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Clinical Senate

Establishing the evidence base for 'multiple site single service' (MSSS) models of care

Systematic review

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Executive summary

Clinical service reconfiguration is complex and driven by multiple factors, including clinical quality, finance, workforce and inequalities in access.

Models of care which deliver a single clinical service over multiple hospital sites, theoretically offer the potential to maintain geographical access to services whilst delivering care, finance and workforce outcomes.

There is currently no systematic overview of the evidence in relation to these models of care.

This systematic review is the first to describe the evidence base for multiple site, single service (MSSS) models of care and highlight the current limitations of available research.

A universal framework to categorise different MSSS models which may be employed in the reorganisation of secondary care services.

A suggested set of outcome measures to guide planning, implementation and evaluation of future clinical service reconfigurations to better understand the population impact of service change.

Introduction

There is wide recognition both internationally and nationally in England that the population health challenges facing future generations require health systems to reconfigure the way primary and secondary care services are delivered to patients¹. Service reconfiguration is always complex and often high profile and political, particularly where it is perceived that a certain population group may be disadvantaged by such change^{2, 3}. In England, the National Health Service (NHS) has a lengthy assurance process aimed at ensuring service reconfiguration is safe and effective⁴. Part of this process involves obtaining independent clinical advice on proposals for service change and this role is fulfilled through 12 Clinical Senates established in 2013, which comprise a range of clinical specialists⁵.

A preliminary review of completed Clinical Senate assessments found that more than half of service change proposals contained some elements of what we have termed for the purpose of this research a 'multiple site, single service' (MSSS) model. These models describe a method of delivering care across more than one clinical site or location, often across a regional geography, via a single clinical service or team. Frequently, these models are proposed to avoid full 'consolidation' or 'centralisation' of services which, as previously highlighted, can be particularly high profile, politically contentious and can result in access inequalities for hard to reach parts of the population.

However, there is no summary of the evidence base for these models of care or guidance available to inform the decision regarding their adoption and implementation. This is a significant evidence gap facing commissioners and providers redesigning clinical services. Recent reviews in the East Midlands⁶, London^{7, 8} and Yorkshire and the Humber⁹ highlighted the challenge of evaluating these models which are often at odds with national service specifications and/or clinical evidence.

This scoping review therefore aims to address the following three research questions:

1. Is there a common definition for what constitutes a MSSS model of care?
2. What is the effect of these models on clinical outcomes and patient experience?
3. What are the barriers and enablers to implementing MSSS models of care?

Methods

Literature search and study selection

A Clinical Working Group (CWG) was formed with members drawn from the East Midlands Clinical Senate Council. The group included a wide range of clinical expertise alongside patient representation. The CWG held 2 teleconferences to develop the research questions and corresponding Population Intervention Comparator Outcome (PICO) template which formed the basis of the search strategy (Appendix A).

Two authors (PL and MD) designed the search strategy to enhance sensitivity. Three medical databases were selected to search: CINAHL, MEDLINE and EMBASE. Two management databases (HMIC and HBE) and one for social science research (Social P&P) were also searched.

An initial scoping search was conducted to look for possible keywords and free text terms, which were then matched to their Medical Subject Headings (MeSH) on Medline. These were then discussed by the CWG and the final list of terms agreed.

The search strategy devised was based on 4 key concepts. The first related to the *model of care*; terms used included 'clinical network', 'cross-site working', and 'integrated service', among others. The second set of key terms isolated papers *involving secondary care services* which was agreed as the focus of this review by the Clinical Working Group. The third ensured the results were limited to studies published from *OECD countries* to ensure the healthcare systems were drawn from an internationally recognised grouping of developed countries where comparisons with the United Kingdom's NHS could be made. The final set of terms related to possible *reported outcomes*, including 'access', 'patient experience' and 'quality'. The full search strategy is included in Appendix B.

Study selection was completed by 2 authors (DB and MD), with disagreements about inclusion being resolved by consensus, with referral to a third reviewer (BP) if this could not be achieved.

All study types were considered for inclusion if they were published in a peer-reviewed journal and related to health services based in OECD countries. Given the nature of the review topic, studies were only included if their focus was the delivery of a single clinical service working across multiple hospital or provider sites or geographic locations or whose focus was an established model of service delivery.

Studies were excluded if they were published before 2013, prior to the main policy drivers for MSSS models being introduced in the UK. Studies were also excluded if they were not published in English.

Quality assessment

Quality assessment of included studies were completed by 8 authors (DB, MD, EI, RP, BP, RW, SM, CG) and collated by 2 authors (DB and MD).

The Public Health Ontario Meta-tool for Quality Appraisal of Public Health Evidence (MetaQAT) was used as a quality assessment tool¹⁰. This was chosen due to its successful validation for use in mixed-methods systematic reviews.

No study was excluded on the basis of the quality assessment, although the limitations of available evidence and potential for bias were taken account of in synthesis and interpretation of findings.

