Delivering the 48-hour antimicrobial review on inpatient drug charts

ABSTRACT

Background: Prolonged or inappropriate antibiotic therapy increases the risk of health-care-associated infections and the development of resistance to antibiotics, and lengthens hospital admissions. There are clear guidelines on antimicrobial stewardship which state that antibiotics should be reviewed between 48 and 72 hours from commencement (National Institute of Health and Care Excellence, 2015). Despite these guidelines this review was often not documented as having been carried out on the authors' inpatient wards.

Methods: A quality improvement project was undertaken with the aim of improving the percentage completion of the 48-hour antimicrobial review box section of the inpatient drug charts to over 90% across two 30-bed acute respiratory wards within 7 weeks. The primary outcome measures were percentage completion of 48-hour antibiotic review and number of days on intravenous antibiotics. The quality improvement programme took place over 7 weeks and included seven interventions designed to improve completion of the 48-hour review.

Results: During the study, the percentage completion of 48-hour review rose from a baseline median of 68% to 100% and was accompanied by a reduction in the number of days on intravenous antibiotics from a baseline median of 2.25 days to 1.5 days.

Conclusions: This simple quality improvement project led to a greatly improved review of antimicrobial therapy which was associated with significantly reduced time on intravenous antibiotics. The quality improvement methodology could easily be adapted for other inpatient medical wards.

Prolonged or inappropriate antibiotic therapy is a significant challenge worldwide. Poor antimicrobial stewardship leads to increased antimicrobial resistance and development of so-called 'superbugs' (World Health Organization, 2014). Furthermore, there is an increased risk of health-care-associated infections such as *Clostridium difficile* (Dingle et al, 2017) and lengthening of hospital admission time (Nathwani et al, 2014).

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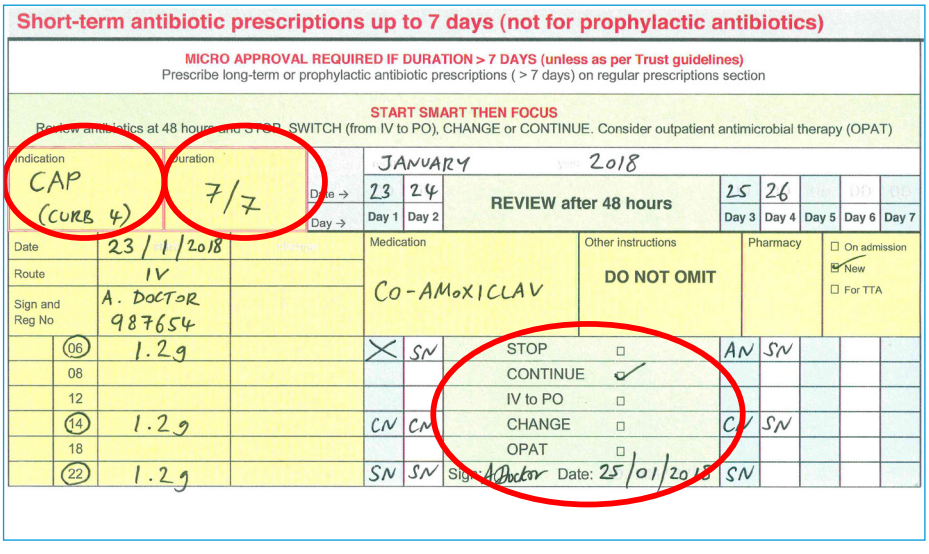

Figure 1. Barking, Havering and Redbridge University Hospitals NHS Trust antibiotic prescription chart with indication, duration and 48-hour review sections.

