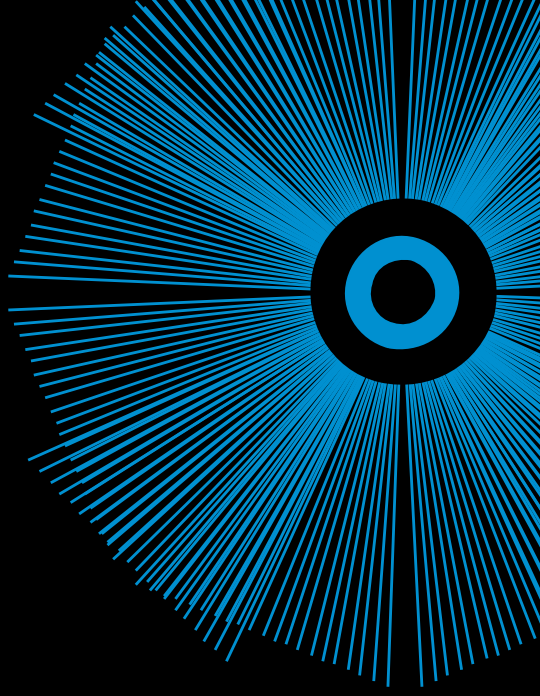

Shine 2012 final report

Improving patient safety through providing feedback to junior doctors on their prescribing errors: the Prescribing Improvement Model

Imperial College Healthcare NHS Trust

March 2014

The Health Foundation

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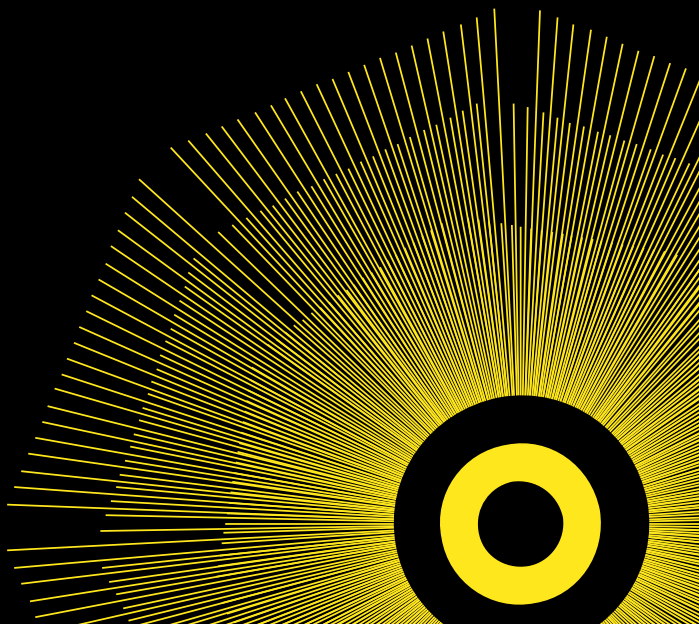

1. Part 1. Abstract

Project title: The Prescribing Improvement Model

Lead organisation: Imperial College Healthcare NHS Trust

Partner organisation: Imperial College

Lead Clinician: Professor Bryony Dean Franklin
Other key members of the team: Dr. Jon Benn
Seetal Jheeta
Matthew Reynolds
Plus wider valuable support from all members of the project's Clinical Engagement Group

Background

UK studies show that prescribing errors occur in 1-15% of inpatient medication errors; local data indicate this is also the case locally. The literature suggests 1-2% of inpatients are consequently harmed, and there have been few studies of interventions to reduce them.

A common theme in UK studies of the causes of prescribing error is that junior doctors get little feedback on errors they make, and are often unaware of having made them. Questionnaires and focus groups conducted within our trust confirmed this was an issue locally and identified a key barrier: individual prescribers often could not be identified.

We therefore wanted to address these issues.

Description of innovation

Our Prescribing Improvement Model (PIM) aimed to improve patient safety by reducing prescribing errors made by foundation year 1 (FY1) doctors in the hospital setting. Our "change theory" was that provision of feedback on prescribing errors by pharmacists would facilitate learning, reflection and changes to practice, and thus increase the safety of prescribing.

Our innovation comprised three interlinked interventions:

1. To facilitate pharmacists' identification of prescribers, we used a multi-faceted approach to encourage FY1s to state their name when prescribing on inpatient medication charts. This included the design and distribution of name-stamps for use when prescribing, minor redesign of the hospital drug chart, and an awareness campaign aimed at prescribers and pharmacists.
2. We developed and introduced working practices whereby ward pharmacists were encouraged and supported to feed back to FY1s on their individual prescribing errors using appropriate terminology and a clear and constructive approach.
3. To support further shared learning, we developed and sent fortnightly emails to our intervention cohort of FY1s and pharmacists. These discussed a common and / or serious prescribing error in more detail, including how to prevent it happening again.

Our objectives were to:

1. Increase the proportion of inpatient medication orders written by FY1 doctors for which the prescriber has specified their name, in order to facilitate personal feedback on any errors made;
2. Support hospital pharmacists in providing constructive but explicit feedback to FY1 doctors on any prescribing errors identified;
3. Develop an approach to sharing common or serious errors among FY1s and pharmacists to facilitate shared learning;
4. Explore the views of FY1s and pharmacists on prescribing feedback, and on our interventions, their benefits and any unintended consequences;
5. Evaluate the impact of our interventions on the prevalence of prescribing errors in both the intervention hospital and a control hospital;
6. Develop a "toolkit" to facilitate roll-out of these interventions at other organisations.

Methods

Our interventions were initially introduced at one trust hospital, with another hospital acting as control. The study was approved locally as a service evaluation; ethics approval was not required.

Implementation

We used the NHS change model as a framework; our improvement methodology was based on PDSA cycles for each of our three linked interventions, collecting both qualitative and quantitative data between successive cycles. To incorporate patients' perspectives into our work, we also conducted a focus group with patient representatives to explore their views on prescribing errors and feedback.

Evaluation

Process measures:

1. The proportion of inpatient medication orders written by FY1 doctors for which the prescriber had stated their name, either using a name stamp or by writing by hand, was audited each week for a sample of drug charts, and the data presented as run charts emailed fortnightly to FY1s.
2. Provision of feedback by ward pharmacists was assessed during routine accompanied ward visits.

Outcome measures:

1. At both intervention and control hospitals, we designed and administered a quantitative questionnaire to elucidate FY1s' and pharmacists' understanding of prescribing errors, and their perceptions of current feedback provision.
2. At the intervention hospital, we conducted focus groups with FY1s and pharmacists to further explore their views on the interventions and identify any unintended consequences.
3. We studied the prevalence of erroneous medication orders written by FY1 doctors at both intervention and control hospitals. Ward pharmacists collected data on a sample of medication orders on a weekly basis. We used time series analysis to compare the rate of change in prescribing error rates at both control and intervention sites, and selected a random sample of errors each week to assess their clinical importance.

What we achieved

- We estimate that we increased the percentage of medication orders written by FY1 doctors for which the prescriber was identifiable from about 6% to 50%.
- .We developed and introduced working practices whereby ward pharmacists were encouraged and enabled to feed back to FY1s on their individual prescribing errors. Working with FY1 and pharmacist representatives, we developed appropriate terminology and provided a clear and constructive approach. We developed a core set of feedback

Principles of effective feedback

- As soon as possible after the event
- Ensure the prescriber is aware that an error has been made
- Identify possible solutions
- Highlight any relevant prescribing resources (e.g. clinical guidelines)
- Be non-judgemental and blame-free

principles, designed to be generalisable to any pharmacists providing feedback to any level of prescriber

- Qualitative findings suggest that this work has led to increased engagement of FY1s in the safe prescribing agenda
- We designed a practical method to measure the prevalence of prescribing errors at our intervention and control sites. We were unable to detect an overall difference in error rates between the control and intervention sites, but there appears to have been a small but significant increase in the rate of change in the error rate at the intervention site, in comparison to the control site.
- Focus groups with pharmacists and FY1s suggested real benefits of our interventions and no evidence of negative unintended consequences. A focus group with members of the public also supported our approach.
- We designed and introduced “Good Prescribing Tip” emails which were visually appealing, readable on desktops, smartphones and tablets, and provided links to relevant prescribing resources.
- We developed a quantitative questionnaire to explore views on feedback on prescribing errors and established its psychometric properties.
- We concluded that attempts to produce a measureable reduction in prescribing errors are likely to need a multi-faceted approach of which feedback should form part.