Data extraction and synthesis

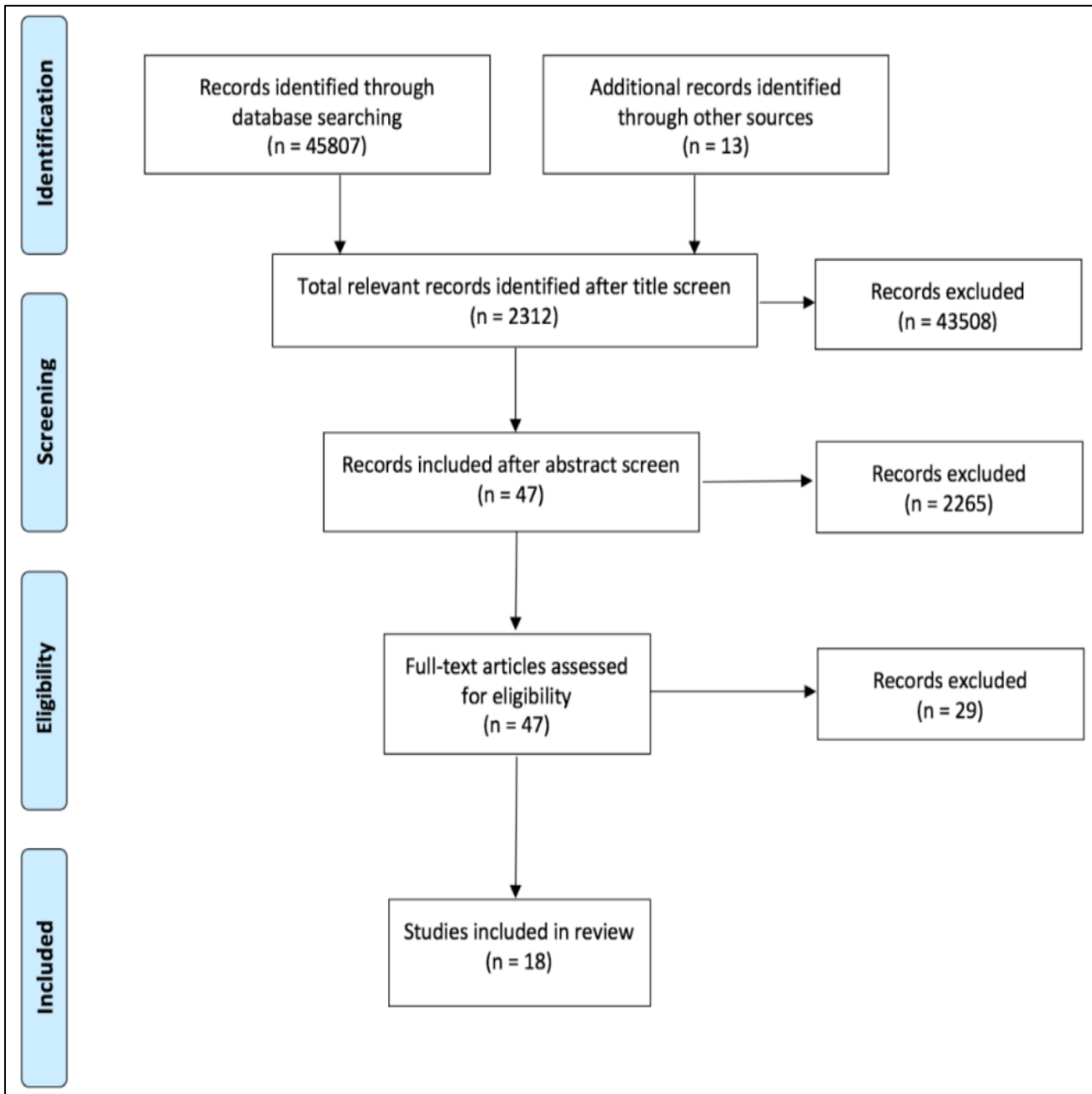
Data was extracted by 2 authors (DB and MD) using a standardised data extraction form.

An integrated methodology was used to collate study findings and allow the results of quantitative and qualitative studies to be synthesised¹¹. This approach was chosen due to the significant heterogeneity in the identified studies, particularly in relation to methodology and reported outcomes. For this reason, statistical analysis (including meta-analysis) was not feasible or appropriate.

A thematic analysis was conducted to identify common elements between studies. The findings and reported outcomes of all included studies were then organised using identified themes as subject headings to allow a narrative synthesis to be completed. Emerging themes were discussed between the lead authors and the wider Clinical Working Group.

The below PRISMA diagram outlines the screening process.

Figure 1. PRISMA Diagram of Screening Process



Results

Study inclusion and study characteristics

After screening by title and abstract, the full texts of 47 studies were reviewed to determine eligibility. After applying the inclusion and exclusion criteria, 18 studies were included in the review. A full list of included studies is in Appendix C.

The search and screening process produced a mix of empirical studies (n=16) and descriptive or expert opinion articles (n=2). As per the agreed inclusion criteria, all were included for analysis. Most studies (n=11) reported on service reorganisation undertaken in the UK. The other research identified originated in Australia (n=3), Canada (n=1), the United States (n=1), New Zealand (n=1) and Sweden (n=1). No study reported on a service change or delivery taking place prior to 2000, with the majority reporting service change from 2010 onwards (n=10).