Barking, Havering and Redbridge University Hospitals NHS Trust recently introduced a new drug chart (*Figure 1*) incorporating the national 'Start smart – then focus' approach which aims to start the correct antibiotic promptly and, at 48 hours, prompt the clinician to review the antibiotics and make an 'antimicrobial review decision' for ongoing antibiotic therapy (focus) (Public Health England, 2015). This is one of the key elements of a good antimicrobial stewardship programme (Srinivasan, 2017). The initial data suggested that this newly designed section of the drug

chart was completed poorly. The authors were also unable to ascertain whether completion of this section resulted in better patient outcomes in relation to antimicrobial stewardship.

One of the largest users of antimicrobials in the authors' hospitals is patients on the respiratory wards. A quality improvement programme was undertaken to increase the percentage completion of the 48-hour antimicrobial review box section of the inpatient drug charts to over 90% across two thirty-bedded acute respiratory wards within 7 weeks. The authors also evaluated the use of intravenous antibiotics during the quality improvement programme for these patients as a surrogate marker of improved patient outcome.

Methods

This quality improvement programme was performed using model of improvement methodology using the 'Quality Improvement Essentials Toolkit' as provided by the Institute for Healthcare Improvement (2017). This analysed aspects that may influence review of inpatient drug charts and specifically review of antibiotic therapy. Potential influencers and potential change interventions are illustrated on the driver diagram (*Figure 2*).

Data from 30 randomly selected prescription charts from two respiratory wards (15 charts per ward) were collected and analysed twice weekly for a 7-week period. A total of 420 prescription charts were reviewed. Inclusion criteria were that charts were accepted for analysis if there was an active antimicrobial prescription present for at least 2 days. Prescription charts were excluded if antimicrobial therapies had run longer than 7 days or already been marked as completed. Any patients on long-term antimicrobial therapy (such as those patients on anti-tuberculous therapy) were excluded.

The main outcome measure was completion of the 48-hour antimicrobial review tick box on inpatient drug charts. To help the authors examine whether this resulted in a positive change in practice they also collected the number of total days that the patient was on intravenous antibiotics. Process measures were signing and dating of the 48-hour review section. The balancing measures were clinician documenting indication and duration for antibiotics. Additional information was collected on clinical indication for antibiotic, type of antibiotic and number of days on antibiotic at time of data collection. All outcome, process and balancing measures were captured on run charts. The baseline median was calculated for each run chart by taking the median value of the first six data points of the 14 measurement cycles completed. Information was collated in a specially designed electronic spreadsheet.

Seven PDSA (plan, do, study, act) cycles were completed with each cycle including assessment of the effectiveness of a PDSA intervention. The quality improvement team was multidisciplinary and consisted of six trainee doctors, one pharmacist, one occupational therapist, one quality improvement Darzi fellow and one respiratory consultant who acted as mentor. The quality improvement team on each ward collated data onto a shared electronic spreadsheet (with set mandatory fields) which facilitated completeness of data collection. Measurement of outcome, process and balancing measures took place regularly between PDSA cycles. The quality

