Investigating the challenges and opportunities for medicines management in an NHS field hospital during the COVID-19 pandemic

Jennifer de Val,[1] Gurjit Sohal,[1] Asif Sarwar,[1] Haseeb Ahmed,[1] Inderjit Singh,[1] Jamie J Coleman [1,2]

[1]Pharmacy Department, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK
[2]School of Medicine, College of Medical and Dental Sciences, University of Birmingham, Birmingham, UK

Correspondence to
Prof Jamie J Coleman, Pharmacy Department, University Hospitals Birmingham NHS Foundation Trust, Birmingham B15 2QH, UK; jamie.coleman@uhb.nhs.uk

Received 15 May 2020
Revised 10 June 2020
Accepted 14 July 2020
Published Online First 4 December 2020

EAHP Statement 4: Clinical Pharmacy Services.

To cite: de Val J, Sohal G, Sarwar A, *et al*. *Eur J Hosp Pharm* 2021;**28**:10–15.

ABSTRACT

Introduction Hospital admissions from COVID-19 initially increased rapidly within the UK. National Health Service (NHS) field hospitals are part of a capacity building response built at great scale and speed to respond to the anticipated increased demand the NHS faces during this time. NHS Nightingale Hospital Birmingham (NHB) is modelled to treat mild to moderate (non-critical care) COVID-19 disease, to provide step-down capacity for patients in recovery, or for palliating patients in the dying phase of their disease in the Midlands. Opportunities and challenges presented for optimal medicines management (MM) during the development of the NHB are investigated, and a framework developed to support future NHS field hospitals of this model.

Methods A team, comprised of an associate medical director, trust chief pharmacist and senior pharmacists iteratively developed a framework to convert the large non-hospital setting into a functioning NHS field hospital with standardised MM processes adjusted appropriately to cope with operational constraints in the pandemic situation. NHB has, because of its repurposing, both challenges and advantages affecting MM that influence development of the framework. Throughout implementation, a 7-week period between announcement and opening, there was continuous evaluation, external stakeholder validation and peer review.

Results The PESTLE model, a mechanism of analysis to identify elements of a project environment (Political, Environmental, Social, Technological, Legal and Economic), was applied to identify influencing factors and support detailed project planning. Compliance with medicines legislation was at the forefront of all MM process development for the NHB field hospital. Internal factors were identified by the core MM team, resulting in a workforce, education & training and clinical pharmacy MM plan.

Discussion MM processes are extensive and integral to NHS field hospitals. The presented framework of influencing factors may support future NHS field hospital development. It is pertinent to have a broad team working approach to any large-scale project such as outlined here, and suggest the identified factors be used as a core framework for development of any future MM processes in NHS field hospitals.

INTRODUCTION

Across the world, countries have taken unprecedented steps to manage the health threat to their populations from the SARS-CoV-2 pandemic.[1 2] The UK Government response has centred on 'Staying Home, Protecting the National Health Service (NHS) and Saving Lives'.[3] Hospital admissions from COVID-19 initially increased rapidly. The field hospitals (table 1) are part of a capacity building response built at great scale and speed to respond to the anticipated increased demand the NHS faces during this time.

NHS Nightingale Hospital Birmingham (NHB) is modelled to treat mild to moderate (non-critical care) COVID-19 disease, to provide step-down capacity for patients in recovery, or for palliating patients in the dying phase of their disease in the Midlands (box 1).

As with any hospital, medicines are an essential aspect of care delivery. Opportunities and challenges presented for optimal medicines management (MM) during the development of the NHB are investigated, and a framework developed to support future NHS field hospitals of this model.

METHODS

The National Exhibition Centre is a conference and hospitality centre located in the West Midlands. The West Midlands has a population of circa 5.9 million housing 14 acute NHS trusts with 23 individual hospital sites that will refer to NHB (feeder hospitals). The facility will not receive emergency admissions or direct referrals from primary care.