The studies referenced a range of different clinical services, with Stroke Medicine (n=4) being the most commonly reported, followed by Surgery (n=4), Cardiology (n=2) and Oncology (n=2). In 4 studies, models of care were discussed without reference to an individual specialty, either because the service delivery cut across numerous different specialties or findings were presented without reference to a particular clinical service (eg qualitative research exploring views of hospital administrators).

There is significant variation in the methodology of the included empirical studies. Many different study types are represented, with the most frequently reported being cohort (n=4) and mixed methods (n=4).

The study period also varied significantly; a retrospective data analysis of 9 years of clinical records was the longest included. Most quantitative studies reported more than 12 months of outcome data following a service change, whilst data from the qualitative studies were collected over a shorter time period.

Description of service reorganisation

This review was prompted by the lack of common definition for MSSS models of care. The included studies that described a service design in detail allowed common factors to be explored and thematic analysis to be undertaken.

Table 1 describes the results of this analysis and outlines the distinct models identified and the variation between them, ordered by a progressive increase in the level of centralisation.

Table 1. Description of models of care identified in literature

Model	Description of Model of Care	Examples of clinical service delivery	References
A	Model has strong central coordination, clear evidence of shared governance arrangements and agreed protocols for pathways across multiple clinical sites	Cancer Screening; Paediatrics	Villanueva et al ¹² ; Kash et al ¹³
B	Model in which all sites provide a defined level of treatment, but some aspects of care are restricted to a smaller number of sites at certain times (eg night or weekend provision)	Stroke services	Agarwal et al ¹⁴
C	Model has a tertiary centre providing specialist care, but 'feeder' sites offer a standardised level of triage, diagnostics and clinical management before patient transfer	Cardiology; Organ Transplantation; Abdominal (AAA) Surgery	Stub et al ¹⁵ ; Tai et al ¹⁶ ; Tideman et al ¹⁷ ; Proctor et al ¹⁸
D	Model involves clinicians from a specialist centre travelling to other clinical sites to offer some element of peer support, clinical advice and/or patient care	Paediatric Surgery; General Medicine (Rural Outreach)	Quinn et al ¹⁹ ; O'Sullivan et al ²⁰
E	Model in which all specialist care is provided at tertiary centre, accepting patient referrals from 'feeder' sites in a defined geographical area	Paediatric Surgery; Stroke Services	Taylor et al ²¹ ; Balinskaite et al ²²

Reported Patient Outcomes

Among the included studies that report quantitative data relating to patient care, there was some variation in the clinical outcome measures used. There was also variation in how studies reported outcome data. Some studies used registry or published data to use as a 'control' or comparator (see Agarwal et al¹⁴; Quinn et al¹⁹; Stub et al¹⁵), whilst others used a before/after analysis (see Balinskaite et al²²; Moynihan et al²³; Tideman et al¹⁷). A small number compared data from specialist centre and feeder hospitals to assess the effectiveness of clinical support and treatment pathways (see Proctor et al¹⁸; Tai et al¹⁶).

Tables 2 and 3 summarise the results related to mortality and patient experience measures. The descriptions of service change refer to the models of care outlined in Table 1.

Mortality

The most frequently reported patient measure was 30-day mortality. No study reported increased patient mortality after service reorganisation. Most studies found no statistically significant difference in mortality rates either between specialist centre and feeder hospital, or pre- and post-service reorganisation (see Agarwal et al¹⁴; Balinskaite et al²²; Proctor et al¹⁸; Stub et al¹⁵; Tai et al¹⁶). This led many authors to conclude that the MSSS model of care introduced was safe. Tideman et al¹⁷, whose study examined the effect of a clinical cardiac support network on patient mortality showed a 22% relative risk reduction in mortality between patients treated in a rural network hospital vs. a rural non-network hospital. Additionally, the authors found a statistically significant improved mortality in specialist centres ('hubs') compared to rural network hospitals (Odds Ratio (OR) 1.46, CI 1.33-1.60).

Other patient outcomes

Other service-specific outcome measures were also occasionally reported. Moynihan et al²³ found centralising acute stroke care to a small number of regional specialist centres improved thrombolysis rates by more than 10% (a measure of statistical significance was not provided).

Some studies measured the occurrence of adverse events. Quinn et al¹⁹ reported no increase of recurrence or atrophy when orchidopexy or inguinal herniotomy were performed by upskilled, networked general surgeons compared to specialist centre paediatric surgeons.

Likewise, Stub et al¹⁵ found no increased rate of complications or adverse events amongst patients having trans-catheter aortic valve replacement (TAVI) in a network hospital compared to the previous specialist centre.

Tai et al¹⁶ found that patients triaged and assessed at a 'feeder' hospital were more likely to be listed for transplant at the specialist centre despite no evidence of a difference in case mix (139/180 vs 312/475, P 0.005). The study also found that the MSSS model of care increased overall transplant activity. The authors found this was confirmatory evidence of the model's ability to increase access to a specialised service.

Proctor et al¹⁸ found no difference in mortality between patients undergoing regional transfer for ruptured abdominal aortic aneurysm, but did find increased postoperative morbidity among patients who were transferred, which the authors ascribed to differences in preoperative management between 'feeder' hospitals and the specialist centre (complications seen in 35.9% of specialist centre patients vs 78.6% of feeder unit 1 patients and 70% of feeder unit 2 patients, P=0.006 and P=0.02 respectively).