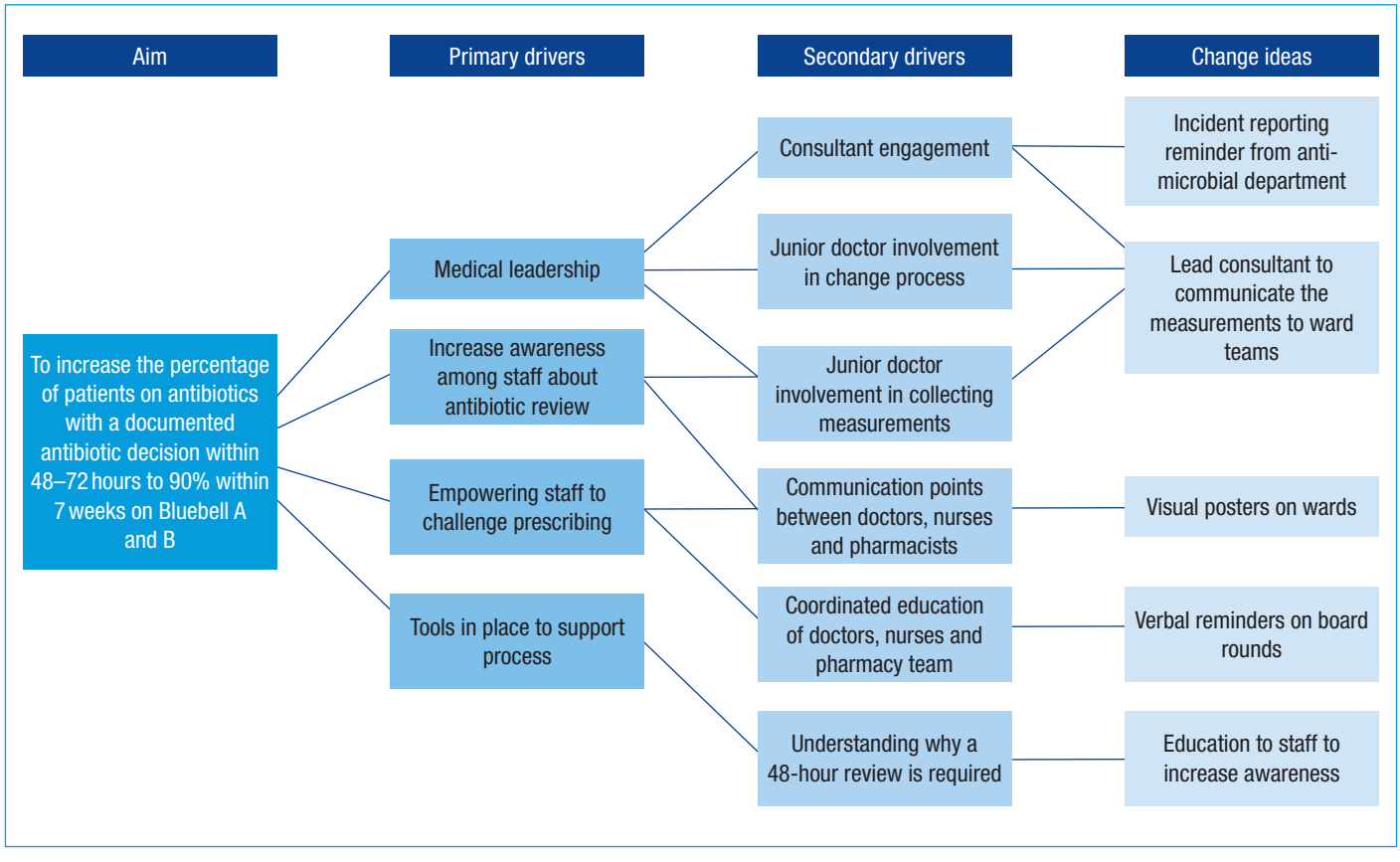

Figure 2. Driver diagram to improve antimicrobial stewardship on acute respiratory wards.

improvement team had weekly meetings with their mentor to review the impact of each intervention to either adopt, adapt or discard. The quality improvement team would then agree upon the next intervention. Communication between PDSA cycles was via instant messaging and group email.

Results

Baseline audit

An initial internal pharmaceutical audit was performed 3 months post-implementation of the new drug charts. The audit revealed that on only 37% of inpatient drug charts was the 48-hour antimicrobial review section completed. The completion rate was lower still on the two respiratory wards at 29%.

Clinical indications for prescribing antimicrobials

Of the 420 respiratory inpatient drug charts analysed during the quality improvement programme, 406 (96.7%) had a clear indication stated. The most common clinical indications were community-acquired pneumonia (*n*=115, 28%), lower respiratory tract infection (*n*=93, 22%), infective exacerbation of chronic obstructive pulmonary disorder (*n*=36, 8%) and hospital-acquired pneumonia (*n*=32, 7%).