2. Part 2. Quality impact: outcomes

2.1 Setting

The project took place at Imperial College Healthcare NHS Trust. Our intervention site was Charing Cross Hospital (CXH). A second hospital, St. Mary's Hospital (SMH), acted as control. At the end of the evaluation period, the intervention was rolled out to SMH and a further site, Hammersmith Hospital (HH). All used paper-based prescribing for inpatients, and electronic prescribing at discharge.

Our intervention focused on pharmacists and foundation year 1 doctors (FY1s) at CXH during the evaluation period, and then all pharmacists and FY1s within the trust following roll-out. At any one time there were 31-33 FY1s at CXH, largely based on 12 wards, and 43-45 at SMH, again based on 12 main wards. FY1s rotated between specialties every four months. Pharmacists provided a typical UK ward pharmacy service, visiting each ward for 1-3 hours each weekday. Pharmacists were responsible for clinically screening medication orders to ensure that they were clear, legal, and clinically appropriate for the patient. If prescribing errors were identified, pharmacists could resolve them with any available doctor. Pharmacists were also permitted to make minor corrections to drug charts without contacting a prescriber when appropriate.

2.2 Course of intervention, tests of change, adjustments

Our innovation comprised three interlinked interventions:

1. To facilitate pharmacists' identification of prescribers, we used a multi-faceted approach to encourage FY1s to state their name when prescribing on inpatient charts. This included the design and distribution of name-stamps for use when prescribing, minor redesign of the hospital drug chart, and an awareness campaign aimed at prescribers and pharmacists.
2. We developed and introduced working practices whereby ward pharmacists were encouraged and supported to feed back to FY1s on their individual prescribing errors using appropriate terminology and a clear and constructive approach.
3. To support further shared learning, we developed and sent fortnightly "prescribing tip" emails to our intervention cohort of FY1s and pharmacists. These discussed a common and / or serious prescribing error in more detail, including how to prevent it happening again.

Figure 1 presents an overview of our timeline; a more detailed timeline is attached in appendix 2.1. The first three of the four phases will next be described; the roll-out phase is described in section 7 of this report.

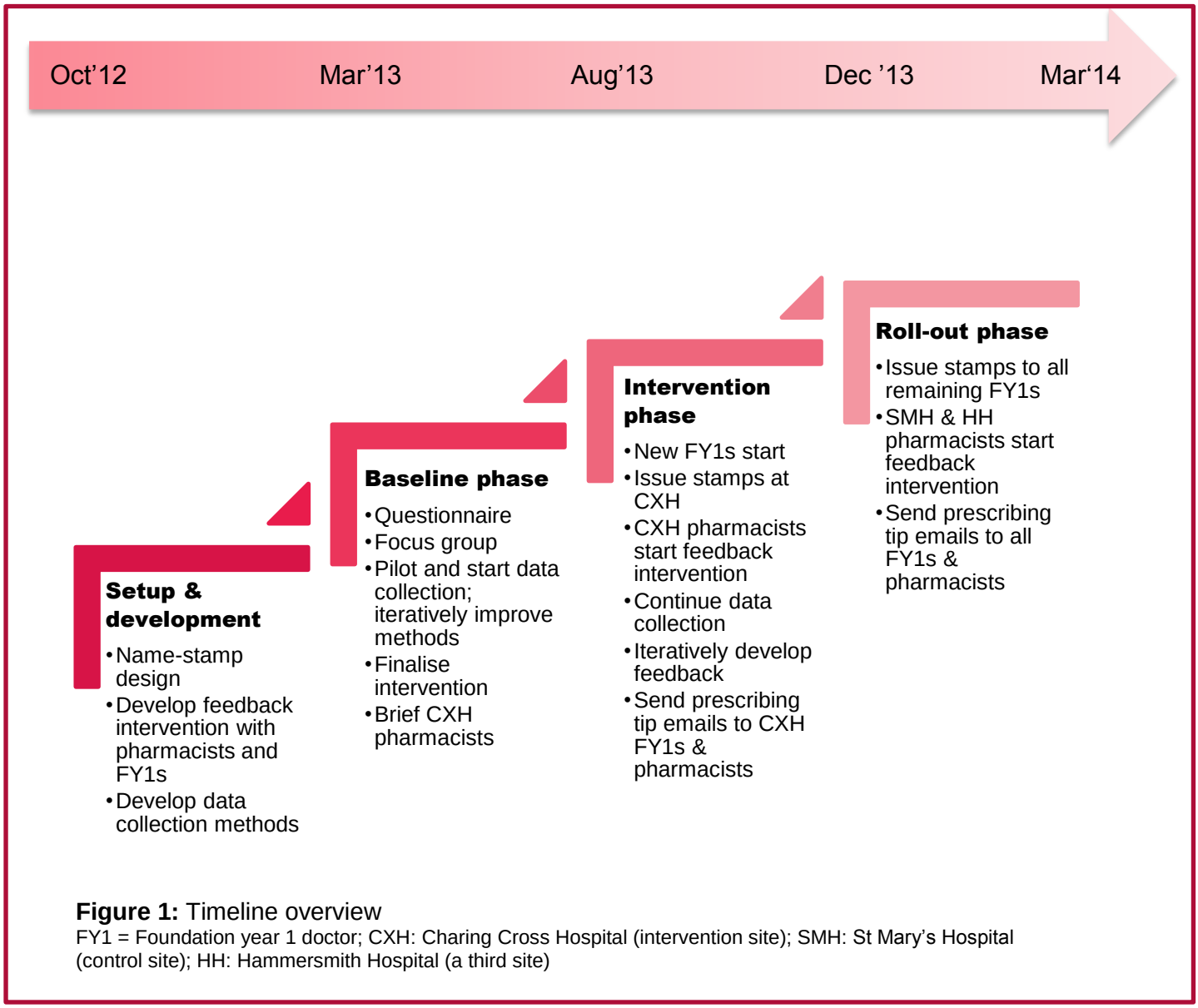

Figure 1: Timeline overview
FY1 = Foundation year 1 doctor; CXH: Charing Cross Hospital (intervention site); SMH: St Mary's Hospital (control site); HH: Hammersmith Hospital (a third site)

2.2.1 Setup and development phase

In this phase, we recruited six FY1s with whom to conduct small-scale tests of our interventions using a Plan, Do, Study, Act (PDSA) approach.

These FY1s piloted successive iterations of name-stamps between March and July 2013, leading to changes to our briefing document, the addition of reminder stickers to the stamps

(figure 2), inclusion of the prefix “Dr”, and dissemination of information on how to order new stamps and ink pads. Some examples of our PDSA cycles are given in appendix 2.2.

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Figure 2: name-stamp and reminder stickers

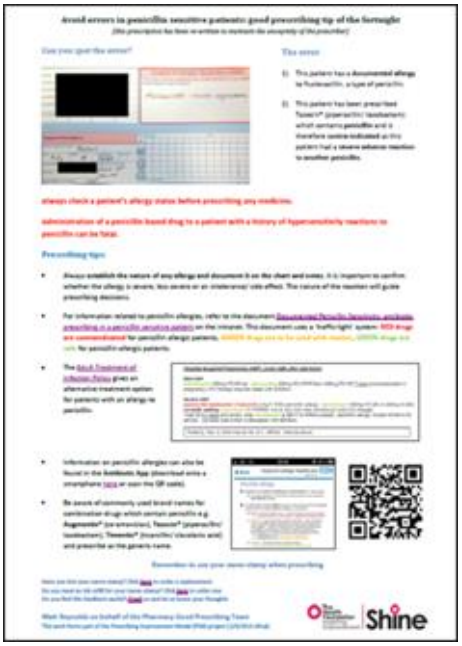

Figure 3: example prescribing tip

We also worked with these FY1s to develop suitable phrases for pharmacists to use when providing feedback on errors; these had to be explicit about an error having occurred, but also constructive and acceptable to recipients. We created a set of principles which characterise effective individual feedback (see “Key Messages” document in appendix 2.3). FY1s felt strongly that feedback should be verbal, rather than written; we therefore focused our intervention accordingly.

As well as developing an approach to individual feedback to FY1s, we developed our “prescribing tip” emails (figure 3), again using PDSA cycles. Emails generally included a screenshot and an invitation to “spot the error”. The error and its consequences were then highlighted. We provided summaries and hyperlinks to appropriate local prescribing resources. Further examples are given in appendix 2.4.

Finally during this phase, we developed data collection methods for our process and outcome measures, using PDSA where appropriate. For example, our key process measure

was the proportion of inpatient medication orders written by FY1 doctors for which the prescriber had stated their name. We collected these data on a sample of inpatient drug charts each week and created a run chart to display the information. Figure 4 shows how these evolved during this time.