Table 2. Reported mortality outcomes identified in literature

Study	Clinical service	Description of service change	Outcome reported	Summary of finding
Agarwal et al ¹⁴	Stroke (Telestroke)	Model E → Model B	8.1% in-hospital mortality in thrombolysis group, 7.4% in-hospital mortality in non-thrombolysis group (p=0.78)	No statistically significant difference between patients receiving thrombolysis via MSSS model of care and those not receiving thrombolysis. "No cases of in-hospital mortality occurred due to haemorrhage, indicating safety of the approach"
Balinskaite et al ²²	Stroke	Separate clinical services → Model E	In the intervention area, the weekend/weekday 7-day in-hospital mortality relative risk in 2008 was 1.28 (95% CI 1.09 to 1.47), which declined to 1.09 (95% CI 0.91 to 1.32) in 2014. For the rest of England, the weekend/weekday 7-day in-hospital mortality relative risk in 2008 was 1.15 (95% CI 1.09 to 1.22), which declined to 1.03 (95% CI 0.97 to 1.10) in 2014. In the intervention area, the weekend/weekday 30-day in-hospital mortality relative risk in 2008 was 1.12 (95% CI 1.00 to 1.26), which slightly increased to 1.14 (95% CI 1.00 to 1.30) in 2014. In the rest of England, the	No statistically significant difference in 7-day or 30-day mortality rates were seen after the reorganisation of care and introduction of a new model of care.

			weekend/weekday 30-day in-hospital mortality relative risk in 2008 was 1.11 (95% CI 1.07 to 1.15), which declined to 1.04 (95% CI 0.99 to 1.09) in 2014.	
Proctor et al ¹⁸	Abdominal (AAA) Surgery	Model C	30-day mortality rates were 27.7% in patients presenting directly to the tertiary centre, and 35.5% (Site 1) and 30.0% (Site 2) for patients presenting to feeder hospital sites before being transferred. There was no significant difference between mortality in the tertiary centre and Site 1 (P = 0.44, Z-test) or the tertiary centre and Site 2 (P = 0.68, Z-test) or the 2 feeder units (P = 0.72, Z-test).	There was no statistical difference in mortality between patients presenting directly to tertiary centre and those presenting to feeder sites.
Stub et al ¹⁵	Cardiology (TAVI)	Model C	The 30-day all-cause mortality was 3.5% for patients treated via the MSSS model of care. All-cause in-hospital mortality occurred in 3.1%.	This mortality rate compares favourably to international trial and registry data for TAVI.
Tai et al ¹⁶	Transplant Surgery	Model E → Model C	Patient survival post-transplant was similar between the smaller clinical sites and the specialist centre at 1 year (94/99 vs 192/202 p=0.78) and 3 years (92/99 vs 186/202 p=0.78).	No statistically significant difference between 1- and 3- year mortality between sites delivered as part of a MSSS model.
Taylor et al ²¹	Paediatric Surgery	Model E	At 2 years, 63% of patients survived transplant-free following surgery at the group of specialist centres (described	The authors conclude that local clinical networks need to be improved to improve clinical outcomes across

			as Group A centres in study). The authors compare this to historical data from previously regionally designated units (65% of patients alive transplant-free at 2 years).	the pathway prior to specialist intervention.
Tideman et al ¹⁷	Cardiology	Separate clinical services → Model C	<p>30-day mortality was lower among patients presenting to hospitals integrated into the MSSS model (rural before, 337/ 2419 [13.9%] v rural after, 368/3211 [11.5%] v metropolitan, 2140/23 993 [8.9%]; P < 0.001).</p> <p>After adjusting for baseline comorbidities and MI characteristics, presentation to an MSSS hospital was associated with a 22% relative odds reduction in the risk of 30-day mortality (OR risk-adj 0.78 [95% CI, 0.65–0.93]; P = 0.007) compared with other rural centres, although these patients remained at increased risk of 30-day mortality compared with patients presenting to metropolitan hospitals (OR risk-adj 1.57 [95% CI, 1.38–1.79]; P < 0.001).</p>	Delivery of cardiac care via the MSSS model closed the gap in mortality between rural and metropolitan patients in South Australia.

Reported impact on patient experience

Four studies reported data related to patient satisfaction with MSSS models of care, the results of which are included in Table 3. The majority used surveys or questionnaires to capture this information (Grigg et al²⁴; Moynihan et al²³; Svederud et al²⁵), with only one study gathering information during clinic review (Tai et al¹⁶).

Grigg et al²⁴ used postal and online surveys (6 weeks and 6 months after birth) to explore women's experiences of transfer from a 'feeder' hospital to a specialist centre for maternity care. The authors concluded that the most important factors to patients were a sense of control, communication, and relational continuity of care (ie cared for by a familiar midwife or clinician). The majority of women were not negatively impacted by the transfer, and those that were, were unhappy about the change to a prior agreed birth plan, rather than the transfer itself.