NHB has initial capacity for 596 inpatient beds, with ability to scale to 4500 beds. NHB has, because of its repurposing, both challenges and advantages affecting MM and influence development of the framework. The host organisation, University Hospitals Birmingham (UHB), one of the largest NHS trusts in England, treats more than 2.2 million people every year across its sites. UHB is a regional centre for cancer, trauma, renal dialysis, burns and plastics, and organ transplantation.[4]

An MM team, comprised of an associate medical director, trust chief pharmacist and senior pharmacists iteratively developed a framework to convert the large non-hospital setting into a functioning NHS field hospital with standardised MM processes adjusted appropriately to cope with operational constraints in the pandemic situation. A lead for clinical, governance, process management and procurement aspects of MM were quickly identified. Processes and internal and external influencing factors were identified and categorised. Throughout implementation, a 7-week period

Table 1 Field hospitals commissioned in the UK

Hospital	Site location	Current capacity (potential)	Announced	Officially opened
NHS Nightingale Hospital London	ExCeL London	500 (4000–5000)	24 March 2020	3 April 2020
NHS Nightingale Hospital Birmingham	National Exhibition Centre, Birmingham	596 (4500)	27 March 2020	16 April 2020
NHS Nightingale Hospital North West	Manchester Central Convention Complex	750	27 March 2020	17 April 2020
NHS Nightingale Hospital Yorkshire and the Humber	Harrogate Convention Centre	500	3 April 2020	21 April 2020
NHS Nightingale Hospital Bristol	University of the West of England, Bristol	300	3 April 2020	27 April 2020
NHS Nightingale Hospital North East	Sunderland International Innovation Centre in Sunderland	460	10 April 2020	5 May 2020
NHS Louisa Jordan Hospital (Scotland)	Scottish Events Campus (SEC) in Glasgow	300 (1036)	30 March 2020	30 April 2020
NHS Dragon's Heart Hospital (Wales)	Millennium Stadium in Cardiff	330 (2000)	27 March 2020	13 April 2000
Florence Nightingale Field Hospital	Europa Point, Gibraltar	300	11 March 2020	3 April 2020

between announcement and opening, there was continuous evaluation, external stakeholder validation and peer review.

RESULTS

External factors

The PESTLE model,[5] a mechanism of analysis to identify elements of a project environment (Political, Environmental, Social, Technological, Legal and Economic), was applied to identify external influencing factors and support detailed project planning (figure 1).

Political

The NHS has long-courted political interest; during the pandemic response, NHS performance is a key factor in the public's perception of government. During framework development, regional and national political factors were considered. Those directly impacting on the NHB MM framework include the speed and scalability with which processes needed to be implemented.

Environmental

Security of medicines storage, transportation and logistics were identified as priority processes. Other environmental factors such as size of the facility influenced decisions around clinical pharmacy processes, and how staff would move and interact around the facility. Communication strategies for clinical pharmacy teams, for example, a bleep system commonly used in most NHS hospitals were not available. This was also influenced by strict infection control measures required for a facility that was taking entirely COVID-19 patients. Baton phones to remain inside clinical areas assigned to clinical pharmacy team leaders and procurement liaison roles were implemented.

Box 1 Nightingale Hospital Birmingham objectives

- Reduce deaths in the Midlands region.
- Free capacity in acute providers, by consolidating general medical patients with COVID-19 into the Nightingale Hospital, to allow referring hospitals to maintain flow in and out of their surge capacity.
- Provide single specialty general medical level 0 and 1 care in the Nightingale Hospital.
- Allow intensive therapy unit (ITU) manpower and expertise resource to be concentrated within each hospital site where the acuity is highest.
- Provide hope.

Social

During COVID-19 pandemic, many social factors influenced the patient population and the usual treatment pathways. COVID-19 disease mainly affects elderly, multimorbid patients who have a wide set of healthcare needs. This translates to a requirement for appropriate complexity of MM. Usual communication with patients is challenged, as social distancing means that NHB required a no visiting policy. Given the multicultural demographics of the population, potential challenges about cultural and language barriers usually seen in our local populations are exacerbated by the lack of family to support or translate for patients. Social distancing and self-isolation rules required consideration around the discharge process and medicines on discharge.

Technological

The reliance of MM processes on digital solutions has developed remarkably in recent years within the NHS.[6] UHB as host trust has a complete electronic prescribing solution. The digital infrastructure at NHB relied on that in place prior to repurposing. Although the implementation of an electronic prescribing and medication administration system was considered, the facility was to use healthcare staff from across the region and the training challenges for quickly learning systems ruled out its use.

Stock management of medicines and labelling medicines for discharge required technological support, and selection of the appropriate solution was based on ease of implementation and availability of ongoing pharmacy information technological support.

Legal

Compliance with medicines legislation was at the forefront of all MM process development for the NHB field hospital. Patient safety, public protection and the safety of all staff on site at NHB is paramount.