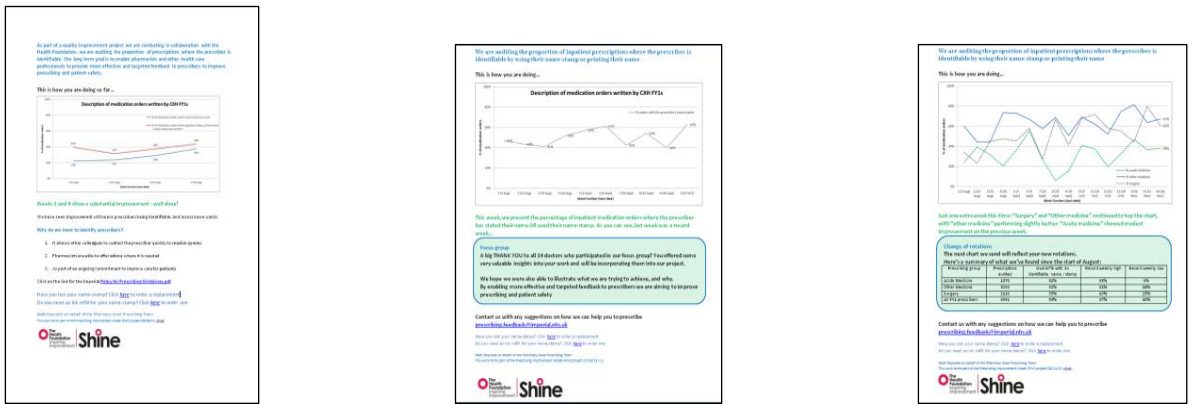

Figure 4: Run chart examples. Left: early run chart; centre: chart with emphasis on "write or stamp your name"; right: later chart showing results by prescribing speciality

2.2.2 Baseline phase

First, to assess baseline views and experiences of FY1s and pharmacists in relation to feedback on prescribing errors, we conducted a questionnaire-based survey of all FY1s and pharmacists within our trust in May/June 2013. Two complementary questionnaires were developed, one for FY1s and one for pharmacists, based on previous work (Bertels et al, 2013). We established the psychometric properties of these questionnaires; final versions are provided in appendix 2.5.

Second, we facilitated a focus group in July 2013 with seven members of the public to explore their views on prescribing errors and feedback. The findings supported our approach and confirmed that a robust feedback system was supported by the public. We also extracted illustrative quotes which we used to facilitate FY1 and pharmacist engagement in this work.

> *"…it's OK to screw up once but there ought to be a process that says you've screwed up once and we're going to correct it so that it doesn't happen again. What's unforgivable is if you've got the ability to go on screwing up time and time again"*
>
> Patient focus group participant

Third, we started collected data on prescribing errors made by FY1 doctors at both intervention and control sites. Once weekly, we asked ward pharmacists to collect data on the first 8-12 medication orders written by an FY1 that they encounter on their ward. All pharmacists were given a written and verbal briefing (see appendix 2.6) beforehand. Errors were classified into one of 29 mutually exclusive categories. Data collection began on the intervention site week commencing 17 June 2013, and week commencing 15 July 2013 on the control site due to having to wait for a suitable staff meeting to brief data collectors.

2.2.3 Intervention phase

On the intervention site, pharmacists were briefed on providing feedback during July and August 2013 using presentations (appendix 2.7) at education and training sessions, posters (appendix 2.8), emails, and personally by project team members at departmental meetings. In each case, our principles of effective feedback were highlighted, as in the box above.

Principles of effective feedback

Pharmacists were encouraged to:

1) Identify the prescriber
2) Contact the prescriber
3) Describe the problem and state that an error has been made
4) Direct the prescriber to appropriate resources
5) Resolve the error

Personalised name-stamps (figure 5) and briefing documents (appendix 2.9) were distributed to the 33 intervention site FY1s in the 2013-14 cohort during their trust induction on 1-2 August 2013.

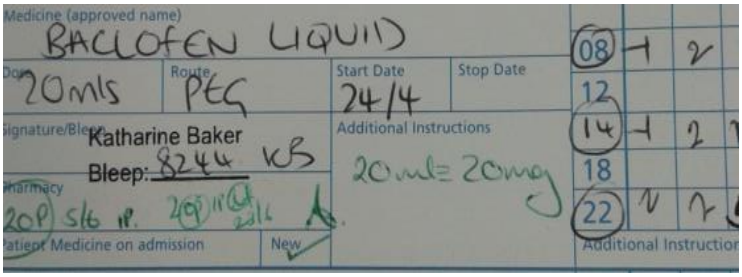

Figure 5: Name-stamp in use

Prescribing tip emails were also sent fortnightly starting in August 2013.

2.3 Data used to demonstrate impact on quality

2.3.1 Process measures

We identified three process measures: (1) use of name-stamps by FY1s, (2) feedback provision by pharmacists, and (3) feedback uptake by FY1s. Each of these will briefly be described:

(1) We audited whether and how FY1s stated their names when prescribing. Data collection on prescriber identification at our intervention site was initiated in April 2013 with the pilot FY1s and concluded in February 2014. For each medication order written by an FY1, the project pharmacist recorded the presence or absence of each of the following for each medication order: name-stamp, signature, bleep number, and handwritten name (figure 5). This required her to become familiar with the signatures of this entire cohort of FY1s. The data recorded were presented as run charts and emailed fortnightly to intervention group FY1s from August 2013 onwards (figure 6). Data from our intervention site indicate an increase from about 40% to about 50% in the percentage of medication orders for which the prescriber can be identified during the course of the intervention. However we do not have true baseline data from the intervention site as we did not start data collection until after name stamps had been issued. We therefore collected several weeks' baseline data at our control site, before the intervention was also rolled out to this site; we found the baseline level to be 6% which then increased to 37% following intervention rollout. We therefore assume that the baseline identification rate at our original intervention site would have been similar to the figure of 6%.

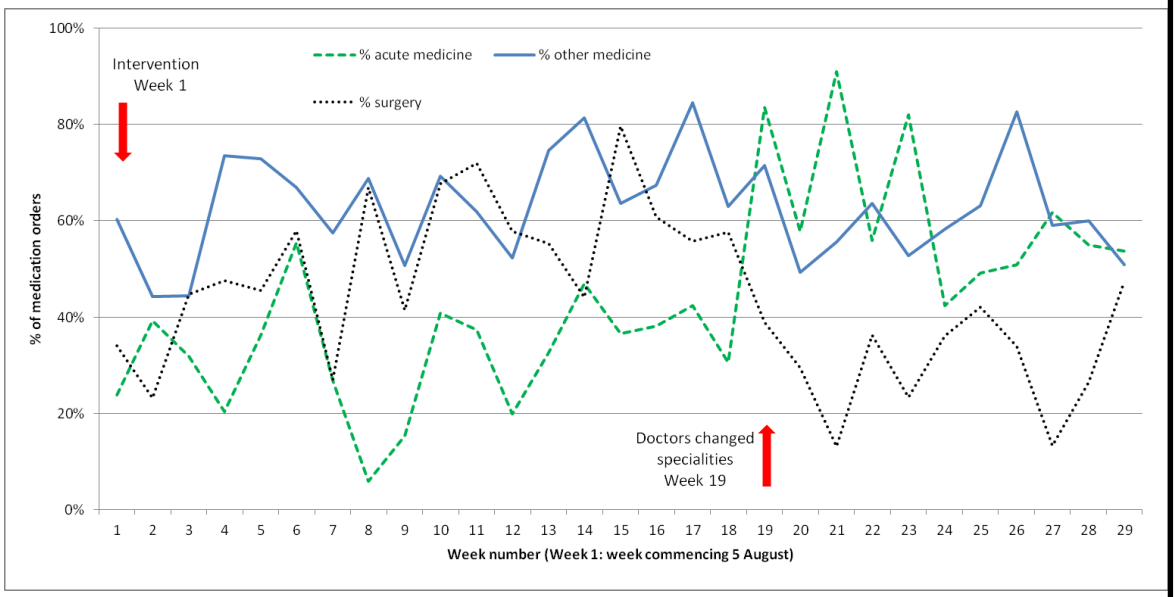

Figure 6: percentage FY1 inpatient medication orders for which a name was stated, either by hand or using a name stamp, at our intervention site.

