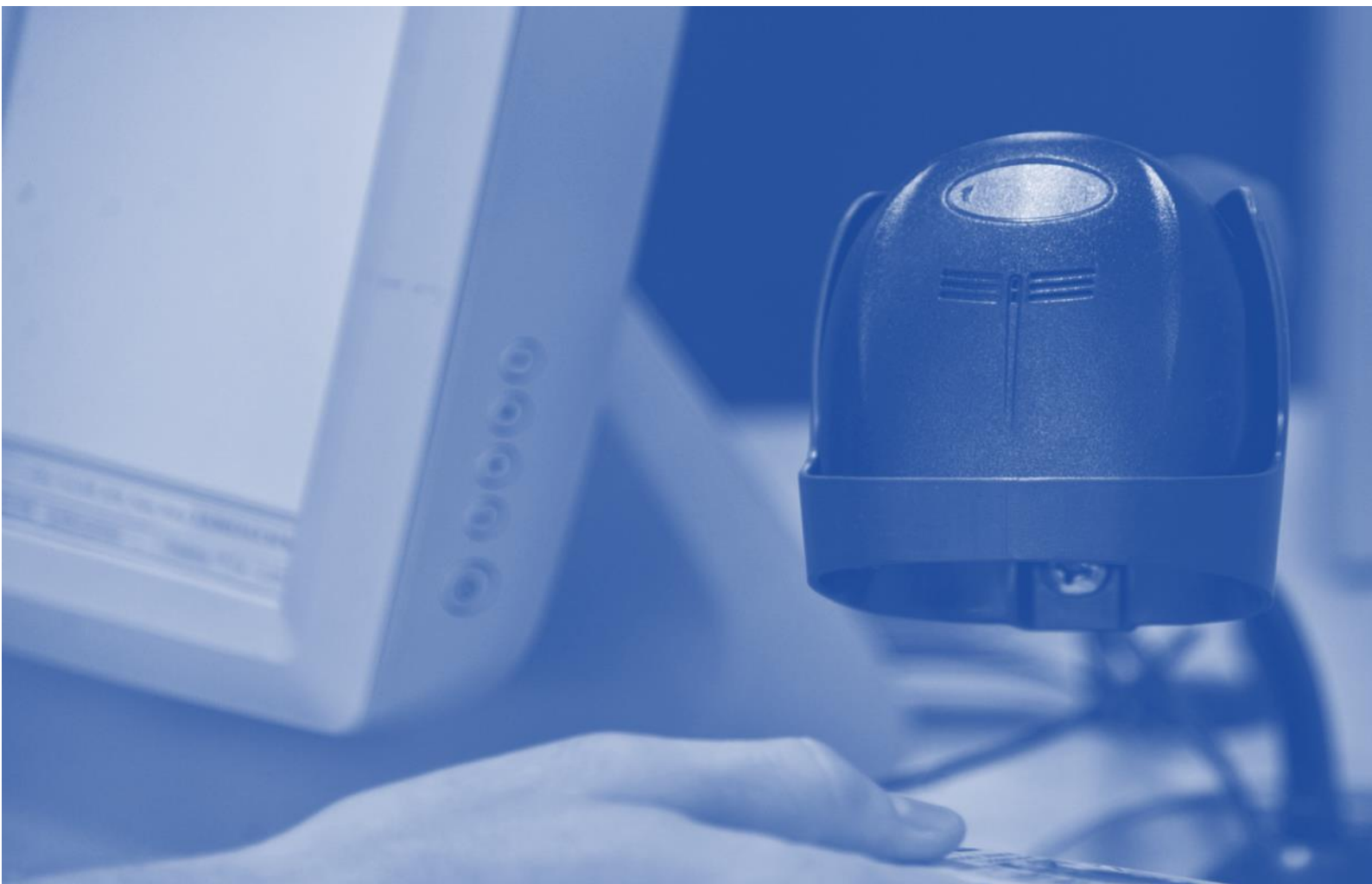


# Closed Loop Medicines Administration Toolkit Implementation Lessons Shared



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Version: 1.0  
Date: June 2019

This document has been published by the Global Digital Exemplar Learning  
Networks Team, part of *TheAHSNNetwork*

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# Chapter 1: Background

## 1.1 Purpose

The purpose of this toolkit is to provide information with regards to the practical delivery of closed loop medicines administration (CLMA). It aims to support Trust teams including Chief Clinical Information Officers, nursing and pharmacy teams.

This document has been developed on behalf of the Medicine's Optimisation Digital Learning Network, through a series of engagements with NHS organisations and workshops. The objective is to reduce the challenges associated with the implementation of CLMA through sharing learning from early adopters. As adoption of CLMA is in its infancy across the NHS, it is hoped that sharing knowledge will help to prevent duplication of lessons learnt and further promote collaborative working<sup>1</sup>.

## 1.2 Definition

The national definition adopted for CLMA was derived from work undertaken by Global Digital Exemplar (GDE) and 'Fast Follower' sites. It has been agreed as:

*“Functionality that supports the cross checking of the correct patient, medicine and prescription using digital technologies. Specifically checking should be used to confirm the patient identity against the medicine/dose due and the actual medicine that is selected for administration - appropriate decision support should be generated if there is a mismatch, whilst the administration should be recorded as given should the checks all match correctly.”*

## 1.3 Background

The driver behind the introduction of CLMA is to reduce medication administration related risks and errors as well as improving the quality of care.

An estimated 237 million medication errors occur in the NHS in England every year<sup>2</sup>. Of these, 54.4% are administration errors across all settings<sup>2</sup>. Furthermore, adverse drug events can lead to increased length of hospital stay, healthcare costs, patient morbidity and mortality. Studies have found medicines administration error rates in hospital to be between 10.5-19.7%<sup>3</sup>.

The Medicines Safety Programme<sup>4</sup> has been established in response to the WHO Global Patient Safety Challenge which aims to reduce the level of severe, avoidable harm related to medications by 50% over 5 years, globally<sup>5</sup>.

The NHS Long Term Plan<sup>6</sup> describes how innovation and technology in clinical practice is reshaping healthcare building on the recommendations focussed on increasing the digital maturity of the provider sector in the Wachter<sup>7</sup> review. The Topol Review highlights that at the heart of digital transformation is the opportunity to improve the quality and efficiency of interactions between patients, healthcare professionals and the healthcare system<sup>1</sup>. CLMA is a good example of a digital transformation which can improve care and efficiency.

