if we are to make a significant difference to infection we must now look at tackling the sepsis that is the root cause of the infection problems pouring into our hospitals.

Interestingly, the infection control team has recognised the direct fit with these proposals from last December with the Health Ministers recent discussions around prudent healthcare. Similarly, the Public Health Wales led but informal collaboration with academics in Wales\(^1\) around complexity science in healthcare also discussed how a complexity science fitted with these discussions around prudent healthcare. This paper brings these streams together.

This paper therefore seeks to assure formal sign-off on this policy shift. The Quality and Safety Committee is asked to agree the content of this paper and forward to the Board for formal adoption.

Background:

Hospital Acquired Infection for HDHB from the 2010 prevalence study was 6.4% of patients. The principle causes (70%) were:

Respiratory infection: 22.1% (pneumonia 20.3%; LRI 1.8%)
Urinary tract infection: 24.3%
Skin and surgical site infection: 25.7% (Skin:8.1%; SSI: 17.6%)
Community Acquired Infection for HDUHB from the 2012 prevalence study in care homes was around 4.9%. The principle causes (95%) were:

- Respiratory infections: 61.2%
- Urinary tract infection: 19.4%
- Skin infections: 14.9%

All of these should be considered HCAI, given that the patients are in healthcare premises, although at any point in time, some will be acquired from the community via staff and visitors, primarily some of the respiratory infections.

From the 2006 prevalence survey of all hospital patients, we had a HAI rate of 6% but also a CAI rate of 18%. This reinforces the importance of infection in our hospitals where at any time around 25% of patients will have an infection.

This suggests that as infection in care homes and the community become more difficult to manage, they are admitted to secondary care. As a result, the burden of infection admissions in our hospitals is significant.

For Hywel Dda, the rate of MRSA bacteraemia is 4/100,000 bed days

However, for the other top ten causes of bacteraemia the most recent published data for 2012 shows:

<table>
<thead>
<tr>
<th>HAI type</th>
<th>Number of HAI</th>
<th>% of HAI</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWTHB total</td>
<td>74</td>
<td>6.9</td>
<td></td>
</tr>
<tr>
<td>UTI</td>
<td>18</td>
<td>24.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>15</td>
<td>20.3</td>
<td>1.4</td>
</tr>
<tr>
<td>SSI</td>
<td>13</td>
<td>17.6</td>
<td>1.2</td>
</tr>
<tr>
<td>BSI</td>
<td>6</td>
<td>8.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Eyes and ENT</td>
<td>6</td>
<td>8.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Skin and soft tissue infection</td>
<td>6</td>
<td>8.1</td>
<td>0.6</td>
</tr>
<tr>
<td>GI infection</td>
<td>4</td>
<td>5.4</td>
<td>0.4</td>
</tr>
<tr>
<td>CVS infection</td>
<td>1</td>
<td>1.4</td>
<td>0.1</td>
</tr>
<tr>
<td>LRT</td>
<td>1</td>
<td>1.4</td>
<td>0.1</td>
</tr>
<tr>
<td>CRI-PVC</td>
<td>1</td>
<td>1.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Systemic infection</td>
<td>1</td>
<td>1.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Bone and joint infection</td>
<td>1</td>
<td>1.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Reproductive infection</td>
<td>1</td>
<td>1.4</td>
<td>0.1</td>
</tr>
</tbody>
</table>

* Counts the number of HAI (i.e. Patients may have multiple HAI).
Key: UTI = urinary tract infection; SSI = surgical site infection; GI = gastrointestinal; BSI = bloodstream infection; LRT = lower respiratory tract; ENT = ear - nose - throat; CRI-CVC = catheter related infection (central venous catheter); CRI-PVC = catheter related infection (peripheral vascular cannula); CNS = central nervous system; CVS = cardiovascular system.
<table>
<thead>
<tr>
<th>Rank</th>
<th>Organism</th>
<th>Rate per 100,000 bed days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Escherichia coli (E. coli)</td>
<td>84</td>
</tr>
<tr>
<td>2</td>
<td>Staphylococcus aureus (MSSA)</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>Enterococcus species</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>Klebsiella species</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>Streptococcus pneumonia</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>Coagulase negative Staphs</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Proteus species</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Coliform</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Pseudomonas aeruginosa</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>Enterobacter species</td>
<td>5</td>
</tr>
</tbody>
</table>