The need to register the premises as a retail pharmacy premises with the General Pharmaceutical Council was considered but as NHB only provides medicines to its own inpatients this was not deemed necessary.

The Misuse of Drugs (Safe Custody) Regulations 1973 does not apply to NHS trusts.[7] However, as their purpose is to protect patients, staff and wider public, there is a commitment that appropriate secure storage and supervision arrangements would be established. A working assumption that NHB is a 'secure' facility with controlled access that was agreed with the chief pharmacist, site and host trust security leads. Designated secure

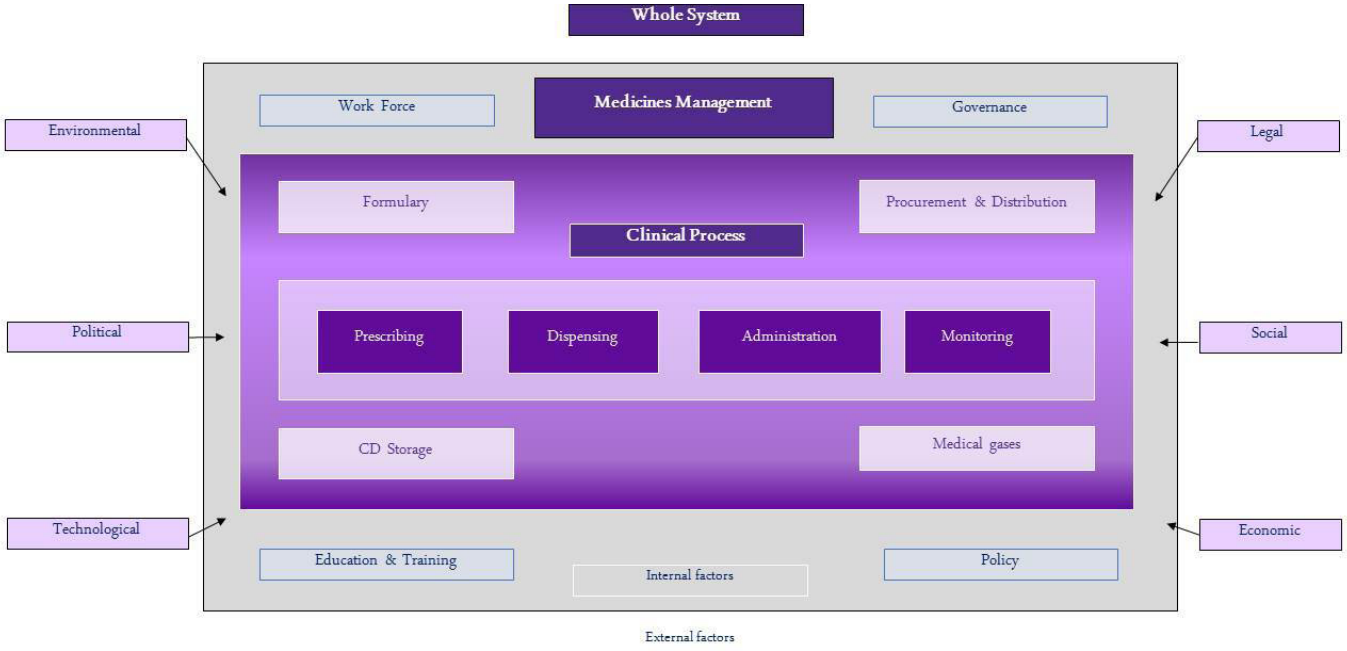

Figure 1 Field hospital medicines management processes and influencing factors.

areas were identified within the NHB for the storage of medicines, with appropriate access controls.

The Misuse of Drugs Regulations 2001[8] and Controlled Drugs (Supervision of Management and Use) Regulations[9] apply in their entirety to NHB. These support the safe use of controlled drugs (CDs) (of all schedules) in health settings. UHB is a 'designated body' under the regulations. The chief pharmacist is the controlled drugs accountable officer (CDAO) to discharge the statutory functions appointed under the 2013 Regulations. The chief pharmacist also holds the role of CDAO for NHB delegating the operational requirements of this function through the clinical lead pharmacist on-site. The use of CDs (and all medicines) will be monitored, through trends, centrally by the pharmacy at the Nightingale site. Unexpected variation will be investigated through the established host trust process.