In a similar way, Moynihan et al²³ reported the findings of patient and carer questionnaire designed to capture the experience of being transferred to a Specialist Stroke Centre, particularly asking about the route of admission, communication, ease of visiting and repatriation. 90% of patients were happy with the transfer and only 11% felt it negatively affected the outcome of their care.

Svederud et al²⁵ conducted 20 interviews with patient representatives and collated 561 survey responses to identify patient attitudes to specialist centre provision and the impact of transfer from local 'feeder' hospitals. The most important aspects of care were reported to be the quality of care provided (98%), continuity of treatment (90%), and a well-functioning care pathway (83%). Also important to patients were an individualised care plan (79%), accessibility of information (72%), involvement in the care process (66%) and waiting time (66%). Interestingly, the least important aspect of the care was reported to be the geographical location of its delivery (49%).

Whilst Tai et al¹⁶ found patient satisfaction with a MSSS care model to be high, there was a difference in opinion between patients cared for in a smaller network hospital, compared to patients cared for at the specialist centre. The overwhelming majority of patients treated in the network hospitals felt the service they received was safe (98%) and the ability to be cared for by a familiar clinician was also highly valued (87%). Whilst patients treated in the specialist centre also reported very high satisfaction levels with their care, they had a lack of confidence in the quality of care delivered in their local network hospital. This perhaps suggests patients do perceive care to be of better quality in specialist centres prior to their direct experience of a local networked site.

Table 3. Reported patient experience outcomes identified in literature

Study	Country of Origin	Clinical Service	Description of service	Method	Outcome Reported	Summary of Finding
Grigg et al ²⁴	New Zealand	Obstetrics	Model C	<p>Patient surveys (postal and online) completed 6 weeks and 6 months after birth</p> <p>407 study participants planned to give birth in a smaller 'satellite' unit on entry into the study. 238 women experienced any type of change of plan or transfer, 174 of which responded to survey questions</p>	<p>39% rated themselves on a Likert scale as unhappy (combined 'very unhappy' or 'unhappy') about the decision to change birthplace, regardless of when the decision was made</p> <p>A similar proportion of women were neutral about the decision (38%)</p> <p>The proportion who rated themselves 'it did not bother me at all' for change antenatally, pre-admission in labour or post-admission in labour were 34%, 42% and 52% respectively</p> <p>Despite not wanting or planning to change birthplace overall 22 % of respondents reported being happy with the decision</p> <p>The themes of control, communication and 'my midwife' (interpreted as relational continuity of care) were identified as key themes identified as contributors to women's positive birth experiences</p>	<p>Change in birth plan due to tertiary centre transfer was negatively experienced by approximately a third of study participants. The authors note that most of those patients were unhappy about the change to the agreed birth plan, rather than the transfer itself</p> <p>Themes identified reflect the key dimensions of 'patient-centred care': control, participation in decision making, support and information</p>

<p>Moynihan et al²³</p>	<p>UK</p>	<p>Stroke Services</p>	<p>Separate clinical services → Model E</p>	<p>Patient and carer experiences were evaluated using a modified Picker Questionnaire</p> <p>Separate questionnaires were used for patients discharged directly home from the specialist centre (429 admissions, 213 responses), those repatriated to local stroke recovery units (220 transfers, 100 responses), and for carers of patients admitted to the specialist centre (483 sent, 235 responses)</p>	<p>Of those patients discharged directly home, the vast majority (90%) were happy to be transferred to a more remote specialist centre, and their experience of care was excellent. Only a minority reported difficulties with access for visitors</p> <p>Patient's views were also positive in those discharged back to a local stroke unit, although levels of satisfaction were not as high as in those discharged directly home, probably influenced by the increased stroke severity in this group</p> <p>About half were happy to be admitted to the remote specialist centre, whereas a third did not mind</p> <p>There was some anxiety about repatriation back to their local stroke unit with approximately a quarter feeling anxious and patients requiring a few days to settle down in their new environment. However, only 6% reported a negative effect of the transfer on their outcome</p> <p>Only 1% of relatives were unhappy with care in a specialist centre.</p>	<p>Stroke care delivered following service reorganisation was associated with good levels of patient and carer satisfaction</p>
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					However, like patients, there was considerable concern about repatriation to the local unit with about a half of relatives showing anxiety. Despite this, only a minority (15%) felt the transfer had impacted negatively on outcome	
Svederud et al ²⁵	Sweden	Low volume, highly specialised services	Model E	A survey directed to members of patient associations (561 responses) and semi-structured interviews with patient association representatives and health care decision makers (n=20)	<p>The vast majority of the patient association members responded that quality of care (98%), continuity of treatment (90%), and a well-functioning care pathway (83%) were among the most important factors for them in relation to healthcare</p> <p>Individualised care-plan (79%), accessibility for contact or information (72%), patient involvement in the care process (66%) and waiting time (66%) were also reported to be among the factors of most importance by a majority of respondents</p> <p>The factors most commonly regarded as least important by the survey respondents were the organisation of health care (52%), costs and income loss (50%) and geographical location (49%)</p>	The results showed that from a patient perspective, quality of care in terms of treatment outcomes is the most important factor in decisions regarding centralisation of low volume, highly specialised health care
Tai et al ¹⁶	UK	Transplant surgery	Model E → Model C	Patient satisfaction was assessed at	Over 90% of patients managed at spoke centres felt there was good bilateral communication between	The new model of care delivered high patient satisfaction