Outcome, process and balancing measures

The baseline median measurement for the main outcome showed 68% of patients had their antimicrobial 48-hour review box ticked on their drug chart. This improved to 100% by measurement cycle 11 and was sustained thereafter. The average time on intravenous antibiotics showed an associated reduction from a baseline median measurement of 2.25 days to 1.5 days by cycles 13–14. This constitutes an average reduction of 0.75 days (*Figure 3a*). The process measures of signing and dating the 48-hour review section also showed significant improvement. At median baseline, 66.7% of 48-hour antimicrobial reviews were signed (*Figure 3b*) and 63.3% were dated. Following a similar trend to the 48-hour review box, both rose to 100% by measurement cycle 11 and remained at 100%. The balancing measures of recording of indication (*Figure 3c*) and duration for antibiotics completed on drug chart reassuringly did not fall. At median baseline, 93.3% had a clinical indication for antimicrobial documented on the drug chart rising to a median of 98.3% and 86.7% a treatment duration rising to a median of 95% by cycle 13–14.

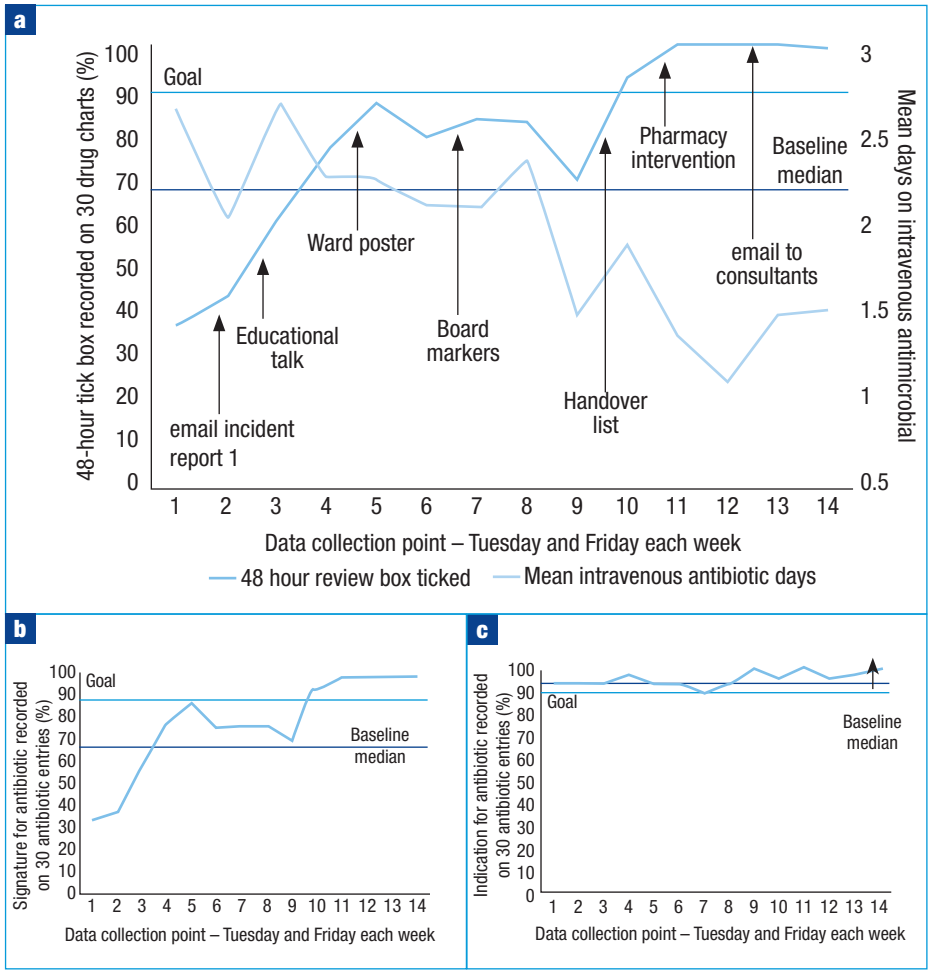

Figure 3. Outcome, process and balancing measures for quality improvement programme over 7 weeks. a. Main outcome measure with annotation for each plan, do, see, act intervention – run chart displaying 48-hour review tick box and mean days in intravenous antimicrobials over 14 measurement cycles. The baseline median is calculated from the median value of the first six measurements. b. A process measure – 48-hour signature recorded on drug chart. c. A balancing measure – indication for antibiotic documented on drug chart.