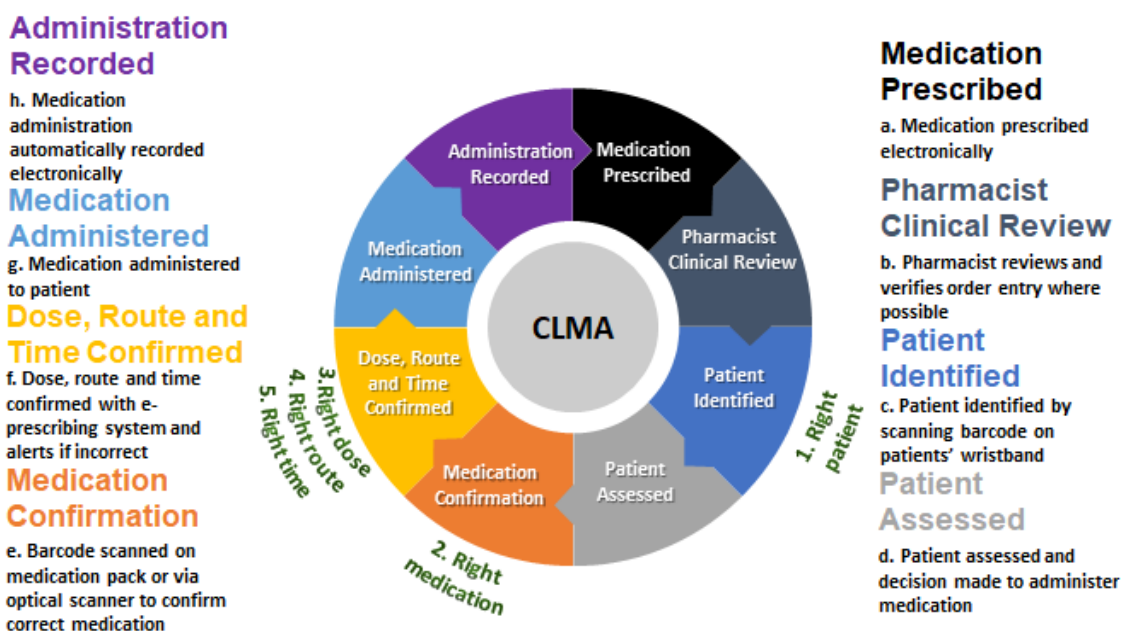
## 1.4 Why is Closed Loop Medicines Administration important?

Whilst it is widely recognised that medication errors and near misses from manual ('traditional') administration of medications may be underreported<sup>8</sup>, published studies suggest errors occur in up to 1 in 10 medicines administrations<sup>2</sup>. CLMA offers a means of reducing medication related administration error whilst identifying the type of error potentially avoided. Using 'traditional' methods, staff are not always aware that an error or near miss has occurred, particularly where no patient harm has resulted<sup>9</sup>. Evidence demonstrates that medication errors can be minimised using CLMA by addressing the 'five rights' of medicines administration.

**Table 1. Evidence shows that CLMA can reduce the overall rate of adverse drug events and decrease transcription errors by supporting staff administering medications in confirming the 'five rights' of medication administration in real time<sup>10</sup>:**

1. **Right Patient.** Identifiable by scanning the barcode on a patient's wristband<sup>10</sup>.
2. **Right Medication.** Identifiable by scanning a barcode on the medication package/label or by using an optical medication scanner. If the medication scanned does not match that which is prescribed, a warning appears<sup>10</sup>.
3. **Right Route.** The electronic prescription can be cross referenced to ensure the right route is used for administration based on the profile of the scanned medication. The system provides a warning alert if the 'normal' route for the medication scanned does not match the prescription<sup>10</sup> via the formulation.
4. **Right Time.** The user can ensure the medication is being administered at the right time by searching for a scheduled due time that falls within the permitted time window for documenting administrations. A warning alert is generated if the medication scanned falls outside the scheduled administration window<sup>10</sup>.
5. **Right Dose.** The integrated medication scanning system compares the dose to be administered with the prescription; a warning appears if the doses do not match<sup>10</sup>.

Figure 1: Confirming 'five rights' within the overall Medicines Process



# Chapter 2: Context

## 2.1 The Global Digital Exemplar Programme

CLMA adoption is limited to a relatively small number of early adopter sites across the NHS with many looking to follow.

This is set to change as GDE sites are required to deliver digital maturity equivalent to Healthcare Information and Management Systems Society (HIMSS) level 7<sup>11</sup> of which CLMA is a core component. This requires trusts to achieve levels of CLMA equating to 95% of doses administered. Trusts that have been supported as part of the accelerated uptake of Electronic Prescribing and Medication Administration (EPMA) systems are also required to implement CLMA. Allowing others to adopt solutions quickly through shared learning is a core component of both the GDE and wider digital acceleration strategy.

The early adopter sites have made considerable progress with CLMA and have been addressing the technical, process and cultural challenges.

This toolkit builds on the initial CLMA blueprint produced by Cambridge University Hospitals NHS Foundation Trust<sup>10</sup> as part of their GDE work. To request a copy of this blueprint, please contact; [england.gdeblueprints@nhs.net](mailto:england.gdeblueprints@nhs.net) or visit <https://future.nhs.uk/connect.ti/GDEcommunity/grouphome>.

HIMSS standards are developed from international processes and practices. HIMSS assessment of CLMA is mainly based on review of systems that use unit dose dispensing (medications packed and administered as single doses) and less on the United Kingdom (UK) practice of using floor stock and individual patient pack dispensing. This has given rise to the false belief that unit dose dispensing is a prerequisite for CLMA, this is not the case.

In the UK, dispensing practice is to supply medicines in original packs (usually via an automated dispensing system also known as a pharmacy robot) or split packs rather than unit doses. Indeed, national policy does not currently support the use of unit dose dispensing. Whilst there are a limited number of Trusts investigating unit dose dispensing, the adoption of unit dose provision is not currently desirable across the NHS due to the need for considerable investment in technical solutions and the potential disruption of health economy supply changes, especially at discharge from hospital.

## 2.2 Scan4Safety

The Scan4Safety (S4S) programme uses GS1 and PEPOL (Pan-European Public Procurement On Line)<sup>12</sup> standards for product, location and patient identification to track products and their usage from the point of manufacture to the point of care.

Although CLMA is not an essential part of Scan4Safety (S4S), there is generic learning from the programme that may be helpful. There is considerable overlap in the practical challenges addressed within this work and resources that can be used interchangeably. More information is available at <https://www.scan4safety.nhs.uk/about/>. Further case studies on related work utilising GS1 codes can be found via the GS1 website at <https://healthcare.gs1uk.org/cases/>.

## 2.3 Mental and Community Health Trusts

The GDE mental health medicines optimisation network considered the adoption of CLMA in mental health and community settings to understand whether it could be extended from the current focus on acute care. Widespread agreement was achieved with the following consensus statement and principles identified.

### Consensus Statement

This statement was derived from a workshop held with GDE and 'Fast Follower' sites within mental health.