				<p>routine post-operative clinic review in 73 (of 99) 'satellite' unit patients and 50 consecutive specialist centre patients</p> <p>These focused on patient perception of communication, safety, visibility on the waiting list and overall satisfaction</p>	<p>the satellite unit and specialist centre, 95% did not feel disadvantaged by having their pre- and post-transplant care managed away from the centre and 96% stated an appreciation for 'locally' delivered specialist care</p> <p>The main reasons for preferring 'local' specialist care were 'familiar hospital/doctor' (87%), 'proximity to home/travel time' (81%) and 'travel cost' (37%)</p> <p>Patient satisfaction with care received at the satellite unit was ranked at 9.4/10 (patient satisfaction with care at specialist centre also rated 9.4/10)</p> <p>In comparison to satellite unit patients, only 25% of hub patients stated they would have preferred 'locally' delivered pre- and post-transplant care (11/50 vs 70/73, P 0.0001), with loss of confidence in their local centre being cited as the main reason</p> <p>The reasons stated for a preference for 'local' care were travel time and cost (75%, 8/11) with only 27% (3/11) stating familiarity as a reason</p>	<p>across both satellite units and the specialist centre</p>
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Description of MSSS models of care drivers, enablers and barriers

Of the 6 studies which reported enablers and barriers, 4 reported on service change in the UK (see Fulop et al²⁶; Haire et al²⁷; Imison et al²⁸; Manley et al²⁹), whilst the other 2 studies were reporting on the experience of Australian (see O'Sullivan et al²⁰) and North American health systems (see Kash et al¹³). The themes identified in those studies are included in Table 4.

Imison et al²⁸ conducted a qualitative analysis of reports produced by the UK National Clinical Advisory Team (NCAT, forerunner to regional Clinical Senates) when assessing proposed service reorganisations. The 2 most significant drivers were found to be finance and workforce. Improving outcomes and patient safety were reported to be largely only secondary considerations. The exception to these findings was specialised services (commissioned by NHS England), where the main drivers for change were reported as Quality of Care and National Policy.

Both Manley et al²⁹ and Haire et al²⁷ report clinical leadership as the most important factor enabling complex system change. In addition, informatics, a culture of quality and service improvement and focus on patient experience were also found to be of significance in ensuring successful redesign of clinical services.

Fulop et al²⁶ conducted 125 semi-structured interviews with staff from management and service delivery and reviewed 653 documents relating to the adoption of 2 MSSS models of care. The authors found that a single launch of the service redesign (a 'Big Bang launch') was preferable to a phased implementation period to focus the energies of staff and provide clarity of design and purpose. They also found simple, more inclusive referral pathways were required for change to be effective and that setting the reorganisation in the context of targeted improvement in standards increased the capacity and motivation of staff to deliver change.

Kash et al¹³ also emphasise the importance of driving change with a clear communication of the culture and values of the organisation. This was important in ensuring any difference in values between staff and their departments was aligned, and staff had confidence to deliver change despite the associated risk. Strong leadership and good communication were also identified as important factors, as was the patient and staff engagement (particularly in reducing staff turnover and improving retention). Whilst this study provides a US-centric perspective on systems change, many of the factors identified are similar to those reported in UK-based studies.

O'Sullivan et al²⁰ report important factors relating to the success of MSSS models of care in rural Australia. Their conclusions are necessarily specific to the context of the Australian health system and geography, and highlight the differences in care provision between rural clinicians and metropolitan specialists. An identified challenge to this

method of delivering care is to ensure that outreach services focus on specialties that complement existing rural provision, and are not concentrated in a specific area, neglecting more rural communities.

Table 4. Reported drivers, enablers and barriers reported in literature

Theme identified	Studies identifying theme	Summary
Finance	Imison et al ²⁸	Review of previous NCAT assessments suggests that finance was the most frequently cited driver of reconfiguration, although this was rarely stated in the literature identified by this review
Workforce	Imison et al ²⁸ ; Manley et al ²⁹	Availability of clinical staff is a key driver of system change, and can be an important enabler/barrier An integrated career and competence framework was also identified as an important factor, allowing staff to be moved between community and hospital settings, as well as improving staff recruitment and retention
Governance	Kash et al ¹³ ; Villaneuva et al ¹²	Clear and explicit governance arrangements were identified as an important enabler of systems change
Quality of Care	Haire et al ²⁷ ; Imison et al ²⁸ ; Kash et al ¹³	Often an important driver of system change where evidence exists of improved outcomes (eg specialised services)
Clinical leadership	Fulop et al ²⁶ ; Haire et al ²⁷ ; Manley et al ²⁹	Clinical leadership identified as being very important to facilitate system change; "strong collective leadership demonstrated by clinicians who have a clear and ambitious view of how to provide high quality, patient-centred, integrated services and who are able to engage and motivate their colleagues and wider stakeholders" (Haire et al) It was noted that having clinical credibility was important to drive service change and