Economic

NHB was commissioned by NHS England/NHS improvement, and budgetary factors were managed centrally.

Internal factors

Internal factors were identified by the core MM team.

Workforce

MM processes had to be contextualised to the availability and capability of workforce available for deployment. An ever-expanding group of professional and non-registered staff interact with medicines as part of care delivery, and this was highlighted in the range of volunteer staff to support NHB. Much consideration had to be given to the development of guidance and procedural documents to support practice. The wide competence base also required a 'lowest common denominator' approach to proposed medicines prescribing, administration and supply processes.

Patient care activity would be 24/7 at NHB, but patient transfers in from other hospital providers were planned between 08:00 and 22:00 hours; therefore, it was agreed that the clinical pharmacy service would initially run on a 08:00-20:00 model, with consideration of expansion to a 06:00-23:00 model at a later established phase.

An NHB corporate induction was developed and overseen by the associate medical director. As part of this corporate induction, an e-learning package (Massive Open Online Course) was produced containing an MM module developed in conjunction with education and pharmacy teams. This focused on the basic tenets of safe medication practice in a hospital setting to ensure minimum baseline knowledge in all volunteer staff. In addition, the NHB pharmacy team also hosted a webinar for volunteer pharmacy staff, allowing time to go through the proposed pharmacy service.

Governance

A *de minimis* approach was pursued to regulation and governance. It was agreed at the outset that the host trust medicines policies apply, unless exceptions were agreed. Deviations may be requested by the clinical pharmacy lead on-site in discussion with the host trust chief pharmacist and approved through established trust processes.

An MM risk register was held and, in addition, a decision log documenting key practice decisions.

Policy

Trust approval processes were already modified for fast mobilisation of guidance and policy in the pandemic period. A COVID-19 Medical and Scientific Advisory Group (MSAG) was established by UHB to ensure rapid approval of required guidance and overseeing its publication.

A 'Medicines Management - Temporary changes to practice during COVID-19 pandemic response' policy document holds exceptions to any agreed trust medicines procedures.[10]

Clinical guideline modification was undertaken quickly to ensure appropriateness for patients and staff at NHB, examples including the use of intermittent subcutaneous use of anticipatory medicines (via a butterfly device) which may be needed due to a shortage of syringe drivers, reduction in the use of variable rate intravenous infusions and changes to management of

delirium. Close working between MSAG and pharmacy teams ensured availability of appropriate medicines.

An 'UHB Coronavirus staff microsite', available on all digital interfaces, improved accessibility for volunteer staff to procedural and guideline information (www.uhb.nhs.uk/coronavirus-staff).

Clinical MM processes

Prescribing

As previously described, the host trust has a complete electronic prescribing solution, known as PICS (Prescribing, Information and Communication System). At the NHB, PICS carried a training burden that was considered incompatible with the speed and scale of induction processes.

A paper prescription chart was designed by the MM team which highlighted pre-printed venous thromboembolism prophylaxis, insulin, intravenous fluids and oxygen prescription and administration sections to reduce prescribing errors. The prescription chart also comprised a section to allow for medication history to be recorded, and notes on medicines reconciliation to be shared. A communication section on the charts' front supported documentation of pharmaceutical interventions needed. A supplementary end-of-life prescription chart for multiconstituent parenteral administration was also constructed.

Paper charting carried the risk of less clinical decision support. Therefore, staff induction included orientation to the prescription chart to increase familiarity. Particular consideration for the lack of allergy decision support required action and visually catching bedside allergy posters clearly identified patients with allergies. Patient allergies and time-critical medicines were also components on the patient safety huddle checklist undertaken by multidisciplinary teams daily at NHB.

Paper-prescribing processes impact on logistical factors and maintenance of paper and supplementary charts was factored into the daily pharmacy team activity.

All host trust clinical guidelines to support prescribing were available. Pharmacists will undertake a structured, critical examination of a patient's medicines to optimise clinical benefit, minimise medication-related problems and reduce waste. This includes reviewing admission reason, medicines reconciliation, prescription checks for accuracy and appropriateness, drug interaction checks and appropriate ordering and maintenance of drug supplies.