*“Trusts should implement closed loop medicines administration so that patients are given parity of esteem and are not denied improvements in reducing medication errors, whilst respecting their dignity and independence.”*

### Principles:

The approach

- implementation should be flexible taking into account patient preferences and choice around identification
- must adapt and scale to different settings and support a mobile environment
- must be cognisant of citizen concerns around data security

Issues to address:

- patient concerns around identification
- wristbands (where/if used) may have a value/currency and be swapped if there is a perception that someone else's medicines may worth receiving
- exclusions need to be agreed – for example rapid tranquilisation
- flexible approach to implementation will need to be developed by individual organisations according to location, service type, patient type and medication type
- technology solutions will need to be adaptable and flexible, particularly around patient identification and location

Further work needs to be undertaken to ensure that this is also agreed across wider professional groups. First of type site(s) are now looking to take the work forward and will test out the assumptions.



# Chapter 3: Different methods of delivering closed loop medicines administration

There are two different methods that are currently being used in England to deliver CLMA; namely barcode medicines administration systems (BCMA) and the use of optical medication scanners.

## 3.1 Barcode medicines administration

BCMA involves scanning the barcode on the patient's wristband and the medication barcode. The electronic prescription record (EPR) confirms if there is a match.



*Cambridge University Hospital's introduction of barcode medication administration (BCMA) has improved patient safety by reducing the overall rate of adverse drug events and decreasing transcription errors. Watch the 'The 10-minute blueprint' video series where Helen Balsdon, Assistant Director of Nursing at Cambridge University Hospitals NHS Foundation Trust and team share their Barcode Administration journey. Visit <http://bit.ly/BCMAJourney> to watch the video.*

## 3.2 Optical medication scanners

The integration of an optical medication scanning solution with an electronic prescription allows for solid oral medications to be identified or validated by an optical scanner. The nurse can put solid oral dosage forms of the medications for an individual patient in a disposable tray; the optical scanning then identifies the medication(s) to verify they are correct<sup>13</sup>. Non-oral solids are identifiable by scanning the barcode on the pack<sup>13</sup>. The identification of the correct patient depends on the solution adopted and on hospital policy.

# Chapter 4: Minimum infrastructure requirements for successful implementation

Prior to implementing CLMA, the following should be in place to enable successful adoption.

## 4.1 Electronic prescribing system

CLMA can only be introduced in Trusts that have an EPMA system in place preferably covering most patient areas.

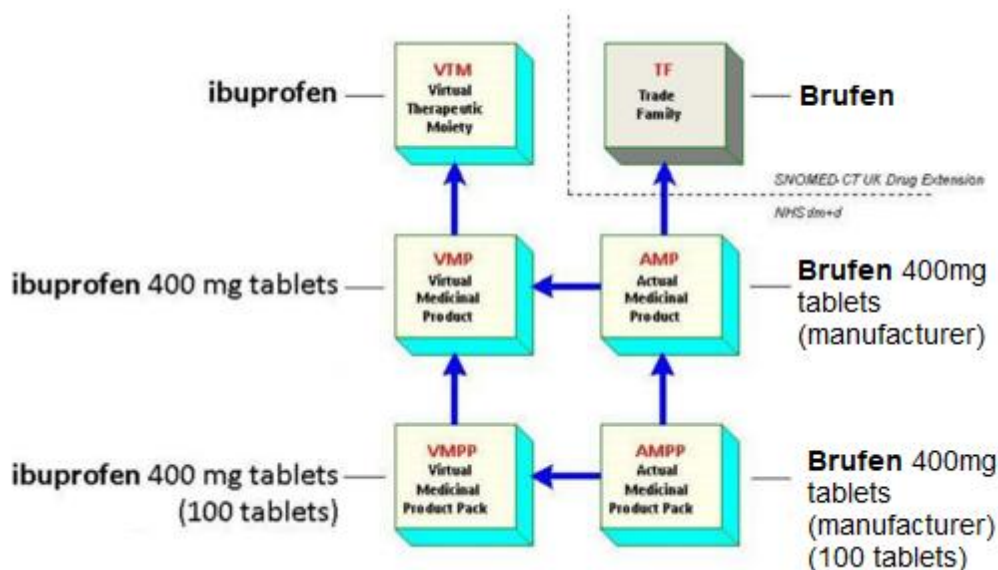
It is not necessary for EPMA systems to be integrated with the pharmacy stock control systems for CLMA to be introduced, unless the Trust is also adopting closed loop medicines supply in tandem.

## 4.2 NHS Dictionary of Medicines and Devices (dm+d) coded drug dictionary

CLMA requires the EPMA system to be dm+d compliant. dm+d is the NHS standard for the electronic communication of medicines, as approved by the Standardisation Committee for Care Information SCCI0052<sup>14</sup>.

dm+d compliance can be used to facilitate the translation of a prescription (usually VTM or VMP/AMP level) to product data (Global Trade Item Number (GTIN) barcode). The GTIN barcode is linked to the Actual Medicinal Product Pack.

Figure 2: dm+d model and transfer of information through barcodes<sup>15</sup>



VTM: Virtual Therapeutic Moiety  
 VMP: Virtual Medicinal Product  
 VMPP: Virtual Medicinal Product Pack  
 AMPP: Actual Medicinal Product  
 AMP: Actual Medicinal Product  
 TF: Trade Family



### 4.3 dm+d coded database mapped to GTIN codes

The GTIN describes a family of GS1 (EAN.UCC) global data structures that employ 14 digits and can be encoded into various types of data carriers<sup>16</sup>. Currently, medications predominantly use GTIN barcodes. The Falsified Medicines Directive (FMD) will drive some medicines packs towards 2D GS1 DataMatrix barcodes. Currently there is a mixed economy of both 1D and 2D barcodes in circulation.

Figure 3: Examples of 2D and 1D GTIN code<sup>16</sup>



The dm+d dictionary holds maps to GTIN barcodes at the AMPP level. These maps enable CLMA.

A centralised database of dm+d AMPP codes mapped to GTIN barcodes has been produced in collaboration with NHS Business Services Authority. Approximately 94% of AMPP's have been mapped to dm+d (excluding specials and parallel imports). Access is available via the link to the national data pool of Technology Reference data Update Distribution (TRUD) files <https://isd.digital.nhs.uk/trud3/user/guest/group/0/home>. It is usually the system supplier that deals with this or the in-house IT/EPMA team.

Hospitals should be aware of potential errors that may take place. Historically there have been incidents of the wrong barcode being used for a product, or barcodes being reused i.e. the same barcode on two different products. If such an error is identified, then the product manufacturer and the Medicines Healthcare and Regulatory Authority should be contacted and GS1 UK informed for further investigation. To prevent this leading to an administration error, hospitals should review GTIN barcodes on receipt into the hospital.

### 4.4 Patient identifiable barcode

Patient identifiable barcodes in England, usually on patient wristbands, must be compliant with the NHS standard for patient wristbands as approved by the Information Standards Board – ISB1077<sup>17</sup>. The standard is currently undergoing review and update with the new NHS Standards approval board.