During the whole quality improvement period 334/420 (79%) of drug charts had the 48-hour review box ticked. The options ticked were 'continue' (*n*=230, 54.85%), 'intravenous to oral' (*n*=88, 21.0%) and 'stop' (*n*=15, 3.6%). None were ticked for options 'change' or 'OPAT' (outpatient parenteral antimicrobial therapy).

PDSA cycles

The PDSA interventions with greatest impact were:

1. Educational talk by a consultant
2. Inclusion of 48-hour review status on daily handover list
3. Active ward pharmacy involvement.

A full description of each PDSA and their effect on the quality improvement programme is given in *Table 1*. The first intervention was a trust-wide email to all doctors and pharmacists highlighting the importance of the 48-hour antimicrobial review. In this email pharmacists were asked to file a mandatory incident report each time the review was not carried out. Although this was not instigated by the authors' quality improvement team, it may have had some effect on the outcome and so was included in this study. The fourth intervention of magnets on patient whiteboards was not implemented because the magnets were not available on time. There were no other incidents that impacted on the project.

> “Ticking the 48-hour review box was selected as the main outcome measure as this was used by the authors’ hospitals to measure 48-hour antimicrobial review.”

Discussion

Main study findings

This quality improvement programme achieved its chosen aim of improving completion of the 48-hour antimicrobial review to over 90% with an associated reduction in intravenous antibiotic prescribing. It was notable that the average time on intravenous antibiotics fell below 48 hours by completion of the quality improvement programme, suggesting that an increased awareness of antimicrobial review was leading to reviews being carried out before 48 hours. In addition, the balancing measures of documenting duration and indication for antibiotic remained very high, as these were also elements of good antimicrobial stewardship.

Strengths and weaknesses of the quality improvement programme

One of the strengths of the programme was the adherence to model of improvement methodology. The driver diagram shows interventions that were designed to increase awareness and sustain system changes across the whole multidisciplinary team to achieve the 48-hour antimicrobial review. Further strengths were having a large quality improvement team who were able to implement interventions and adherence to regular meetings to discuss progress and prospective interventions.

The programme included a large and near complete data set. Choice of measurements were guided by SMART criteria (Doran, 1981). Ticking the 48-hour review box was selected as the main outcome measure as this was used by the authors’ hospitals to measure 48-hour antimicrobial review. This was simple to collect prospectively on the ward. The number of days a patient was on intravenous antibiotics was selected as an important surrogate measure to evaluate if there was any meaningful change in practice on achieving the primary outcome.

Signing and dating the 48-hour review section as process measures and recording of indication and duration on drug chart as balancing measures were also chosen for ease of data collection. The authors postulated that increased attention to the 48-hour antimicrobial review tick box may detract from recording of indication and duration. Instead, the authors found a slight improvement, suggesting a wider engagement of antimicrobial stewardship elements. More expected was the close correlation between the process measures of signing and dating the 48-hour review