As shown in Table 1, prescribers were more likely to use their name stamps when prescribing regular medications, and less likely to use them for other types of medication order. This is likely to be at least partly due to differences in the space available on the drug chart for the different types of medication order.

Site	Section of chart	Name present	Name absent	Total	% identifiable medication orders
CXH post-intervention (29 weeks' data)	Stat	133	418	551	24.1
	Regular	4,754	3,095	7,849	60.6
	PRN	529	919	1,448	36.5
	Infusions	519	1004	1,523	34.1
	Total	5,935	5,436	11,371	52.2
SMH pre intervention (3 weeks' data)	Stat	2	21	23	8.7
	Regular	40	568	608	6.6
	PRN	6	74	80	7.5
	Infusions	0	78	78	0.0
	Total	48	741	789	6.1
SMH post	Stat	26	116	142	18.3

intervention (6 weeks' data)	Regular	698	964	1,662	42.0
	PRN	82	202	284	28.9
	Infusions	54	190	244	22.1
	Total	860	1,472	2,332	36.9

Table 1: Prescriber identification on different sections of the drug chart, for both control and intervention sites

PRN: pro re nata ("when required"); stat: once only; CXH: Charing Cross Hospital (intervention site); SMH: St Mary's Hospital (control site)

(2) Feedback provision by pharmacists was assessed during pharmacists' accompanied ward visits conducted by our clinical pharmacy training team. Five of these were carried out, all with junior pharmacists, during our study period. Two of the five pharmacists were felt to lack confidence when providing feedback and further coaching provided in this regard. Further details are presented in appendix 2.10.

(3) Our third process measure was intended to be the reading of the "prescribing tip" emails by FY1s, and we wanted to explore the possibility of using email 'read-receipts' to assess this. However, following piloting we decided that this was not practical for four reasons: (1) recipients can decline to send a read-receipt, either globally or for individual emails; (2) email interfaces on smart phones often do not support the use of read-receipts; (3) sending a read receipt means only that someone has opened an email, not that it has been read, and (4) we were concerned that our FY1 doctors may feel that we were "checking up" on them which was contrary to our overall collaborative approach.

2.3.2 Outcome measures

Our outcome measures were: (1) quantification of FY1s' and pharmacists' views on feedback using a questionnaire survey, (2) focus groups with both FY1s and pharmacists to explore their views on the interventions in more detail and to identify any unintended consequences, and (3) the prevalence and clinical importance of prescribing errors made by FY1 doctors. Each is next considered in turn:

(1) At both intervention and control hospitals, we administered our quantitative questionnaires to elucidate FY1s' and pharmacists' perceptions of current feedback provision to provide an understanding of such perceptions at baseline. All FY1s and all trust pharmacists were eligible to complete the questionnaires, which were distributed in May/June 2013. Responses were received from 73% (65/89) FY1s, and 58% (57/98) pharmacists; higher

response rates than the 54% we achieved previously (Bertels et al, 2013). Selected results are presented in figure 7. This illustrates how FY1 doctors believed that they were aware of all prescribing errors they made, in marked contrast to pharmacists. Both however agreed that giving and receiving feedback was a valuable use of time. Verbal feedback provision, the focus of our intervention, was thought to be good, but with room for improvement. Full results are presented in appendix 2.11. Post intervention data will be collected using the same questionnaire in May 2014; collection of data at the same point during the training year will provide a robust evaluation.

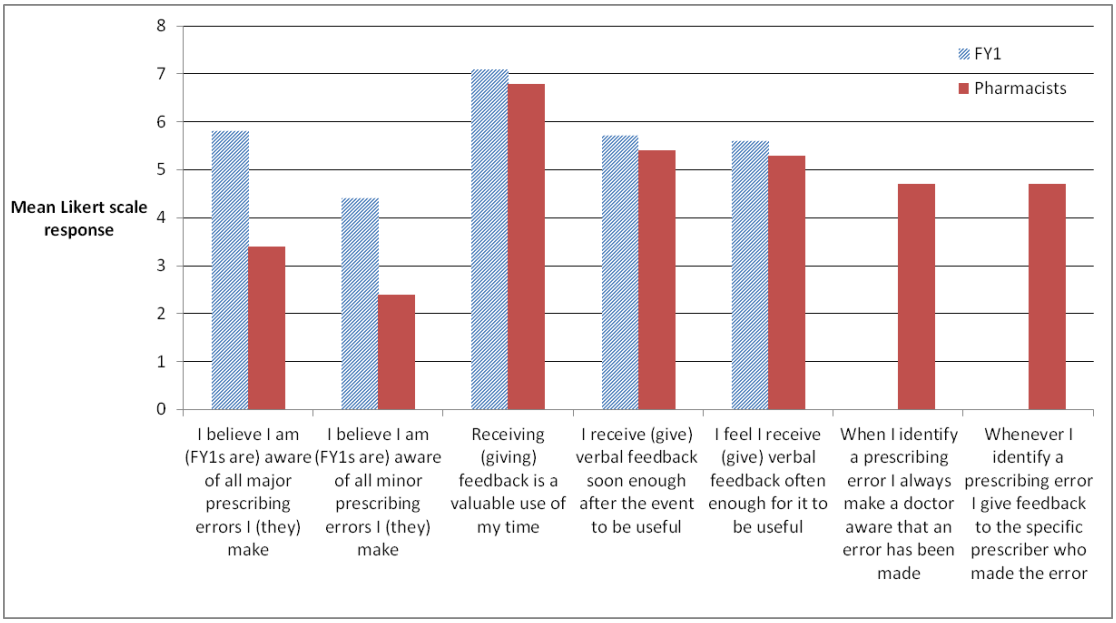

Figure 7: Illustrative questionnaire responses. A higher Likert score indicates a higher level of agreement. FY1: Foundation year 1 doctor. FY1s were not asked equivalents of the final two questions presented.

(2) Part way into our interventions, we conducted focus groups with FY1s and pharmacists at the intervention hospital. In October 2013 we explored four main subjects with 14 FY1s: individual feedback, prescribing tip emails, identification of prescriber and name-stamps, and prescriber identification run charts. For each of these we explored the perceived advantages and disadvantages, and facilitators and barriers, according to a coding tree (appendix 2.12). FY1s generally expressed positive views and experiences of receiving feedback and reported understanding the importance of ensuring their identity is known when prescribing. Participants also suggested introducing an element of competition amongst FY1s by breaking down prescriber identification data by speciality on the run-charts; we subsequently made this change.

"I find using the stamp makes me take a lot more ownership of [the prescription]. I think, do I really know what I'm doing?"

Foundation Year 1 doctor

"… [an error] would need to be changed… that can be done by anyone on the team, but I'd like to know personally that I'd made a mistake."

Foundation Year 1 doctor

"I've always found the feedback really helpful and the pharmacists really approachable."

Foundation Year 1 doctor

A similar focus group with four pharmacists was held in November 2013. This analysis was also conducted based on a coding tree (appendix 2.13). Pharmacists felt that feedback was generally well received by doctors, although they still felt uncomfortable referring explicitly to "errors" and seemed very 'protective' of the relationships they were building with their FY1

"I wish everyone would write their bleep number…and their name, because even the nurses who've been on the ward for ages and ages don't know who that signature belongs to. So how can we feed back to somebody when we don't know who they are?"

Pharmacist

"…pharmacists… would probably just change things [and] not even think about it because that's what we've been doing for years... I've seen some senior pharmacists, for example, saying, oh, I did that on the weekend, I really should have spoken to the doctor. So I think that mentality is definitely [changing], which is good."

Pharmacist

colleagues. They preferred to use the terms "mistake" or "incorrect". They also felt that pharmacists were providing more individualised feedback due to increased awareness of the benefits, and did not report time as being a barrier to feedback provision.

(3) We studied the prevalence of erroneous medication orders written by FY1 doctors at both intervention and control hospitals. Ward pharmacists collected data weekly, on a sample of medication orders. We used time series analysis to compare the rate of change in prescribing error rates at both control and intervention sites, and selected a random sample of errors from each data collection week to assess their clinical importance. Pharmacists were given a verbal and written briefing (appendix 2.6) prior to data collection. Data collection forms are also provided in appendix 2.14. Figure 8 summarises the prevalence of erroneous medication orders identified on each site.