The scheme has however been running for a number of years. Taking the data from the Public Health Wales internet site and plotting in Excel reveals the following:

NB: For 2010 coliforms (5) have been added to Ecoli (61) and is plotted as 66. Similarly, for 2012 coliforms (8) have been added to E coli (84) and plotted as 92. Inspection of the laboratory results in 2012 revealed occasionally coliforms had been identified as E coli but not updated in the reporting field.
This highlights the infection issue identified by the top ten bacteraemia scheme for Hywel Dda is not MRSA, which as the first table shows, has dropped out of our top ten. *E. coli* is increasing year on year.

The 2013 data for Wales will be published at some point. We therefore have examined all blood cultures taken during 2013 and our top 5 organisms.

The age distribution of the top 5 organisms demonstrates what we recognise from clinical practice in our acute hospitals: 83% of the bacteraemias are in people over 60 years old.

When we examined the source of the samples for each of the organisms, we found that our A&E departments were commonly the source, most importantly for the E coli, given the higher numbers of these organisms, of which there were 357 during 2013 – Staph aureus contributed 135 (MRSA 26: MSSA 109), Klebsiella 68, Enterococci 66 and Pneumococci 28:
Having noted the importance of specimens arriving via just the A&E department, we subsequently examined the Patient Administration system for details of admissions etc for the 32 E coli bacteraemias collected in December. Twenty two of the 32 patients were admitted within the 2 days prior to the positive sample, which takes the percentage that are community associated from 56% to 69%.

For Staph aureus (MSSA + MRSA), we looked back over November and December to check a comparative number of positives: 14 of 23 patients were community associated, which increases the percentage from 34% to 61%.

The number of positive bacteraemias caused by the other 3 organisms are of lower numbers and have not been retrospectively examined as yet but even the sampling source continues to underlie the importance of these organisms presenting from the community.

We are not alone in recognising the importance of community associated HCAI, Anderson et al.\textsuperscript{3} recently reported a multicentre study from the US and found the majority of bacteraemias were community onset HCAI’s.

**The Vision**

While infection prevention and control is tightly and rapidly managed in our hospitals, if we are to make a difference, we must now take a step change and while continuing with our hospital efforts, move into the community with similar work being undertaken there. To do this, we cannot ignore the hospital work but part of the step change will involve empowering hospital based staff to rise to the continued challenges they face. This is not a departure from the ambitions expressed in the past HCAI strategies published by the Welsh Government where the first statement has remained, “all staff to understand the impact of infection and infection control practices to enable them to discharge their personal
responsibilities to patients, other staff, visitors and themselves." This was made more explicit in the 2011 HCAI action plan "All staff must understand their responsibility and accountability for IPC and employers must assure themselves of this on an ongoing basis."

In a dwindling financial climate, tackling the 3 major HCAI’s highlighted will have the biggest impact. Not only reducing mortality and morbidity from infection but also reducing length of stay, reducing CAI admissions and increasing our capacity to respond to other healthcare demands though increases in capacity and release of funds.

Health Board members at the development day therefore agreed that the approach in Hywel Dda will be to:

1. reinforce the view that all infections are intolerable i.e. Zero Tolerance to HCAI
2. recognise the positive impact of managing & preventing the most frequently occurring infections i.e. Respiratory Infection, Urinary Infection, Skin and Surgical Site Infection
3. engage, energise and empower all our staff across the acute and community sector with special efforts to get upstream into the community
4. continue to use recognised Quality Improvement Methodologies but also learn from the Large Scale Change Initiatives
5. accept that Welsh Government will continue to challenge around MRSA and C. diff
6. monitor E. coli bacteraemia as a better surrogate for infections across our services and will set a local target of 20% reduction over 3 years.

The How:

Healthcare is so complex, it is a system par excellence for the application of complexity science.

The proposal therefore is in tackling Healthcare Associated Infection there will be two top level rules every individual and team should use to guide their thinking through the management of HCAI in their patients:

1. First do no harm
2. Seek and take the positive step or action

What complexity science teaches is that complex systems sit at the edge of chaos (ask yourself if that sounds anything like modern healthcare, with all its competing demands). However, patterns of organisation emerge from the application of simple rules in nature and complexity science seeks to harness the use of similar simple rules and allow the
system to self organise. If we can identify and take positive steps to reduce HCAI's, then we will see patterns of reducing infection emerge. These may not be predicable and we must also be constantly on the lookout for negative effects and if identified, they must be countered quickly by seeking out the positive alternative and taking that alternative action.