Table 1. Plan, do, study, act cycle interventions

Week	Description	Effect
1	**Incident report email** A trust-wide e-mail mandating pharmacists to submit an incident report when a 48-hour review is not completed. Note: intervention not initiated by quality improvement project team	**Slight improvement** The threat of an incident report did motivate action, but the authors felt this was a negative way to encourage change which may have limited short-term effect
2	**Consultant announcement** Consultant speaking directly to all multidisciplinary team members present at the morning board round to explain the quality improvement project and to provide education on the importance of good antimicrobial stewardship	**Significant improvement** This may have been as it was a personal announcement from a senior member of the team to a wide range of disciplines of the ward team. It also signified the ‘beginning’ of the quality improvement programme
3	**Visual prompt** A4 poster in doctors’ areas of the wards to educate and remind them of the importance of the 48-hour review	**No effect** This had a negligible effect as the posters were small and not eye catching enough. Also, they were not visible in nursing areas
4	**Magnets on patient whiteboard** Pharmacists to put magnets on the patient board to highlight patients requiring a 48-hour review	**No effect** Unfortunately, magnets were not available at the start of the week so the intervention was not carried out properly, and was later abandoned
5	**Reminder on handover sheet** Doctors work from paper handover lists. A section highlighting whether the 48-hour review had been done for each patient was created on the sheet to remind the team	**Significant improvement** This may have been as the handover sheet is constantly referred to by doctors on the ward round and throughout the working day
6	**Active pharmacist involvement** Pharmacists were encouraged to verbally highlight incomplete 48-hour reviews to the doctors	**Significant improvement** Previously pharmacists had documented the need for review on the front of the drug chart which was often not looked at by doctors. A verbal prompt thus had a strong effect
7	**Email to consultants** An email was sent to senior members of respiratory team detailing the improvement that had been achieved by week six of the project and encouraging ongoing engagement with completion of the 48-hour review	**Effect uncertain** 100% of 48-hour review had been reached by this stage so the effect cannot be quantified, but consultants generally expressed satisfaction with what the programme had achieved and appeared engaged with its continuation

box and the outcome measure of ticking the 48-hour review box.

The authors were unable to explain fully why options of 'change' and 'OPAT' were rarely ticked. It was noted that 'Change' on a drug chart was often recorded as a straight diagonal line across the current antimicrobial prescription followed by a prescription of a new antimicrobial. OPAT was less used as this was an uncommon event.

Human factors in relation to antimicrobial review quality improvement programme

The quality improvement programme was undertaken in two 30-bedded acute respiratory wards in a busy district general hospital. The unit runs at a 95% or higher bed occupancy. The 48-hour review is normally carried out by doctors on the morning ward round although it can be completed at any time of the day. The authors speculated that some of the reasons behind the initial poor completion rates may be related to time pressures on all multidisciplinary team members, a hesitancy among junior doctors on busy ward rounds to ask seniors about antibiotic review, a reticence among nursing staff and pharmacists to ask doctors about the review, as well as a general lack of education about the importance of the 48-hour antimicrobial review.

It is difficult to quantify the impact of this quality improvement programme on individual staff members. In discussion among the quality improvement team, it was felt that the working relationships between members of the same profession (e.g. doctor to doctor) and between different professions (e.g. doctor to pharmacist or nurse to doctor) had improved during the project. The authors speculate that certain principles which underlie quality improvement methodology like collaboration, valuing input from all multidisciplinary team members equally and a move away from traditional hierarchical multidisciplinary team dynamics, appear to have far-reaching work-based benefits. These may include team members feeling more valued in the workplace and getting an increased sense of satisfaction from their work. This shared goal was felt to be a key factor in achieving the main outcome.

Limitations

Limitations include the relatively short study period. Only one set of data was available before the first intervention. This was a result of the unexpected trust-wide incident reporting email for 48-hour antimicrobial prescribing. A further limitation was that the quality improvement was only done on respiratory wards at one hospital. How these improvements would be generalizable to wards with less antimicrobial use or from a different specialty is unknown. However, the authors remain confident that the steps of this quality improvement project can be modified to another acute hospital ward setting.

Sustainability of quality improvement programme results remains a challenge. The trainee doctors have now rotated away from respiratory medicine. The antimicrobial stewardship programme is now discussed at new doctor induction in the unit. The permanent staff (senior sisters, ward pharmacists and consultants) continue to promote good antimicrobial stewardship. The quality improvement programme lessons and achievements have been presented across the trust at both doctor and pharmacy teaching forums.