The GS1 standard for identification of people is the GSRN, when used for patient identification. The captured data must include the following information:

- NHS number (mandated by the NHS contract)
- Unique identifiable number
- Name
- Date of birth

Early studies and discussion with sites demonstrated that the most common workaround involved the collation of patient identification codes onto a single printout or piece of paper<sup>18</sup>. These were then scanned rather than the barcode on the patient's wristband leading to incorrect patient identification. Sites implementing CLMA may wish to actively monitor to avoid this.

## **4.5 Wi-Fi and IT Hardware**

The hospital must have sufficient Wi-Fi coverage, capacity and the appropriate amount of hardware. The hardware, such as laptops and scanners, that are used for EPMA must be able to deliver the functionality for CLMA, for example the ability to read both 1D and 2D barcodes. The correct amount of hardware must be procured (identified through process mapping), delivered and configured prior to 'going live'.

# Chapter 5: Practical solutions for successful implementation

## 5.1 Clinical leadership and governance

CLMA must not be technology-led but user-led. Strong clinical leadership and staff engagement is of the utmost importance. A multidisciplinary team must be engaged from the outset. The use of scanners in medication administration is a relatively new concept in England and with the implementation of any new functionality, there is a period of adjustment to new processes.

Board level executive support should also be obtained. An appropriately constituted multidisciplinary steering group should be in place to oversee the delivery of the CLMA project.



As part of 'The 10-minute blueprint' BCMA video series, Claire Tolliday, head of eHospital Clinical Liaison explains how her team has been the key in bridging the gap between clinician's and technicians. 'Creating a liaison team will help you maintain compliance beyond the initial go-live'. Watch the video here: <http://bit.ly/BCMAleaders>

## 5.2 Workflow

The introduction of EPMA will often identify different process flows and practice between wards and departments. This is particularly true for medicines administration.

The introduction of barcoding into the process has the potential to create more diversity if optimum workflows are not identified at the outset. There will be concern expressed by nursing staff as the use of CLMA may increase the time required to administer medicines, thus negatively impacting the delivery of care. Process transformation and mapping must be carried out with staff to ensure the future state is fit for purpose and acceptable to users.



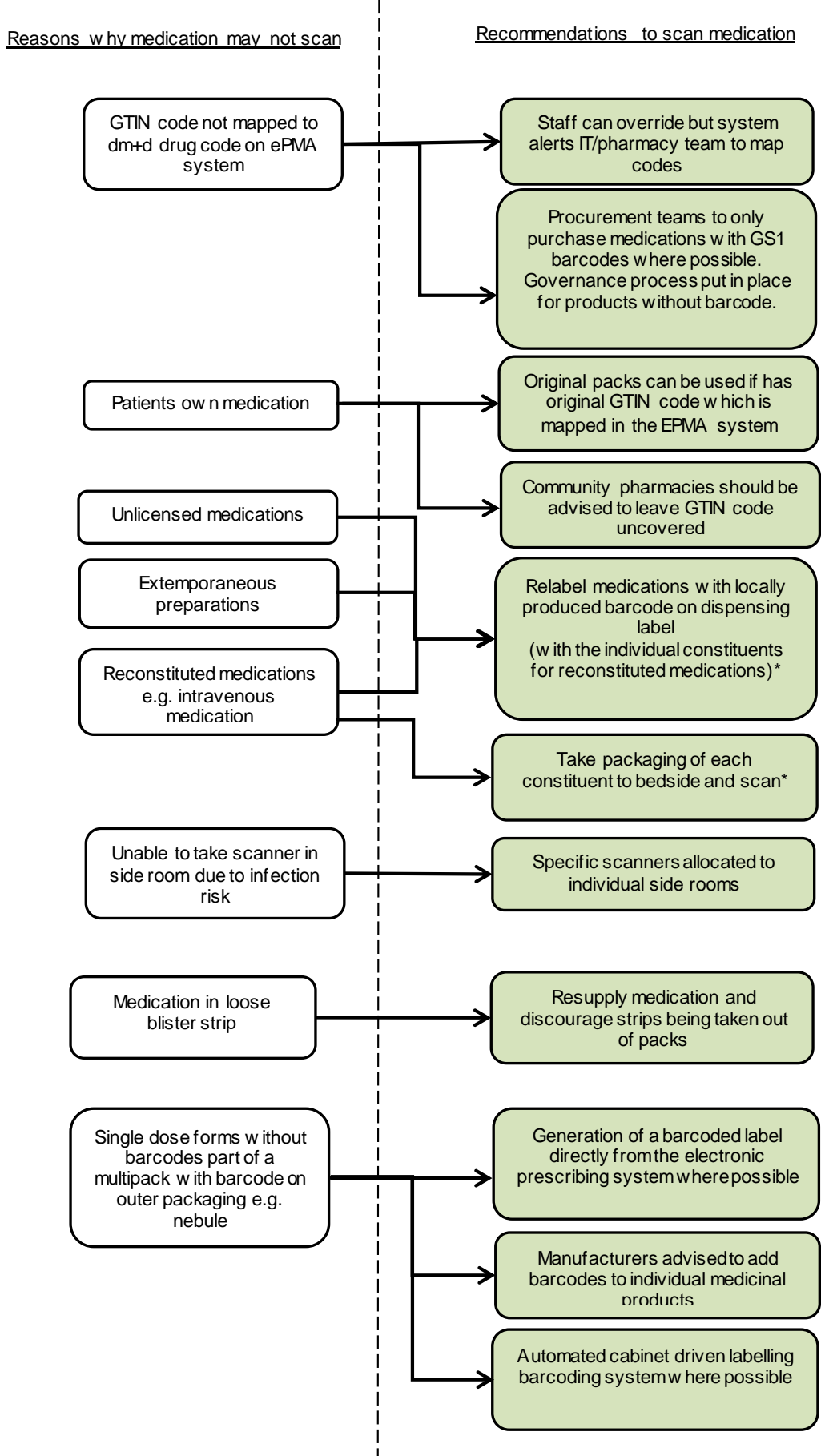
*Hannah Nunn, Lead Practice Development Nurse for Paediatrics, lead the roll out across a paediatric Ward. Here she talks about her experience leading this change and why knowing your staff is key. Watch the video here: <http://bit.ly/BCMAstaff>*

### **5.3 Un-scannable medications and potential solutions**

Even with the minimum requirements being in place, there will be practical issues in scanning medications. Approaches are being developed by the early adopter sites to address these challenges. Figure 4 shows some early suggested solutions or workarounds. Work is on-going to address issues in this evolving area.

To aid resolution of challenges being experienced there are a number of relatively simple strategies that can be adopted to support further improvements post implementation. For example, when a medication cannot be scanned, a reason must be entered on the EPMA system. This will provide further intelligence as to the problems being experienced. Strategies to address these practical challenges can then be underpinned by local learning from override reasons. Override reasons should be meaningful, clear and intuitive.