Dispensing

Patients cared for at NHB could be prescribed and administered to from an agreed range of medicines that are usually available in the hospital setting. An appropriate stocklist taking into account the anticipated patient cohort was agreed. Medicines and fluids required were accessible in drug rooms and clean utilities located in each clinical area, with bulk fluid storage located in the clinical halls. Medication trolleys were made available in defined 'ward' areas within halls, to improve speed of access. Furthermore, identified medicines, where prompt administration would be a clinical priority (eg, treatment of hypoglycaemia, medicines to keep patients comfortable during palliation), were signposted clearly within the clinical areas. An emergency drug cupboard stocklist was created for urgent or critical medicines that may be required but did not need to be held in large quantities.

'Feeder Hospitals' were encouraged to send patients with medications if possible to minimise delayed or omitted doses. However, given that the facility was to relieve capacity during a surge situation, this was not deemed critical such that it should not delay patient transfer to NHB.

Medications stocked in drug rooms and medicines trolleys were not required to be booked out to a specific patient as supply is taken. Stock will be monitored and maintained by the pharmacy team.

Patients who were transferred with medication would be provided with a green wristband, to identify the presence of medication in their bedside locker.

As a patient is identified as fit for discharge, they will be provided with a discharge letter. Patients not returning to their referring hospital would also be provided with a supply of discharge medication (To Take Out - TTO).

A specific NHB discharge letter was produced. This included a statement for general practitioners to advise changes to regular medications that may have been made as a result of restricted availability and/or clinical reasons. All changes in medications needed to be reviewed and a clinical decision made about whether to continue, revert to preadmission regimen or discontinue postdischarge from NHB.

The computerised pharmacy system JAC was implemented to produce dispensing labels at the point of discharge only, when a prepacked medication is not suitable. JAC and labellers were set up in clinical halls, and in the pharmacy office adjacent, where supplementary labels and sundries were stored. If there is a new medication which the pharmacist deemed required counselling, this would occur at the point of discharge. Blister packs on discharge were not routinely available at NHB, but arranged via host trust resources if alternative provisions were not available.

Administration

Medicines must be administered in line with the host trust medicines code-approved processes. Pharmacists and pharmacy technicians were available to support staff administering medication. Out of hours an on-call pharmacy service was available for urgent advice.

A reference guide for nurses was prepared outlining how to reconstitute commonly used intravenous antibiotics. A Medicines Information Resources reference was prepared by the host trust medicines information department, providing usernames and passwords for Handbook of Drug Administration via Enteral Feeding Tubes (The NEWT Guidelines), COVID-19 Drug Administration and many others, to help facilitate safe administration of medications.

To facilitate timely administration of medicines, after consultation with nursing management, second check requirements for intravenous drug preparation were modified at NHB. It was agreed that injectable medications administered via a bolus may be given by a single practitioner without the need for a second independent check; however, the following exceptions requiring second independent check were agreed: cytotoxic or chemotherapeutic medications, CDs, and medicines added to fluid for administration via an infusion. A second check should also be considered when: administering an unfamiliar medicine; complicated calculations are involved, for example, weight-related doses, variable administration rates, changes between units of measurements and where medicines are mixed.

The host trust list of medicines that should not be omitted or delayed was adopted and shared as part of the NHB operational model.

Monitoring

As the MM model evolved, monitoring laboratory tests, assessing patients for therapeutic outcomes and adverse events would be pivotal. Full chemical pathology and haematology facilities were

available at one of the host trust's local hospital sites for rapid turnaround of blood tests as required.

Clinical trials

No clinical trials were agreed to be directly run from the NHB. However, if any patients admitted were under an active clinical trial this would be continued, with host trust clinical trial procedures to be followed, clearly documenting that the patient is on a clinical trial.

Logistical MM processes

Formulary

To rationalise the use of medicines during this resource limited time, a protocol was developed to support deprescribing (to stop, temporarily or otherwise as agreed with doctor, medicines which were not needed during the patients stay at NHB) and therapeutic switches (to temporarily switch medicines to a suitably identified complementary medicine within same class, or appropriate therapeutic equivalence). This supported prescribers and pharmacists in the identification of medicines to be switched or stopped at the NHB for patients with COVID-19, limiting the amount of drugs that would be stocked.

NHB, designed for General Medicine COVID-19-positive patients (as opposed to a critical care), requires a broad range of medicines. Negotiating and liaising with the procurement team and wholesaler key account holders early was crucial to ensuring the quantities and range of medications could be procured in a timely manner.