Recommendations and conclusions

This quality improvement programme has shown a fall in the use of intravenous antimicrobials following an improvement in completion rate of 48-hour antimicrobial review. Delayed change from intravenous to oral antibiotics may increase admission length which in turn is associated with higher costs, higher rates of health-care-associated infection and reduced patient satisfaction (Paton et al, 2014).

Requirement for 48-hour antimicrobial review is common to all inpatient wards and the quality improvement methodology applied here could easily be adapted to other areas of the hospital. Further planned interventions will focus on system changes, such as nursing staff highlighting drug charts for compliance as part of their daily routine, developing a standardized ward round checklist, and regular timetabled educational sessions on antimicrobial stewardship. **BJHM**

Statement of contribution: Dr D Hobday: main author of paper, performed quality improvement project, developed PDSA (plan. do, study, act) interventions, collected and analysed data; Dr A Choudhury: inception of project, mentor for project, data analysis, editor of final document; Dr A Asour: performed quality improvement project, developed PDSA interventions, collected and analysed data, contributed to paper; Dr S Khan: performed quality improvement project, developed PDSA interventions, collected and analysed data, contributed to paper; Dr S Abburu: performed quality improvement project, developed PDSA interventions, collected and analysed data, contributed to paper; Dr J Sood: performed quality improvement project, developed PDSA interventions, collected and analysed data, contributed to paper; Dr N Jaafar: performed quality improvement project, developed PDSA interventions, collected and analysed data, contributed to paper; Ms M Madhani: mentor for project, contributed to paper; Ms N Ahmad: mentor for project, contributed to paper.
Conflict of interest: none.

KEY POINTS

- Adherence to the 48-hour review is an important element of inpatient antimicrobial stewardship.
- The interventions in this quality improvement project led to a rise in completion of the 48-hour review from 68% to 100%.
- This was associated with a significant reduction of time on intravenous antibiotics from 2.25 to 1.5 days.
- These interventions could easily be replicated on other inpatient wards.

Dingle KE, Didelot X, Quan TP et al; Modernising Medical Microbiology Informatics Group (2017) Effects of control interventions on *Clostridium difficile* infection in England: an observational study. *Lancet Infect Dis* **17**(4): 411–421. https://doi.org/10.1016/S1473-3099(16)30514-X

Doran GT (1981) There's a S.M.A.R.T. Way to Write Management's Goals and Objectives. *Manage Rev* **70**(11): 35–36.

Institute of Health Improvement (2017) Quality Improvement Essential Toolkit. www.ihi.org/resources/Pages/Tools/Quality-Improvement-Essentials-Toolkit.aspx (accessed 22 December 2017)

Nathwani D, Eckmann C, Lawson W et al (2014) Pan-European early switch/early discharge opportunities exist for hospitalized patients with methicillin-resistant *Staphylococcus aureus* complicated skin and soft tissue infections. *Clin Microbiol Infect* **20**(10): 993–1000. https://doi.org/10.1111/1469-0691.12632

National Institute of Health and Care Excellence (2015) Antimicrobial stewardship: systems and processes for effective antimicrobial medicine use. www.nice.org.uk/guidance/ng15 (accessed 3 November 2017)

Paton F, Chambers D, Wilson P et al (2014) Initiatives to reduce length of stay in acute hospital settings: a rapid synthesis of evidence relating to enhanced recovery programmes. *Health Services and Delivery Research* **2**(21)

Public Health England (2015) Antimicrobial Stewardship - Start smart - then focus]. www.gov.uk/government/publications/antimicrobial-stewardship-start-smart-then-focus (accessed 3 November 2017)

Srinivasan A (2017) Antibiotic stewardship: why we must, how we can. *Cleve Clin J Med* **84**(9): 673–679. https://doi.org/10.3949/ccjm.84gr.17003

World Health Organization (2014) Antimicrobial resistance: global report on surveillance 2014. www.who.int/drugresistance/documents/surveillancereport/en/ (accessed 3 November 2017)