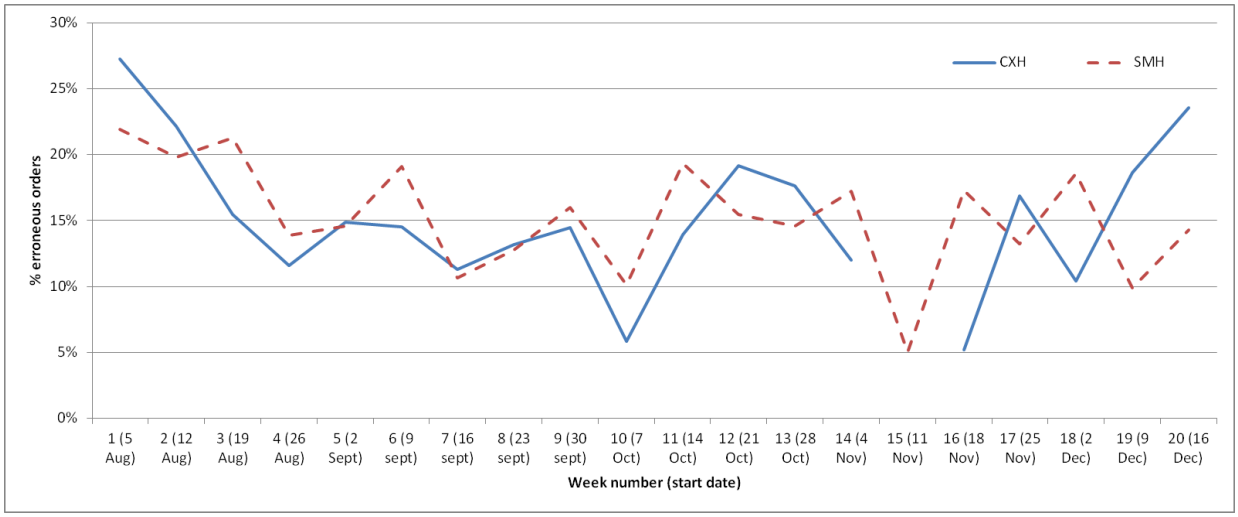

Figure 8: Percentage of medication orders written by foundation year 1 doctors with one or more errors, intervention site (CXH) vs. control site (SMH). Breaks in lines indicate weeks where data were not collected due to other local data collection initiatives.

Based upon interrupted time series analysis of a simple single time point intervention model, we observed no significant effect of the programme of interventions upon error rates at the intervention site, compared with control. However, while the initial statistical model was a direct test for a simple overall effect of our intervention, it did not account for features commonly inherent in quality improvement projects, such as phased development of the intervention, delayed uptake, cumulative effects over the timeline of the project and complex interactions with local context. A model based on a “complex” intervention was a statistically better fit than a simple intervention model, whilst allowing us to isolate temporal effects of the individual feedback onset and full feedback phase, plus isolating the potential confounding effect of the FY1 rotation on error rates. Using this complex model, we identified a significant change in the baseline error rate trend at our intervention site, attributable to the first phase of the intervention to ‘go live’ (use of name stamps and individual pharmacist feedback), having controlled for the effects of the next intervention component to go live (the prescribing tips) and a subsequent change in FY1 personnel. It is therefore possible that the positive

effect of feedback upon FY1 prescribers (and thus error rates) is strongest following first exposure to this intervention. However although statistically significant, this effect is small. A full breakdown of errors classified by type is included in appendix 2.15.

Using a validated method (Dean and Barber 1999) we assessed the importance of a randomly selected sample of the errors to determine any change in the clinical importance of the errors over time, and present the results in figure 9.

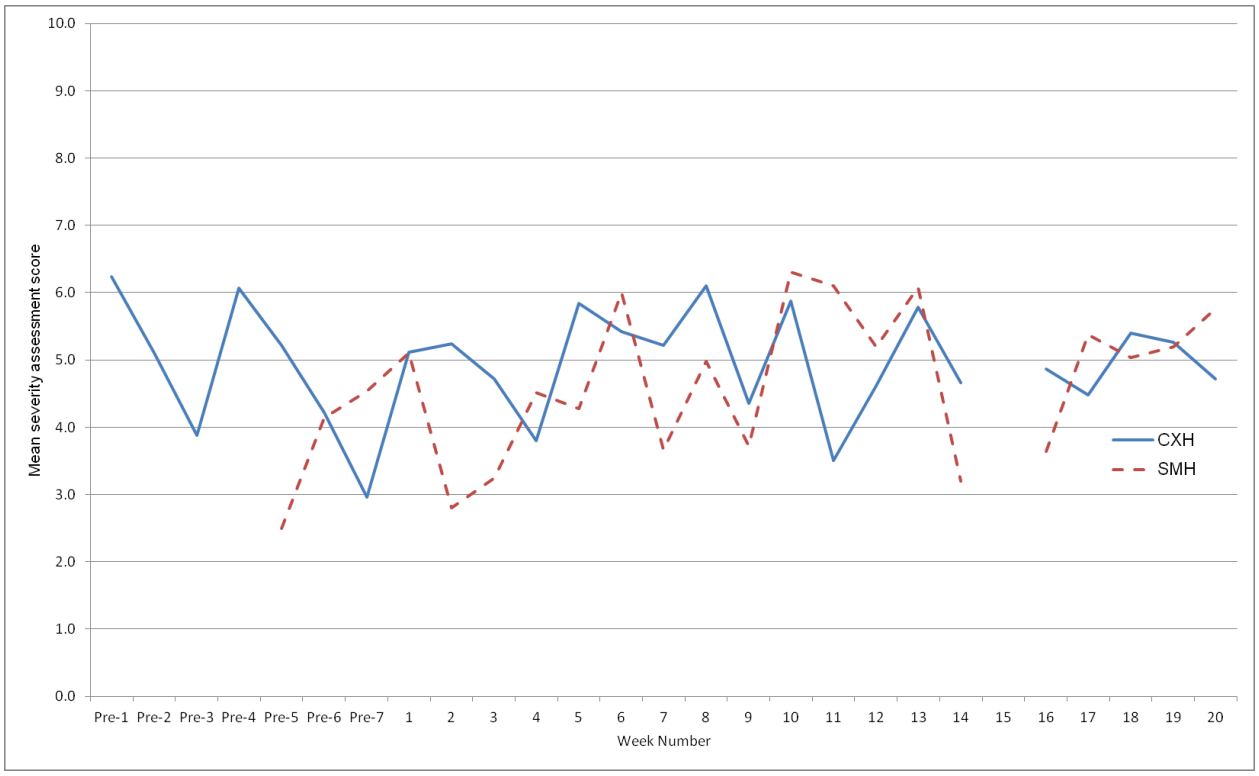

Figure 9: Mean severity score of a random selection of five medication errors per week, intervention site (CXH) vs. control site (SMH). "Pre" weeks are pre-intervention. Severity assessment score scale is from 0 (no harm) to 10 (death).

A more detailed breakdown of results is presented in table 2. The overall mean score was 4.8, comparable to similar studies in the literature (Franklin et al, 2011). The majority (54%) of errors were deemed moderate. There appears to have been an increase in severity on the control site; the different distribution among minor, moderate and severe errors just meets statistical significance (p=0.049; chi square test). On the intervention site there was no change (p=0.58).

Site	Assessment criteria	Pre-intervention (weeks pre 1 - pre 7)	Post-intervention (weeks 1 - 20)	Overall
Intervention site	No. of errors assessed	33	93	126
	Mean	4.7	5.0	4.9
	Median	4.9	5.5	5.5
	Minor	9 (27.3%)	21 (22.6%)	30 (23.8%)
	Moderate	15 (45.5%)	52 (55.9%)	67 (53.2%)
	Severe	9 (27.3%)	20 (21.5%)	29 (23.0%)
Control site	No. of errors assessed	15	95	110
	Mean	3.7	4.7	4.6
	Median	2.5	4.7	4.6
	Minor	8 (53.3%)	22 (23.2%)	30 (27.3%)
	Moderate	5 (33.3%)	56 (58.9%)	61 (55.5%)
	Severe	2 (13.3%)	17 (17.9%)	19 (17.3%)
Both sites	No. of errors assessed	48	188	236
	Mean	4.4	4.9	4.8
	Median	4.5	5.0	4.9
	Minor	17 (35.4%)	43 (22.9%)	60 (25.4%)
	Moderate	20 (41.7%)	108 (57.4%)	128 (54.2%)
	Severe	11 (22.9%)	37 (19.7%)	48 (20.3%)

Table 2: Clinical importance scores for randomly selected errors at both intervention site and control sites. 'Pre-intervention' and 'post-intervention' refer to the initial implementation of our interventions on the intervention site. Minor errors are those with a score less than 3; moderate refers to a score of 3-7 and severe indicates a score greater than 7.