Figure 4: Reasons why medications may not scan with potential solutions



\* Cambridge University Hospitals NHS Foundation Trust advise use of locally produced barcodes linked to the medication order and NOT barcode individual ingredients

## 5.4 Cross scanning

Configuring the system to support cross scanning is a core part of the setup required to implement CLMA. This allows multiple medicines to be recognised as providing appropriate ways of fulfilling a specific dose. These medications are said to be cross scannable. There are a number of reasons that require this, as described below.

### 5.4.1 Multi-route

Medications prescribed as multi-route, for example, paracetamol orally or intravenous (PO/IV) may have to be managed locally through appropriately linking to the relevant product(s).

It is important to ensure cross scanned medicines are safe in all scenarios. For example, with paracetamol the doses for both formulations are the same however for chlorphenamine the doses are different. Therefore, for the system to allow differentiation, substantial maintenance may be required for an individual medication basis if the system does not do this automatically.

### 5.4.2 Dosage

Cross scanning may also be required to ensure that multiple available strengths can be identified to provide a dose. For example, a dose of 750mg that can be fulfilled using two strength formats, namely 500mg and 250mg, may be given using different combinations. The system must support all potential options whilst correctly checking the dose given.

### 5.4.3 Formulation

Where clinically appropriate, the closed loop system should allow the administration of different formulations albeit via the same route – this requires cross scanning options as well. For example, it should support the administration of soluble tablet instead of a non-soluble tablet (both can be administered via the same route).

## 5.5 Pack content

The use of barcodes on original packs gives assurance that the correct pack has been picked; it does not give assurance that the correct medication has been administered as an incorrect blister strip could have been placed in the wrong box.

The use of barcode scanning may reduce staff vigilance when administering medication from blister strips. This will need to be addressed at a local level through policy implementation and good practice around storage.

## 5.6 Medical products of human origin

ISBT 128 is the global standard for the terminology, identification, coding and labelling of medical products of human origin (including blood, cell, tissue, milk, and organ products)<sup>17</sup>. These products do not come under GS1 standards – they are ISBT128 standards. The standard has been designed to ensure the highest levels of accuracy, safety, and efficiency for the benefit of donors and patients worldwide. ISBT 128 provides international consistency to support the transfer, traceability and transfusion/transplantation of blood, cells, tissues and organs<sup>17</sup>. These products are already often scanned as part of closed loop processes to reduce the risk of error and



many of the challenges are likely to be similar. For the purposes of this work, these are out of scope.

## 5.7 Dose confirmation

The use of original pack GTIN barcodes makes it complex to ensure that the number of single dose units or volume of a medication administered can be correctly recorded.

Examples of these include the administration of an antibiotic liquid in paediatrics where a specific number of millilitres of liquid is required rather than a standard 5mL dose or the administration of a dose of Tinzaparin which relates to either a fraction of a syringe contents or the contents of more than one syringe. Standards for describing dose have recently been identified as part of the interoperable medication message work<sup>19</sup>.

Different approaches to checking doses that require multiple tablets, are being implemented by various hospitals. For example, a 40mg dose of prednisolone would be made up of eight 5mg tablets. To confirm correct administration, the following options have been adopted:

- 1) The EPMA system prompts the staff administering the medication to manually enter the number of tablets required to make up the dose or
- 2) The EPMA system calculates the number of tablets required and informs the staff member administering. The GTIN barcode would then be scanned multiple times until the correct dose is achieved.

Local policies and practice, as well as available system functionality should be used to manage these challenges.

## 5.8 Wristbands

Some wristbands in current use are not ISB 1077<sup>17</sup> compliant and contain only the patient hospital number within the barcode. As another patient may share this hospital number elsewhere in the country it may not be unique. The benefit of having an ISB 1077 compliant wristband is that this can be understood in any location reducing the risk of misinterpretation.

# Chapter 6: Physical and environmental factors for successful implementation

## 6.1 Physical factors

Each Trust will have wards and departments that are different in shape and layout. The design and implementation of the placement of hardware must take local workflows, differing ward layouts and Wi-Fi connectivity issues into consideration at the outset.

### 6.1.1 Infection control

Where patients are being barrier nursed in side rooms, the scanning workflow can be difficult as staffs need to be gowned up and computers or scanners cannot be taken into the side room.

Early adopter solutions include:

- leaving the hardware outside the room
- scanning the barcode on the patients' wristband. Then leaving the room to scan the medication box and returning to administer the dose. The scanning device is disinfected at each entry and exit point from the room.

An alternative may be to allocate dedicated computers to side rooms, but this does not address the availability of certain medications such as stock items which may not be taken in to the room due to infection control policies. Some Trusts may have individual patient rooms each containing a wall-mounted work station that can have a scanner permanently attached. To prevent stock items being taken in and out of the room, individual items could be ordered specifically for the patient and then stored in the room.

## 6.2 Central storage

Central storage refers to medications that are kept in a treatment room drug cupboard, clean utility room or an automated cabinet.

Central storage can create challenges as scanning to confirm the 'five rights' should ideally take place at the patient bedside. Strategies to address this are likely to be based on local circumstances/policies, geography and the specific systems in use.

Treatment rooms might need to have a computer, scanner and potentially label printers, based on workflows to be adopted. It may not be possible to remove whole packs of medication from a central storage repository as this may increase issues related with safe storage.

Transporting a dose prepared in central storage to the bedside for administration is challenging. This can be due to:

- the outer packaging alone has the manufacturer barcode, The contents are removed to administer a dose e.g. a single vial does not have individual barcode;
- a single box of medication being required by two patients potentially leading to delays/omissions.

The use of automated carts and cabinets to support CLMA is in its infancy in the UK. There is further work required to identify the most appropriate ways of using these. This is the area in which there is currently much effort to identify the most appropriate solution. Individual sites identified in the final chapter are likely to continue to refine their processes and practice. At present the following have been observed and/or are being trialled.

### **6.2.1 The use of automated drug carts**

To ensure the correct medication is transported to the patient bedside, a small number of trusts have introduced automated drug carts (ADC). These carts are filled at the central storage location with doses due for each patient at the time of preparation and then moved to the patient bedside for the administration.

These drug carts integrate software to ensure the medication loaded is administered to the correct patient. To fill the cart, the staff member administering the dose logs onto the system, scans the location barcode on the ADC which ensures the cart is at a secure designated filling area. The ADC drawers are each assigned to individual patients or general stock. The doses of medication required are placed within a designated patient drawer (the drawer cannot be opened again until it is at the patient bedside). The ADC is then moved to the patient bedside. Scanning the patient's barcode on their wristband automatically opens the patients designated draw, from which the nurse administers the dose. If for any reason the drawer is left open, it automatically closes and locks after a pre-set time.<sup>20</sup>

The use of ADC with bespoke patient drawers is in its relative infancy in the UK – work is on-going to identify the optimal process to ensure that the use of these complies with the 'five rights'. King's College Hospital NHS Trust is actively looking at this area.