		ensure patient care continued to be delivered safely and effectively
Informatics	Haire et al ²⁷	Lack of access to shared electronic patient information across organisations is recognised as a major barrier enabling integrated care integration, and conversely is an important driver of improved care coordination
Implementation design	Fulop et al ²⁶	Evidence suggests a single launch date improves understanding of stakeholders (including staff), helping to increase adoption of new patient pathways
Organisational culture and values	Kash et al ¹³	This was identified as an enabler of service reorganisation, with shared vision and values between departments being an important component, empowering staff to make positive change
Communication	Fulop et al ²⁶ ; Kash et al ¹³	Understanding of new service reorganisation and fidelity to new referral pathways is influenced strongly by how consistently it is understood by healthcare staff and so how well this is communicated to them
Systems Evaluation and Service Improvement	Haire et al ²⁷ ; Kash et al ¹³	Evaluating clinical outcomes and patient experience is an important factor in ensuring service reorganisation has been successful, and building support for system change

Quality assessment

The summary of the results of the MetaQAT assessment is included in Appendix D. The overall quality of the included studies was moderate, although there was considerable variation in the quality of studies.

The choice of methodology (eg expert opinion, audit) was an important factor limiting the validity and generalisability of a number of studies, although the authors of this study acknowledge the challenge of robust evaluation of this type of service change.

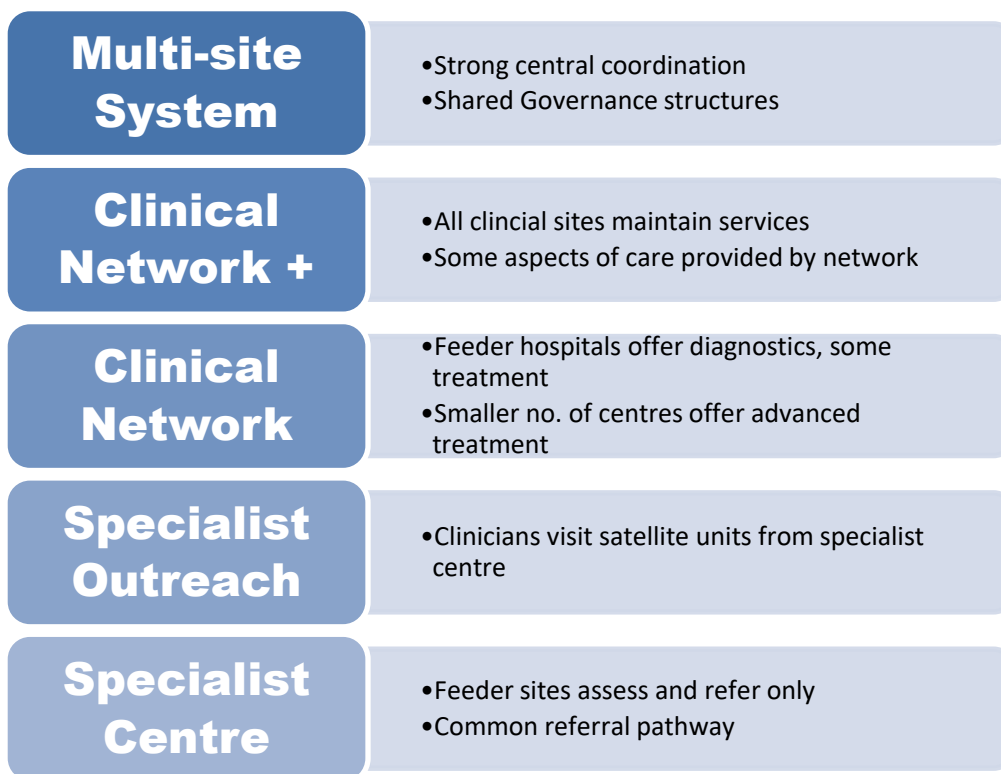
Lack of clear controls or comparator cohorts was a source of potential bias for the majority of studies included in the review. Given the significant heterogeneity in outcomes, there also exists the potential for selective reporting of service data. It should also be noted that there may be publication bias associated with the implementations of MSSS models of care which have not produced improvements in quality and safety, particularly given the often political nature of this type of service change.

The findings of this review should therefore be considered in the context of what is currently an emerging evidence base with important limitations.

Discussion

One of the aims of the review was to identify a common definition of a MSSS model. A thematic analysis identified a range of models of care which have been summarised in Table 1. Furthermore, we propose a framework to help guide the categorisation of this type of model of care in future (see Figure 2). Models of service delivery have been ordered by the level of centralisation of service (from least to most centralised).

Figure 2. Descriptive framework describing the different types of Multiple-Site, Single Service models of care found in the included studies



'Specialist Centre' refers to a model of care which involves a specialist ('tertiary') centre which accepts referrals from feeder hospitals in a defined geographic area (see Taylor et al²¹; Proctor et al¹⁸). 'Specialist Outreach' involves clinicians from a specialist centre travelling out from the centre to smaller sites to offer some elements of peer support, clinical advice and/or patient care (see Quinn et al¹⁹ O'Sullivan et al²⁰). 'Clinical Network' describes a network in which a specialist centre is providing specialist treatment to patients who reside in a defined area, but whose feeder hospitals complete some form of initial assessment, diagnostics and medical management before patient transfer (see Stub et al¹⁵; Tai et al¹⁶; Tideman et al¹⁷).