Example errors

Minor: Omeprazole 10mg daily prescribed to inpatient, but not signed (mean severity score 1.5)

Moderate: Patient's bisoprolol dose mistakenly changed from 2.5mg daily to 5mg daily (6.7)

Severe: Extended thromboprophylaxis with enoxaparin not prescribed at discharge when indicated post-surgery (8.6)

We also received unsolicited positive feedback on our prescribing tip emails from various sources:

This was a good tip! Very commonly done and I don't (think) most people are aware: I certainly had forgotten since exams! It was short and simple as well so I could take it all in. Thanks.

FY1 doctor

Always find these really helpful- especially as a pre-reg because it's useful to be reminded of prescribing guidelines and common prescribing errors associated with them; helps to give us a bit of a heads-up with what to look out for when we're on the wards."

Pre-registration pharmacist

Very useful. Thanks.

Senior pharmacist

Thank you, this is very helpful. Especially pictures. This has confused me before.

FY1 doctor.

Love this one too. Very educational!

Steering group member

2.4 Description of confidence and any adjustments made

Process measures

We are relatively confident in our process measures. In relation to the quantitative data on prescriber identification, we studied a large sample of 14,492 inpatient medication orders over the course of the study. We also have data on five accompanied clinical pharmacy visits in which pharmacists' feedback to doctors was assessed. We did not have a specific target sample size for this measure, but these five represent all relevant visits conducted during our evaluation period. In our original application, we stated that we would also explore the possibility of using email read receipts to assess whether or not FY1 doctors had read our "prescribing tip" emails; we did explore this option, but as explained in section 2.3 above, we decided not to use it as a process measure.

Outcome measures

We stated in our original application that we would use questionnaires developed previously, but subsequently decided to develop more robust versions to allow for longitudinal quantitative analysis. We also established the psychometric properties and internal reliability of these new questionnaires. We collected baseline questionnaire data in May/June 2013 and will collect post-intervention data in May/June 2014. Collection of data earlier than this would have introduced an additional confounding factor in relation to different time points during the FY1s' and pharmacists' training years. These data should therefore be robust and credible.

Our focus group with FY1 doctors was large, with 14 participants, all of whom participated in the discussion. We therefore feel that the findings should be fairly representative of the cohort. Our pharmacists' focus group was smaller and may represent a more specific set of views. As well as the FY1s' and pharmacists' focus groups specified in our application, we also conducted an additional focus group with members of the public as we subsequently felt that it would be important and useful to obtain a lay viewpoint to enhance our work.

In relation to our quantitative data on prescribing error rates among FY1 doctors, our approach was based on identification of prescribing errors by pharmacists, which is generally considered to be the gold standard method. However, we recognise that pharmacists are likely to vary in their adherence to data collection procedures and their interpretation of the definition of a prescribing error. Identification of errors relies on pharmacists' skills and knowledge, which also varies between individuals. FY1s' prescribing may be expected to improve over time as they gain experience. By using a control group we

accounted for any change in prescribing error rates due to this natural improvement. However, the new FY1 intake in August being simultaneous with the initiation of our interventions was perhaps the largest confounding factor.

2.5 Effect on service quality and patient experience

Qualitative findings positively support our intervention and suggest there has been a change in culture to improve prescriber identification and pharmacists' provision of feedback. However, the causes of prescribing errors are multi-factorial, and improving feedback alone is unlikely to significantly reduce their prevalence.

It was not relevant to assess the impact of our work on patient experience, but our interventions were in line with the views expressed during the public focus group, and our lay representative contributed to development of the project throughout.

3. Part 3. Cost impact

Key cost measures

Our interventions were aimed at increasing quality and safety, rather than on saving costs; however we recorded some data to allow us to estimate the costs involved in delivering the intervention and in any time savings achieved.

Intervention costs

The main expense associated with our interventions is the provision of name-stamps for prescribers.

Of the 89 FY1s involved to date, five have requested a replacement stamp. Four of these were because they wished to use a name which was a variation on the list of forenames and surnames we had been given, and one name was incorrectly printed on the stamp. We have received no requests to replace lost stamps, and no requests for replacement ink pads to date. However, based on an assumption that 25% of name stamps would need to be replaced in a given year, and 50% would require a new ink pad, the annual cost is **£8.50 per doctor**. Reductions in cost would be seen if preferred names could be ascertained in advance of FY1 doctors starting work in the trust, so that these could be used on the name stamps.

Each prescribing tip email initially took approximately 3-4 hours of team members' time to produce, and 15 minutes of specialist pharmacists' time. Subsequent prescribing tips took **1-3 hours each fortnight** once email templates and standard formatting had been designed. We did put considerable time into preparing these, to ensure that they were evidence-based, matched local guidelines, and were visually appealing.

To provide training for pharmacists, we conducted a total of **five 1-hour training sessions** across all three hospital sites over the period of the project. For new pharmacists joining the trust, training was incorporated into their clinical pharmacy induction and the additional time required was therefore negligible.

It is debatable whether or not collection of data on prescriber identification was part of the intervention. Since we emailed these data as run charts each fortnight, we consider that this was part of the intervention, albeit one that would not be needed in an organisation using

inpatient electronic prescribing. Data collection on prescriber identification took around 1-1.5 hours each week at the intervention site with around 30 FY1s based on 12 wards. At the control site, 3 hours were generally needed to examine around 45 FY1s' prescribing on 12 wards. Main factors affecting data collection time were distance between wards, ability to identify prescribers' signatures, and ease of drug chart retrieval.

Cost benefits

To comment on potential time savings associated with our intervention, we undertook a four-week study of the time taken for pharmacists to correct prescribing errors during their routine ward practice. We recorded the time taken to correct 102 errors on 18 pharmacists' ward rounds (mean 5.7 per round) and established a median time of 36 seconds (mean 68s, range 2-300s) for pharmacists to correct an error. However as have not demonstrated an appreciable reduction in prescribing errors, we cannot assign a cost saving as a result.

Confidence

We are less confident in our cost measures than in our other evaluation measures. Since this was a very low cost intervention, we focused on assessing its impact on quality and safety.

4. Part 4: Learning from your project

Did we achieve all of what we hoped to achieve?

In our original application, we specified expected benefits and outcomes as listed in table 3, where we also comment on our achievements against each.

Expected benefit / outcome	Achievements
An anticipated reduction in prescribing errors made by junior doctors, which would benefit patients as well as staff who would spend less time resolving errors.	Our qualitative findings suggest real benefits from our intervention, although this was not supported by our quantitative data. This is discussed further below.
As well as costs of the name stamps, we will record the extra time taken to deliver the intervention, and estimate the time saved in staff rectifying prescribing errors if we see the anticipated reduction in numbers.	We recorded these details. However, since we did not achieve a measurable reduction in the overall prevalence of prescribing errors, we are unable to estimate the time savings that resulted.
A key outcome will be a technical guide to assist other organisations in implementing the intervention, taking into account relevant implementation and contextual factors.	We have drafted a toolkit (presented as appendix 3) for staff in other organisations who would like to adopt or adapt our approach. This is currently being finalised in relation to content and branding.
The intervention itself and the wider project will increase engagement of clinicians in the patient safety agenda, as well as providing a case study of using continuous data feedback within a quality improvement model.	Our qualitative findings certainly suggest that this work has led to increased engagement of junior doctors in the safe prescribing agenda, plus an increased focus on this organisation-wide. Our focus group findings suggest that pharmacists and doctors are having more constructive discussions around prescribing errors, and that pharmacists have used the “prescribing tip” emails as a focus of such discussions. Our use of run charts to feed back data on the identification of prescribers was also well received and practical, providing a useful case study in this respect.

Table 3: expected benefits and outcomes specified in our original proposal

Unanticipated benefits

We also identified a number of unexpected additional benefits:

First, FY1 doctors are also using their name-stamps when making entries in patients’ health records. This has been welcomed by fellow FY1 doctors, senior doctors, pharmacists and nurses as it facilitates identification of the source of such documentation.

Second, during the course of our work it became apparent that the trust drug chart, while very well designed in many respects, did not specifically request the prescriber's name (figure 10). It therefore neither supported the trust's prescribing policy nor our intervention. We raised this with the local Drugs and Therapeutics Committee and were successful in having the chart modified as a result.