Controlled drugs

To facilitate the timely ordering of CDs during a time of staff shortages and regular movement of staff, an electronic CD ordering process was implemented across the host trust, which applied to NHB. A risk assessment was undertaken. At NHB, the clinical pharmacy team undertook responsibility for daily CD checks and ordering to minimise the number of staff involved. All CDs will be ordered via the host trust, with NHB responding to verification request calls to ensure appropriate security of supply of CDs.

The safe custody of CDs was adhered to with cupboards and locks.

CD process maps were developed to help healthcare staff navigate the less familiar hospital processes: administering a dose of a CD in the initial or established phase, handling of a prepared CD dose no longer required, discharge prescription needed with a CD, ordering CDs (stock control) in the initial or established phase and CD Waste (pharmacy): expired/obsolete.

Medical gases

Given the nature of COVID-19 disease, the provision and management of oxygen and other medical gases was of paramount importance. Close working between host trust estates, facilities and pharmacy teams was established. Installation of piped oxygen and medical air supply was managed and completed as part of the hospital build. Strain on piped oxygen capacity in hospitals has been an early hallmark of the COVID-19 pandemic,[11] and so emphasis made on preservation of oxygen supply. Prevention of oxygen wasting, by increased vigilance of turning off oxygen supply when not in use was prioritised in staff training and by use of visual prompts at the point of oxygen supply, with specifically designed stickers.

Early decisions were taken that wherever possible, patients reliant on oxygen would remain in their bed space and attached to piped oxygen supply, and any imaging or investigation would be mobilised to their bed space to minimise the need for cylinder oxygen supply on-site.

Portable oxygen cylinders were procured for resuscitation trolleys, which were situated appropriately throughout the facility (including non-ward areas). Given the variation in staff backgrounds, a decision was taken to ensure the one-touch cylinders were available, to minimise any risk of incidents, as outlined in a recent patient safety alert.[12] Portable oxygen cylinders were also available in each clinical hall as they may also be used in evacuation scenarios for patients dependent on oxygen.

Although the risk of piped gas supply disruption was negligible due to the design implemented, consideration needed to be given to continuity planning if this unforeseen event did occur. A contingency of larger J size oxygen cylinders with regulators and trolleys needed to mobilise these if required were also procured. Procedures were mapped for the mobilisation of these cylinders if needed, which required a combination of facilities and estates staff.

As part of the building design, a medical gas store was included. This acted as the cylinder delivery point, and housed cylinders with segregated storage for empty and full cylinders.

DISCUSSION

Reflecting on the pace and scale of the NHB development, it is clear that MM processes are extensive and integral to NHS field hospitals. The presented framework of influencing factors may support future NHS field hospital development, but must be considered in the context of any agreed care models.

The NHB has officially opened and is operationally ready, however to date has not been required to accept patients. This is testament to the undertaking of the public to adhere to government advice regarding social distancing, in addition to huge efforts within the NHS to reimagine and reprioritise care. While the MM processes outlined in this article have not been tested in the live system, multiple 'go/no-go' decision-making simulations were carried out and confidence in the systems is high.

We would commend a broad team-working approach to any large-scale project such as outlined here, and suggest the

Key messagesWhat is already known on this subject

- Mobilisation of National Health Service (NHS) field hospitals has not been undertaken before as part of a pandemic response and therefore UK medicines legislation and governance frameworks have not been tested in this context.
- Responding to COVID-19 is a global priority and it is important that reducing medication harm is considered alongside this. In the context of NHS field hospitals, with disparate professional groups being trained at pace, risk reduction strategies for medication processes must be identified.

What this study adds

- Through a focus on patient pathways and a methodical, multidisciplinary approach to identify system factors, a framework was produced for safer medicines management applicable to any setting.
- Iterative process design using the multidisciplinary team enhances adoption of new medicines governance and clinical processes
- There is not an 'off-the-shelf' pandemic NHS field hospital medicines management model and we recommend this is developed with a collaborative approach from all NHS field hospitals.

identified factors be used as a core framework for development of any future MM processes in NHS field hospitals.

Twitter Jamie J Coleman @colemajj

Contributors JJC, JdV and GS conceived the idea for this article. All authors contributed to the development of the processes described. JdV and GS drafted the initial manuscript to which all authors revised and approved the final version.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; internally peer reviewed.

Data availability statement No data are available. N/A.

ORCID iD
Jamie J Coleman http://orcid.org/0000-0002-7512-5153

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