This principle fits with the PDSA methodology at the heart of Welsh quality improvement methodologies. However, what we must recognise is that we cannot expect that what works in one ward, department or team is automatically transferable to all. This may be true but we must allow teams to explore and refine for their area otherwise, they will fail to internalise and “own” the problem and solutions. This is the fundamental mistake being made by some quality improvement proposals: impose a solution without such ownership and it will be resented, not unreasonably because there will not be the “fit” with their service or issue.

**First do no harm:**

The harms we do our patients in modern healthcare must be viewed from a risk based perspective. Nobody sets out to knowingly harm patients but there is a trend to think of all healthcare as offering an advantage but this could not be further from the truth.

In terms of infection, antibiotics remain "wonder drugs" and their use is seen as offering a positive effect in the management of infection. However, antibiotic use is never neutral and the default position is that antibiotics cause harm: prescribe an antibiotic and it will be distributed throughout the body and inhibit or kill bacteria and thereby influence other bacteria that are resistant and may then multiply. The classic everyday example of this is *C. difficile* associated diarrhoea but the appearance of MRSA, ESBL and opportunistic pathogens are all as the result of antibiotic use. *C. difficile* associated diarrhoea is a negative effect of antibiotic use and therefore in applying our first rule of doing no harm, we would argue against the use of antibiotics. However, we know that if a patient presents with an acute infection, we would seek to take the positive step and prescribe an antibiotic, which might ultimately lead to *C. difficile* associated diarrhoea. In severe sepsis, if we did not prescribe the antibiotic, our patient is at risk of death. Thus, in balancing risks and the rules, we would prescribe and manage the consequences.

In monitoring the patient’s infection over time, we should continue to review the patient in the light of the two rules. The patient may initially be on IV antibiotics; IV antibiotics have to be delivered via a medical device. Every medical device comes with risks and the risks only go when the device is removed. There will be inherent new infection risks if the IV line is kept in place. Thus, the decision to remove an IV line and move to
oral antibiotics obeys both rules by reducing potential harms and by taking 2 positive actions.

As soon as the infection has been conquered, the positive step is to stop the antibiotics; continuing antibiotics unnecessarily continues to kill the body’s normal colonising bacteria and increases the risk of acquiring drug resistant bacteria, including *C. diff*.

**Seek and take the positive step or action**

Perhaps the most striking piece of Welsh evidence of multiple positive actions having a dramatic difference is with postoperative surgical site infections in caesarean sections (C-section). Infection Control Teams across Wales recognized large numbers of HCAI’s following C-section. Early work in one hospital had demonstrated by the whole community engaging with this issue, reductions could be achieved. The obstetric community joined with their infection control teams in a programme of work, drawing in others locally, including healthcare engineers and planners. Data analysis was undertaken by the Welsh Healthcare Associated Infection Programme Team. It is difficult to point at any one issue that led to the reductions in infection following C-section. Local engagement across hospitals and boards sought to look at local issues. These ranged from personnel issues, staffing of theatres, local infection control policies, hand hygiene compliance, theatre usage, theatre ventilation, theatre temperatures, antibiotic polices etc. A large and variable set of issues that required many different staff groups to be engaged and own local problems.

While no single item can be identified as the cause of the HCAI; the results have been staggering as illustrated in Figure 1, which over a 5 year period has shown a drop from over 20% of all young women developing a clinical infection following C-section, to the current figure of around 5%. The author’s assessment is that if this can be achieved in one area, it can be achieved in many others through this application of local engagement and ownership.
Interestingly, because this was not a major issue for hospitals within Hywel Dda, with a starting point of 10%, the fall has not been as dramatic and the fluctuations appear larger although with a downward trend. This again underlies the importance of our health board recognising what our current problems are in relation to infection and concentrating our efforts there to maximise the impact.