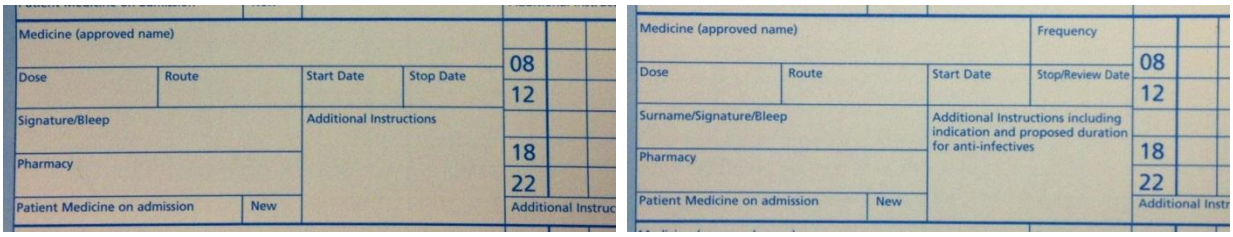

Figure 10: Excerpts from the trust's old (left) and new charts displaying the addition of "surname"

Third, specific clinical areas within the trust have adopted our approach for all prescribers, regardless of grade. For example the paediatric team have ordered name stamps for all prescribers as well as the two FY1 doctors within the team. Some pharmacist non-medical prescribers are also now using name stamps.

Factors contributing to success

We felt that the following factors were helpful in our successes:

First, we had robust project management arrangements. The size and complexity of our organisation meant that our project board was relatively arms-length, but we kept the project board, and other stakeholders, up to date with a monthly project board update. These were on 1-2 sides of A4 paper, produced at the end of each month, and summarised what we had achieved in the last month, what we hoped to achieve the following month, and highlighted any risks and how we proposed to address them. The project board were therefore kept up to date with our work and were able to provide feedback, encouragement and help where needed. While preparing these monthly summaries sometimes felt like an additional task to have to complete, we also found them very beneficial to the core research team in taking stock of our progress each month. We were usually surprised to see how much we had achieved since the previous report, which was very motivating. We have since adopted a similar approach for other research and service development projects.

Second, we believe that our "clinical engagement group" was key to success. This comprised representatives of junior doctors, senior doctors, medical education leads, pharmacists and patients as well as the project team. This group met about every two

months to review progress and to provide a forum for wider discussion around key points and priorities. The core project team then met about every two weeks to agree and action more specific operational issues.

Third, more specifically, we had good engagement from two small groups of FY1 doctors, one group throughout the pilot period, and a second group during the main intervention period. We feel that it was important not to be seen as outsiders and that establishing ownership and involvement from our FY1s at an early stage was essential. Establishing such buy-in took work as FY1s were busy with many conflicting priorities. We also concluded that being to offer something in return, such as evidence for their portfolios (or lunch!) was key to success.

Challenges and things that didn't work out as planned

Why did we not identify a reduction in prescribing errors?

While there seems to have been a small reduction in the rate of prescribing errors following the start of pharmacists' feedback to prescribers, our quantitative prescribing error data does not support the idea that the intervention led to a significant overall reduction in prescribing error rates. Further critical analysis of our logic model (figure 11), together with our data, suggests why this may be the case.

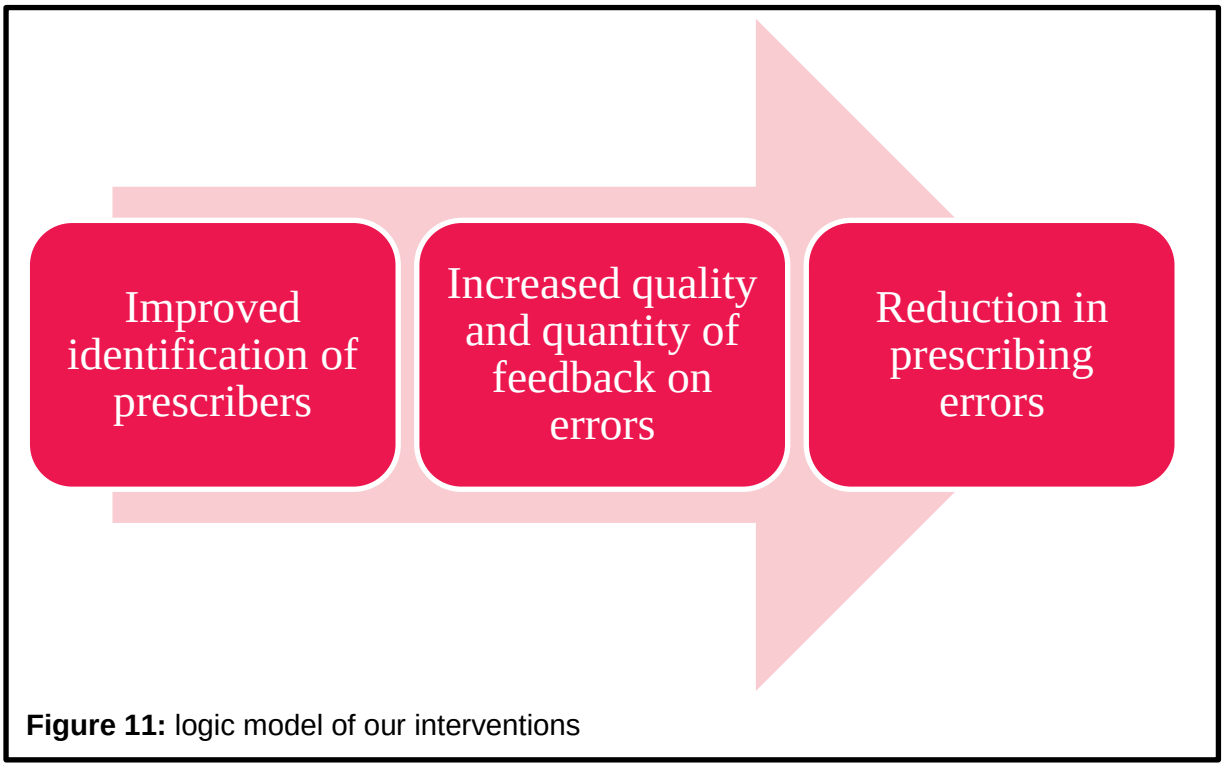

Figure 11: logic model of our interventions

This model is based on the assumption that increasing the identification of prescribers would lead to increased feedback by pharmacists, which would then lead to a reduction in prescribing error rates. However, we were only able to increase the identification of FY1 prescribers to about 50%. While an impressive increase from an estimated baseline of 6%, this means that the prescriber could not be identified for the other 50% of FY1 medication orders, limiting opportunities for personal feedback. We never set out to assess the proportion of FY1s' prescribing errors for which a pharmacist gave feedback to the individual prescriber, but assume this would also only be a proportion of all prescribing errors identified. Time constraints, shift patterns and individual motivation are likely to have prevented some opportunities for feedback. Finally, prescribing errors are multi-factorial and is likely that feedback would only prevent a sub-set of these. As part of our exploration of these issues we created an evidence-based conceptual map of the causes of prescribing error (appendix 2.16) which illustrates the very wide range of factors reported to contribute to prescribing errors; lack of feedback is just one of these.

It seems that percentage of FY1 medication orders for which the prescriber could be identified hit a ceiling around 50%. We sought to explore the reasons for this, which included that name stamps were lost or forgotten, for some sections of the drug chart the signature box is too small (figure 12), it is difficult to depress the stamp onto the chart without resting it on a firm surface (a particular problem on ward rounds), and some FY1 doctors preferred not to carry the name stamp: *"I've got enough hanging around my neck".* We suspect that it will not be possible to achieve 100% prescriber identification until electronic prescribing (with clear prescriber identification) is introduced for hospital inpatients.

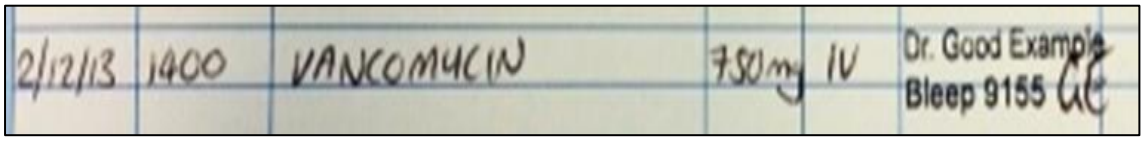

Figure 12: For the 'once only' section of the drug chart**,** even a small stamp spans two lines on the chart.

A further limitation is that interpretation of our data on prescribing errors was hindered by two factors. First, we had some missing data as we were unable to collect data during a week when a large trust-wide audit took priority – we felt that asking pharmacists to collect both datasets simultaneously would result in neither being collected to a high standard and potentially a loss of goodwill. Second, the pattern of FY1s' rotations precluded the collection of substantial baseline data and meant that our intervention was initiated at the same time as a new cohort of FY1s starting.