### **6.2.2 The use of automated cabinets**

Once a dose has been removed from a pack held in an automated cabinet it cannot be adequately identified at the patient bedside. To address this problem the pack is initially checked at the point it is removed from the cabinet by scanning the pack barcode and cross referencing it against the prescription. Some suppliers of cabinets are developing a solution to support the production of a patient specific barcoded label that can be attached to the individual dose to support scanning at the bedside. This may also be used when multiple constituents to make up a dose are being used, for example a syringe.

If this functionality is not available or the medications are simply stored in a locked cupboard, then a barcoded label generated directly from the EPMA system can be considered if supported. This may carry the risk of an incorrect label being attached to the wrong medication if there was a picking error.

Early work at sites has identified that these solutions may not be practical for every dose administered as they could create a large volume of labels. They may therefore be restricted to high risk medications, for example reconstituted intravenous doses. The workforce time and cost are also considerations.

One example of a potential workaround already identified involves labels being printed that are too large. The flagging process is then bypassed and the labels are collated, and the safety process is effectively negated. Further analysis is required to assess the nurse

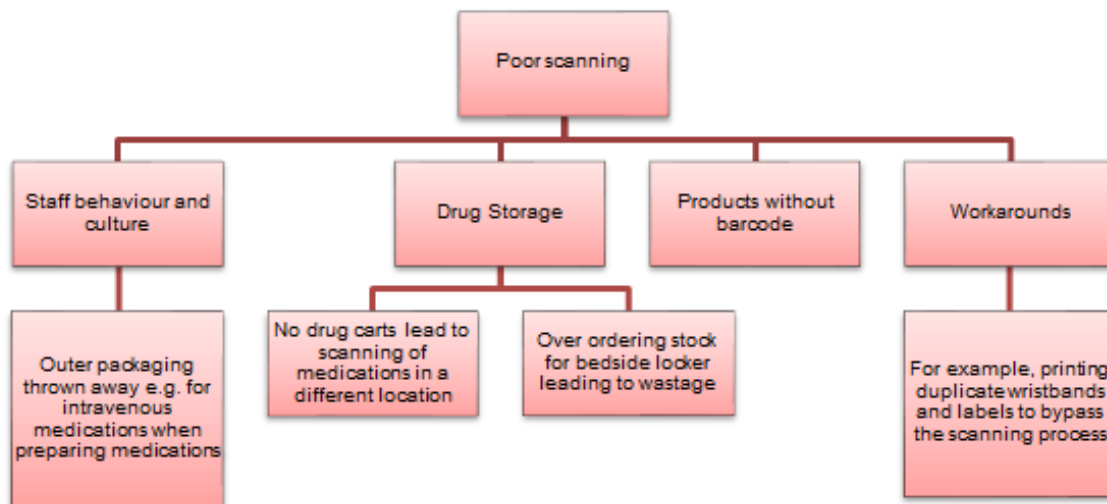
satisfaction and workflow in practice – as outlined in an earlier section, identifying optimal workflow is essential. There remains much work to do in this area.

### 6.3 Scanning rates

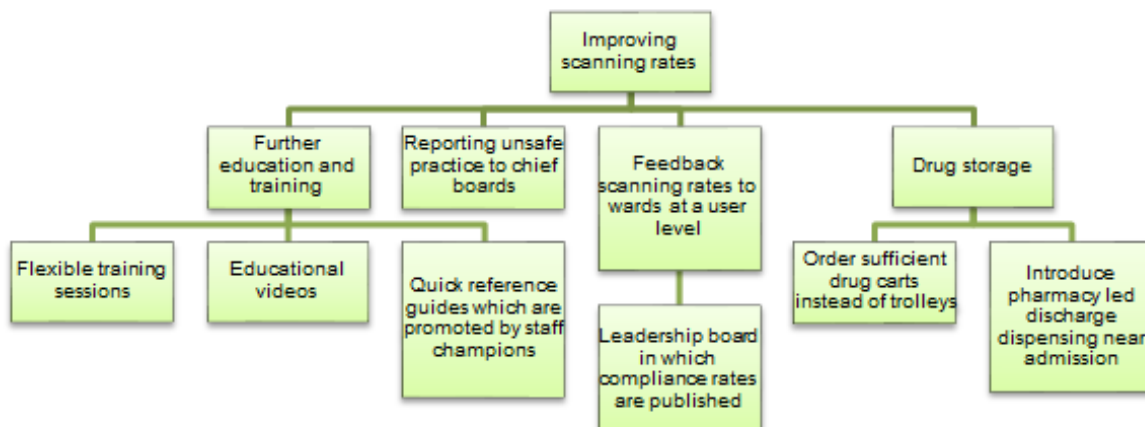
The hospitals that have implemented barcode scanning have come across challenges in achieving high scanning rates. This section describes the scanning of the medication pack (not the barcode on the patient’s wristband).

There are a number of reasons for poor rates that may change over time. The most obvious one is having the barcode scan recognised and cross-scanning set up appropriately. Initially this can seem like a vicious circle as scanning is required to identify missing codes but with too many missing, staff will stop scanning, reducing overall rates. Perseverance, good leadership and governance are key to resolving these challenges. The potential causes and adopted solutions have been highlighted below to help guide Trusts and share learning.

#### 6.3.1 Potential causes identified for poor scanning



#### 6.3.2 Potential solutions to improve scanning rates



## Chapter 7: Patient safety benefits identified by sites

The benefits of providing a CLMA process are now becoming evident as sites are beginning to implement.

Published evidence has largely focussed on the reduction of adverse drug events and the impact on patient care<sup>9</sup>. The opportunity to remove pressure from services and reduce the overall cost of organisational sustainability is also outlined.

Interim work from sites is largely focussing on patient safety benefits.

Cambridge have demonstrated that scanning is highlighting potential errors that are being acted upon by staffing using the process. The interim results can be seen in table 2 below. The data refers to approximately approximately 11,500 administrations per day. The table shows that in February 2019, 2.2% of potential medication errors were averted due to the use of barcode scanning system alerting.

Table 2: Interim results for closed loop medicines administration at Cambridge University Hospitals NHS Foundation Trust

	Nov 18	Dec 18	Jan 19	Feb 19
<b>Medication Scan Rate</b>	<b>65.7 %</b>	<b>66.3 %</b>	<b>68.1 %</b>	<b>70.0 %</b>
<b>No order*</b>	4229 (1.2%)	4401 (1.3%)	4722 (1.3%)	4586 (1.4%)
<b>No active order**</b>	2631 (0.7%)	2369 (0.7%)	2645 (0.7%)	2774 (0.8%)
<b>TOTAL</b>	<b>6860 (1.9%)</b>	<b>6770 (2%)</b>	<b>7367 (2%)</b>	<b>7360 (2.2%)</b>

\*No order

This is when a barcode is scanned and the medication cannot be matched to an active order. It could mean that this is the wrong patient, or that the wrong box was picked up from the drug trolley  
OR

An attempt is being made to administer a medication specifically labelled for one patient to a second patient - it might be for the same drug, but not for that specific patient.