Interestingly, this seems a similar story to that discussed by Pittet in presentations\(^7\) reporting the results of the hand hygiene initiatives in Geneva, Switzerland\(^8\). It was clear that while the measure of success was compliance with hand hygiene and a corresponding reduction in HCAIs, what the project group managed to do was engage staff across the hospital to own the issues at ward and department level. In his presentations, Pittet discussed how departmental staff would create their own posters and report data ("talking walls"), which played an important role in individual engagement and understanding.

It is interesting that as a result of the "Clean your Hands" Campaign, we have rightly instituted major awareness around this issue and a desire to see 100% compliance; in Pittet’s paper, he showed a significant reduction in nosocomial infection but his hand hygiene compliance went from less that 50% to just short of 70%. The reductions owed as much to his staff engagements and understanding as has been simply attributed to hand hygiene compliance. As noted, a similar story to the C-section infection reduction seen in Wales.
Multiple Small Positive Returns

This is the heart of the delivery of the new HCAI reduction programme across the Hywel Dda population, be it hospital or community and fits with the ethos of Large Scale Change advocated at the Team Wales event in December 2013. The process map was presented thus:

It was emphasised that the key to success was “Framing/reframing the issues”, “Engaging/connecting others” and “Making pragmatic change in multiple processes” in repetitive cycles.

Essentially, this is no different to the Plan, Do, Study, Act cycles that have been adopted as central to our quality management initiatives. However, as highlighted above, change cannot be imposed, it must be locally owned and this is what is emphasised in the large scale change map through the framing and reframing principles so that common problems might be tackled slightly differently by different teams in response to local perceptions and need. This is where pragmatism is key and multiple small positive steps will have the same dramatic effect as seen with all Wales C-section infection reductions.

Such multiple small positive returns are created by following the second rule of seeking and taking the positive line.

From a complexity science perspective, the most difficult concept, particularly for managers, is accepting that every member of staff needs to be engaged and empowered in the decisions and actions that need to be taken; managers have to recognise that individual staff and teams will identify the solutions and many of these cannot be planned. The
managerial role is to support teams and set the local ground rules in respect of boundaries, which will include finances and not to try and micro-manage the solutions and actions being taken. These principles are well recognised in business fields; John Timpson, chairman of high street chain of Timpson stores, refers to this concept as, “upside down management.”

**Actions: Putting this all together to reduce infections**

All members of staff across our organisations that provide care to patients within the Hywel Dda area need to be engaged, energised and empowered if we are to achieve reductions in infections.

Microbiology and the infection prevention and control team do not have the answers to how to reduce infections although they clearly have important roles is supporting clinicians and teams. Their insights will have a role and will contribute to the development of solutions. This underpins why all we wish to do generically is suggest the two simple rules that should guide our thinking; thereafter staff engagement will indentify and propose solutions to lead to the changes we need to make to contribute to those multiple small positive effects that will see infections reduce.

Working with other departments and the community, we will conduct a series of engagement events that will develop the healthcare community to undertake the tasks necessary to make the changes they identify. We will use techniques already well recognised in the NHS in Wales but may also need to provide new forms of support identified as we develop this engagement. This equally allows complexity thinking to govern what we need to do in this supporting role. Everyone therefore will recognise that change will happen at all levels and not to allow this to unduly concerns us; this will be an evolutionary process.

For the infection prevention and control team, there will therefore be two principle streams of activity: the engagement with clinical teams noted above and secondly our immediate clinical priority supporting community services with their HCAI challenges, having recognised that community HCAI is the big infection importation challenge to secondary care across Hywel Dda.

**Proposed Top Level Measures**
Local team engagement will encourage staff to identify their own measures, in keeping with the PDSA methodology but the Infection Prevention and Control Team will also aim to identify high level measures that the board will use to assess progress.

Current thinking that we are exploring include:

- Admissions with sepsis – the team are making connections with the RRAILS programme locally and nationally to look at what is available.
- Admissions with urinary catheters
- Admissions with other medical devices
- Bacteraemia rates: primarily E. coli BUT we cannot predict the effect on any particular organism and therefore we should keep a close eye on the effect of all the organisms down to and including MRSA.
References

1 MetaPH website advises: MetaPH is a co-operative of like minded people who believe that improving Public Health "is not rocket science; it's much more complicated than that!" available at: http://www.metaph.org.uk accessed 29th April 2014