Other challenges

While we had excellent engagement from FY1 doctors, we found it harder to engage with more senior doctors. We wanted to better integrate our work with FY1s' formal teaching sessions with FY1s and to establish members of the consultant body who could 'champion' our work with FY1s. We are now making some progress with both of these, but the huge number of conflicting demands on key staff has made this challenging.

As above, we also identified that our drug chart did not support our intervention (or trust policy) but were able to change this during the course of our work.

Staff changes

We did have some staff changes during the course of this work, but the individuals concerned kept in touch with us in order to support this project and so we do not believe that this affected our progress. We were also able to identify other key people to involve where needed.

Were our original ambitions realistic?

We feel that our ambitions were largely realistic and we achieved all of our objectives (box).

Our objectives were to:

1. Increase the proportion of inpatient medication orders written by FY1 doctors for which the prescriber has specified their name, in order to facilitate personal feedback on any errors made;
2. Support hospital pharmacists in providing constructive but explicit feedback to FY1 doctors on any prescribing errors identified;
3. Develop an approach to sharing common or serious errors among FY1s and pharmacists to facilitate shared learning;
4. Explore the views of FY1s and pharmacists on prescribing feedback, and on our interventions, their benefits and any unintended consequences;
5. Evaluate the impact of our interventions on the prevalence of prescribing errors in both the intervention hospital and a control hospital;
6. Develop a "toolkit" to facilitate roll-out of these interventions at other organisations.

What we would do the same, and what we would do differently next time

We would advocate using a similar approach to project management, implementation, and use of process measures. However we would give more consideration to how to measure the impact of our intervention. We would have liked to have had a longer pre-intervention baseline at both intervention and control sites. The timing of the new FY1s beginning also complicated analysis. These issues were mainly due to the dates of both the Shine programme and FY1s inductions being fixed, as highlighted in our original application. However we also consider whether it is indeed feasible to measure the quantitative impact of an intervention on prescribing errors for a subset of prescribers in a hospital using paper-based inpatient prescribing. Such data collection is time-consuming and relies on the combination of motivation and expert clinical knowledge; collecting large enough datasets for meaningful analysis is therefore challenging. There are therefore important lessons to be learnt for improvement science in terms of how we design and conduct evaluations for complex quality improvement interventions that include multiple components, phases and interactions with context.

We would also have liked to explore whether or not individual prescribing tip emails affected the prescribing of the medicines or prescribing concepts that they covered, but this would have required a more comprehensive data set which was beyond the resources available.

5. Part 5. Plans for sustainability and spread

How realistic will it be to sustain the benefits beyond March 2014?

We believe it will be realistic to sustain the interventions beyond March 2014 within our trust. Following support from our trust's Medication Safety Review Group and Drugs and Therapeutics Committee, we have already rolled out our interventions to the other two hospital sites within our trust (early in 2014). We have also been invited to present on our work at the Medical Grand Round in May 2014 which we anticipate will provide a further opportunity to discuss how this work can be sustained and integrated into routine practice.

We consider that such local sustainability will require the following:

First, while we are using paper-based prescribing for hospital inpatients, FY1 doctors will need to be issued with name stamps and encouraged to use them. We are in discussion with our medical education directorate in relation to providing financial support for name stamps for our next few intakes of FY1 doctors. We are also working with our clinical pharmacy team to develop a proposal that an ongoing or periodic audit of prescriber identification be included as a regular departmental audit.

Second, we will need to produce and disseminate fortnightly "prescribing tip" emails on an ongoing basis. We are in discussion with our pharmacy clinical team about building this into the role of the rotational pharmacists within the clinical team. Previous prescribing tips are also now accessible to all staff via the trust's intranet.

Finally, pharmacists will need some ongoing support and encouragement in providing feedback on prescribing errors. Since January 2014, the principles of effective feedback have been included in the induction programme for new pharmacists at all three hospital sites. The checklist for accompanied ward visits, used for peer review and identification of ward pharmacists' training needs, has also been amended to include three criteria relating to providing feedback on prescribing errors. When pharmacists attend the weekly clinical pharmacy meetings and present important clinical interventions, they are now routinely asked whether and how they fed back any prescribing errors to the initial prescriber. We therefore believe that these aspects of our work are already becoming incorporated into standard practice.

How do you plan to spread this innovation beyond the Shine award sites?

Our interventions have already been rolled out to a second nearby trust, North West London Hospitals NHS Trust. We have collaborated with this trust from an early stage following contact by Inderjit Sanghera (IS), Principal Pharmacist for Clinical Services at this trust.

As a key output from our work, we have produced a toolkit aimed at sharing our learning with anyone who would like to introduce a similar intervention in their own organisation. We worked particularly closely with IS at North West London Hospitals NHS Trust and have drawn on their experience of rolling out a similar intervention in a different setting to produce a set of instructions which should facilitate introduction of similar interventions in any secondary or tertiary care setting.

We have also built in the educational principles around common and serious errors into the 'transition course' for final year medical students at Imperial College, which includes a prescribing course with which we are now involved. We believe this will also aid incorporation of these principles into practice.

Future work

In the future, when we have comparative data from the 2014 questionnaires, we will perform an inferential statistical analysis to detect any changes in attitudes between these cohorts.

We have also established that it will be possible to display our prescribing tips on idle computers within the trust using the trust-wide screensaver. We did not use this approach during our intervention period as it was not possible to display these at one site only, but now plan to revisit this approach following our trust-wide rollout.

Future 'research questions' that we would like to explore include: (1) how could this approach be adapted to work with inpatient electronic prescribing systems, making use of any data captured within the system on prescribers and prescribing errors? (2) what are the characteristics of inter-professional relationships between pharmacists and junior doctors? How does this affect the provision of feedback between the two professional groups?

Please detail any external interest/potential contacts that you have identified that you need to pursue and those that you have already engaged with

As stated above, we have worked closely with North West London Hospitals NHS Trust as they introduced the interventions within their trust. Representatives from Derby Hospital NHS Foundation Trust, Newcastle-upon-Tyne NHS Foundation Trust, and East Somerset NHS Trust have contacted us regarding potentially introducing aspects of our work locally. We are also in discussion with Health Education North West London (HENWL) and with the patient safety board of our Academic Health Sciences Network (AHSN) about sector-wide rollout. The AHSN are leading some work around standardising FY1 training across the network, and providing all FY1 doctors with NHS email addresses which do not change when they move hospitals; our interventions would integrate well with these initiatives.

Dissemination and collaboration

This work has already been presented at the following:

- June 2013: Bryony Dean Franklin included aspects of this work in a keynote presentation at the Imperial Centre for Patient Safety and Service Quality's Annual Research Symposium.
- 13 - 16 October 2013: we presented a poster at 30th International ISQua Conference, Edinburgh: Providing feedback on prescribing errors to junior doctors: developing potential solutions. Bryony Dean Franklin, Jeroen Bertels, Matthew Reynolds, Jonathan Benn.
- 21 November 2013: Matthew Reynolds and Indi Sanghera presented the project at the Healthcare Conference UK meeting: Collaborating to improve patient Safety: giving feedback to junior doctors on their prescribing errors.
- 21 November 2013: Bryony Dean Franklin presented this work as part of the Health Foundation Improvement Science PhD Awards Networking event.
- 16 December 2013: Bryony Dean Franklin included this work as part of a presentation on "Interventions to reduce prescribing errors" in Brussels to an audience of PhD supervisors.
- 24 January 2014: Matthew Reynolds and Seetal Jheeta led a session with Imperial MSc Quality and Safety students on quality improvement using this study as the main case study.

- 13 March 2014: Seetal Jheeta and Indi Sanghera presented at the North West London Clinical Pharmacy Meeting: Providing feedback to junior doctors on prescribing errors: the Prescribing Improvement Model.

Other dissemination activities planned:

- 23 April 2014: Bryony Dean Franklin will include aspects of this work in the ISQua webinar “Medication Safety and the Introduction and Evaluation of Interventions”.
- 7 May 2014: Bryony Dean Franklin and Matthew Reynolds will present at the medical grand round at Charing Cross Hospital.
- We are preparing a paper describing the development and validation of our questionnaires for measuring pharmacists’ and FY1s’ views on prescribing error feedback
- We are preparing an abstract for submission to the Royal Pharmaceutical Society Conference, which will take place in September 2014
- We will prepare a quality improvement paper for submission to a suitable peer-reviewed journal.

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