\*\*No active order

This is when an attempt is being made to administer a medication to a patient where that patient previously had an active order for that medication, but the order has since been discontinued by the clinical team

Similarly, St George's University Hospitals NHS Foundation Trust data demonstrates that between February 2018 and February 2019 scanning the barcode on the patient's wristband during medication administration, prevented practitioners from administering to an incorrect patient 14,678 times. Furthermore, scanning the medication pack prevented practitioners from administering an incorrect medication or dose 113,674 times.

# Chapter 8: Experience from early adopter sites

## 8.1 Cambridge University Hospitals Foundation Trust

Cambridge University Hospitals Foundation Trust (CUHFT) is a GDE site and has CLMA implemented across the majority of inpatient areas. CUHFT have an integrated EPR (EPIC) including prescribing, clinical decision support and electronic medication administration chart. They have a coded medication database of 80,000 drug codes and 55,000 barcodes.

The Trust initially introduced CLMA in 2015 and have shared their lessons learnt through the GDE Blueprinting work<sup>10</sup>. The work is also described in a helpful video outlining their approach, highlighted earlier in this toolkit and available at: <http://bit.ly/ePMAlearning>

The Trust does not scan certain products. These include products that do not have a barcode, products where it is difficult to establish the exact dose i.e. inhalers, eye drops, creams, and medications that are being self-administered.

They use iPod scanning devices to scan the barcodes, these are linked to the EPR. The iPod is encased within a medical grade Honeywell device which allows for barcode scanning taking place with an application (Rover) provided by EPIC. It also allows scanning of blood products. For patients that are in side rooms for infection control, the device is taken in to the side room as the case can be cleaned appropriately.

## 8.2 City Hospitals Sunderland NHS Foundation Trust

City Hospitals Sunderland NHS Foundation Trust (CHS) is a GDE site that has CLMA implemented across the majority of inpatient areas.

The current exceptions to implementation include Adult and Children's Emergency Department, Integrated Critical Care, Integrated Admissions Unit and Emergency Ambulatory Care Unit.

The EPMA system used is MediTech (version 6) which is an integrated EPR system.

CHS operates a pharmacy-led Integrated Medicines Management (IMM) system that "dispenses for discharge" at the point of admission. This results in most medicines (oral and any other non-parenteral medications) needing to be administered to patients being present in a bedside locker in original packs that are labelled with medication specific barcodes. Any medication that needs to be "packed-down" out of its original manufacturer pack is done so into a generic white box whose label also contains a barcode for scanning as part of the CLMA process. The IMM system plans for discharge at the point of admission meaning that only minor changes to medicine supply need to be actioned at the point the patient is ready to go home.



### 8.3 Newcastle upon Tyne Hospitals NHS Foundation Trust

Newcastle upon Tyne Hospitals NHS Foundation Trust (NuTH) is a GDE site. Their core EPR system is Cerner.

They will be implementing the alternative solution to barcoding, namely the optical medication scanner, MedEye solution. The pilot is expected to be carried out mid-2019 with a full evaluation of the impact of the MedEye System identifying its impact on medication error rates, nursing efficiency and satisfaction and economic impact.

### 8.4 Royal Free London NHS Foundation Trust

Royal Free London NHS Foundation Trust (RFL) is a GDE site. Their core EPR system is Cerner. They began rolling out CLMA across their three sites in November 2018 and are now working on increasing compliance and scan rates:

1. Royal Free Hospital in Hampstead; has implemented CLMA on a vascular ward, maternity and labour wards.
2. Barnet Hospital: has implemented CLMA across the site except ITU wards. The scan rates were 8% in December 2018 and were approximately 20% in April 2019. The emergency department has a scan rate of 5%.
3. Chase Farm Hospital; In May 2019, this site had a scanning compliance of 85% for barcodes on patient wristbands and 60% for medications. This is a 'cold' elective site where patients are mostly on tablet medications that are brought in.

Medication error rates have not yet been reviewed.

They have developed a video demonstrating their gold standard medication administration process that can be accessed here:

<https://www.youtube.com/watch?v=5NUlfQsdMO0> <sup>121</sup>

### 8.5 St George's University Hospitals NHS Foundation Trust

St George's University Hospitals NHS Foundation Trust (SGUHT) was the first in the country to implement barcode scanning as part of patient and medicine identification. They have used the Cerner system since 2008.

CLMA is in place in the majority of clinical areas including ICU and paediatric wards (excluding maternity and NICU areas which are due to go live in June 2019). They currently have a scan rate of 89%.

They have specific challenges associated with using multiple system - their maternity wards use *Euroking*® Maternity Software Solution and the neonatal ICU use *BadgerNet*®. SGUHT is currently working to provide a solution and/or integration for both areas.

## 8.7 The Royal Cornwall Hospitals NHS Trust

The Royal Cornwall Hospitals NHS Trust (RCHT) is a S4S site and has investigated and implemented the use of barcodes to support inventory management and dispensing and is now looking at medicines administration – much of the learning is transferrable. They use the JAC system with some local development.

They have developed a stock inventory ordering system that integrates with their electronic stock solution. This produces paper drug orders for the dispensary which have barcodes for the key data attributes of patient name, drug name and cost-centre/location. There is currently a break in closing the loop as information moves from the prescribing system to the supply loop, the utilisation of barcode scanning means there is no manual rekeying of information for these data attributes. This has resulted in a 78% reduction in prevented dispensing error rates (see table 3).

The installation of electronic drug cabinets on selected wards at RCHT has facilitated closed loop supply of stock medicines, with electronic orders triggered once a minimum stock level is reached, with the message transmitted directly to the robot for execution.

Through the S4S programme, RCHT is aiming for a complete closed loop supply process, utilising bar-code scanning at the final check stage to undertake the accuracy check, expiry and recall check and the FMD decommissioning step.

Figure 5: Closed loop medicines supply process at RCH<sup>22</sup>

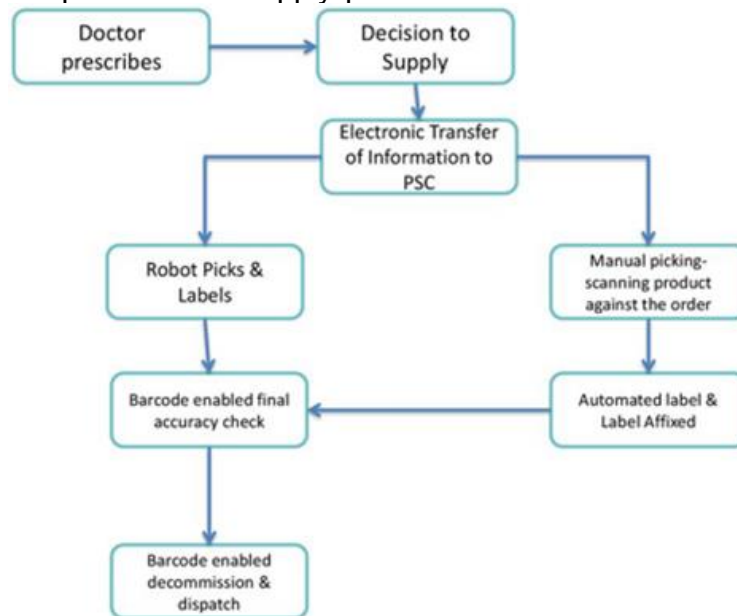


Table 3 below shows the results presented by RCH in April 2019. This study shows a comparison between dispensing errors with or without using barcode scanning. A prevented error is an error that is picked up before it gets to the patient. It was found with the use of closed loop medicines supply, a reduction to zero barcode sensitive errors were seen from period 1 to period 2.

Table 3. Prevented errors seen at the RCHT with the implementation of mandatory barcodes in the dispensing process as presented in April 2019.

	Error type	Dispensing Error Monitoring Period 1 (barcode non mandatory)		Dispensing Error Monitoring Period 2 (barcode mandatory)	
		Prevented Incidents	Rate (%)	Prevented Incidents	Rate (%)
Bar-code Inensitive Errors	Administrative	4	0.11	2	0.04
	Label directions	13	0.35	7	0.15
<b>Total Bar-code Inensitive Errors</b>		<b>17</b>	<b>0.46</b>	<b>9</b>	<b>0.19</b>
Barcode Sensitive Errors	Wrong patient	1	0.03	0	
	Drug strength	5	0.13	0	
	Drug form	3	0.08	0	
	Drug name	2	0.05	0	
	Cost centre	1	0.03	0	
<b>Total Bar-code Sensitive Errors</b>		<b>12</b>	<b>0.32</b>	<b>0</b>	
<b>Total Number of prevented Errors</b>		<b>29</b>		<b>9</b>	
<b>Number of non-stock items dispensed</b>		<b>3736</b>		<b>4667</b>	
<b>Prevented Error Rate (%)</b>		<b>0.78</b>		<b>0.19 (P &lt;0.001)</b>	

## 8.8 Other Sites

There are many other sites that are also on the journey to implement CLMA – these include, but are not limited to, University of Oxford NHS Foundation Trust, Royal Liverpool and Broad Green University NHS Foundation Trust, University College Hospital London, Great Ormond Street Hospital, Imperial College NHS Foundation Trust, Alder Hey Children’s Hospital and West Sussex Foundation Trust.

Wirral University Teaching Hospital NHS Foundation Trust (WUTH) is a GDE site and has used the Cerner system as their ePMA solution since 2014. WUTH has selected an optical medication scanner (MedEye) as their solution to pilot CLMA. The project is scheduled to start in the next few months.

## Chapter 9: Conclusion

In common with other transformation programmes, the introduction to CLMA requires careful planning and wide engagement with clinical leadership to ensure success.

There is growing experience of implementing technology to support medicines administration with positive benefits being identified. Sites embarking on their journey should learn from and collaborate with others as well as use the national resources available. The Medicines Optimisation Digital Learning Network will continue to provide a central platform to support and share this work.

# Glossary

<b>CLMA</b>	Closed Loop Medicines Administration
<b>BCMA</b>	Barcode Medicines Administration
<b>GDE</b>	Global Digital Exemplar
<b>HIMMS</b>	Healthcare Information and Management Systems Society
<b>EPMA</b>	Electronic Prescribing and Medicines Administration
<b>CUHT</b>	Cambridge University Hospitals Foundation Trust
<b>CHS</b>	City Hospitals Sunderland NHS Foundation Trust
<b>NuTH</b>	Newcastle upon Tyne Hospitals NHS Foundation Trust
<b>RFL</b>	Royal Free London NHS Foundation Trust
<b>SGUHT</b>	St George's University Hospitals NHS Foundation Trust
<b>WUHT</b>	Wirral University Teaching Hospital NHS Foundation Trust
<b>RCHT</b>	The Royal Cornwall Hospitals NHS Trust
<b>EPR</b>	Electronic prescription record
<b>EHR</b>	Electronic Health Record
<b>FMD</b>	Falsified Medicines Directive
<b>GTIN</b>	Global Trade Item Number
<b>EAN</b>	European Article Number
<b>GS1</b>	Global Standards One

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# Acknowledgements

I would like to thank all those who helped, support and guided me during this work. Particularly to those who invited me to visit their organisation and observe their practice.

*A special thanks to Ann Slee (NHS England and Improvement), for her supervision and tremendous support throughout.*

*Alison Ewing - Royal Liverpool & Broadgreen University Hospitals NHS Trust  
Amanda Whitworth - West Suffolk NHS Foundation Trust  
Andrew Davies - NHS England and Improvement  
Ann Jacklin - NHS England and Improvement  
Annette Nicholson - Kingston Hospital NHS Trust  
Audrey Khoo - St George's Healthcare NHS Trust  
Brian Power - Wirral University Teaching Hospitals  
Caroline Anderson - Kings College Hospital NHS Foundation Trust  
Claire Clarke - GS1 UK  
Clare Tolley - Newcastle Hospitals NHS Foundation Trust  
Derek Swanson - Royal Liverpool & Broadgreen University Hospitals NHS Trust  
Fintan Grant - NHS Digital  
Guy Jepson - NHS Business Services Authority  
Hannah Heales - Royal Free London NHS Foundation Trust  
Helen Taylor - Whittington Health NHS Trust  
Iain Davidson - Royal Cornwall NHS Hospitals Trust  
Jo Goulding - NHS Digital  
Judith Foy - Kingston Hospital NHS Trust  
Kathryn Miller - Addenbrooke's Hospital  
Kevin Joice - City Hospitals Sunderland  
Laura Stanton-Davis - West Suffolk NHS Foundation Trust  
Lynn Tarpey - Wirral University Teaching Hospitals  
Mary Evans - Luton & Dunstable Hospital  
Mo Murhaba - NHS Digital  
Neil Watson - Newcastle Hospitals NHS Foundation Trust  
Patrick Lynch - Addenbrooke's Hospital  
Paul Mooney - Wirral University Teaching Hospitals  
Rahul Singal - Kings College Hospital NHS Foundation Trust  
Richard Eyles - Leeds Teaching Hospital NHS Trust  
Shazmin Motiwala - West Suffolk NHS Foundation Trust  
Simon Whitworth - West Suffolk NHS Foundation Trust  
Stephen Goundry-Smith - Royal Pharmaceutical Society  
Steven Marks - NHS Digital  
Stuart Richardson - Whittington Health NHS Trust  
Thomas Harris - City Hospitals Sunderland  
Tom Skelland - St George's Healthcare NHS Trust  
Vinodh Kumar - St George's Healthcare NHS Trust  
Zainab Hussain - Lewisham and Greenwich NHS Trust*

**This document has been published by the Global Digital Exemplar Learning  
Networks Team, part of *TheAHSN*Network**