'Clinical Network Plus (+)' describes a network in which all sites provide the same treatment to patients, but some aspects of care are restricted to a smaller number of sites at certain times. For example, Agarwal et al¹⁴ describe a Tele-stroke service delivered in the UK in which 7 hospital sites coordinate to provide thrombolysis to patients outside of core working hours, without the need for transfer to specialist centre; a regional rota of 10 clinicians working across those sites work to deliver a thrombolysis service to all sites in the network, overnight and at weekends, employing telemedicine technology to enable the specialist to communicate with local clinical teams.

'Multi-site System' describes a model of care in which all clinical sites provide the same level of care to patients, based on shared treatment pathways and clinical policies and with shared governance across the system (see Villanueva et al¹²; Kash et al¹⁴). This model of care was only referenced in US-based literature, although it may be relevant to the provision of screening programmes in the UK. This level of service integration and governance may not be realistic for most UK-based clinical services, whilst the three intermediate models of care included in the framework ('specialist outreach', 'clinical network', 'clinical network +') offer a more pragmatic balance between consolidation of workforce and estate, and maintaining access to services.

We found insufficient evidence to conclude which model of care was most effective or was the most appropriate solution in a given context.

The vast majority of data related to patient outcomes was positive, including reported 30-day mortality. It also appears from studies reporting measures related to patient experience that the majority of patients were satisfied with the care received via MSSS models of care.

The drivers and enablers we identified align with important aspects of service change reported elsewhere^{30 31}. It appears that the local context of the service change is important in determining the relative importance of one factor versus another. Further research to describe specific challenges of different MSSS models we have described would be valuable.

The findings in our review relating to patient outcomes and experience should be placed in the context of the variation in quality of studies and the potential for bias to have affected the results presented. In order for a more robust evidence base to develop, it is important that organisations conduct rigorous evaluation and disseminate the findings of such evaluation in future. This may be challenging to prioritise in the context of service change partly driven by financial scarcity, but it is essential if the results of that service change are to be fully understood and the resultant learning disseminated.

We propose a list of outcome measures to be used in the planning of future MSSS evaluation (see Figure 3), developed with reference to common outcomes reported in

the current evidence base, as well as consultation with the Clinical Working Group. Taken in conjunction with our proposed framework for MSSS models presented in Figure 2, this package can form a basis for health systems to consider the most clinically appropriate model at the outset, and include evidence of the outcomes presented in Figure 3 throughout the clinical reconfiguration process from development to implementation, and through to evaluation. In England this approach will be highly relevant for Commissioners and Providers, alongside independent bodies such as Clinical Senates who have a key role providing advice on clinical reconfiguration⁴.

Figure 3. Proposed set of standardised outcome measures for future MSSS evaluation

Proposed measures are:

- measures relating to specific service activity (eg rate of procedures completed)
- measures related to mortality and morbidity (eg 30 -day mortality, length of stay, rate of adverse events)
- measures related to patient experience (eg ease of access to service, patient satisfaction, confidence in quality and safety of care provided)
- measures related to staff experience (eg staff wellbeing, staff satisfaction, staff feedback)
- monitoring of demographics of patient cohort (ie are patients being treated under new MSSS model of care similar to those treated under the previous system)

This review is the first to outline the evidence base on MSSS models of care. We hope this review and its findings will assist health decision makers in the planning, implementation and evaluation of MSSS models. By using systematic methodology, the authors have sought to reduce error or bias that may have been introduced otherwise.

By limiting the search to peer-reviewed studies published in 2013 or after, we may have missed relevant evidence or grey literature. Given the challenge of service change research, there may be a significant number of reports published outside peer-review journals which would have added to our understanding of the research area. In addition, there may have been relevant studies published in a language other than English which we were not able to capture in this review. The recommendations and conclusions drawn by the authors must be interpreted in the context of the reported quality of the studies.

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Appendix A – PICO and inclusion / exclusion criteria

Participants/population

Inclusion criteria:

All individuals receiving healthcare services in OECD countries

Exclusion criteria:

Individuals receiving healthcare services in non-OECD countries.

Intervention(s), exposure(s)

Inclusion criteria:

- studies whose focus is the delivery of a single clinical service working across multiple hospital or provider sites / geographic locations
- studies whose focus may be an established model of service delivery, but one which contains some element of a hub and spoke service, a networked service, or de-centralised centralisation
- studies published in peer-reviewed journals
- studies published between 2013 and date of search

Exclusion criteria:

- studies which do not have some element of 'multiple site single service' models of care as their focus
- studies not published in peer-reviewed journals
- studies published prior to 2013

Comparator(s)/control

Comparator is a single service delivered by one team of people working on one site or usual practice or a previously established model of service delivery.

Main outcome(s)

The optimal definition of 'multiple site single service' models of care.

The impact of 'multiple site single service' models of care on patient outcomes and quality of care.

Additional outcome(s)

Review commonly used outcomes for 'multiple site single service' models.

Enablers and barriers to implementing / adopting 'multiple site single service' models of care.

Appendix B – Key search terms

Key concept 1	Key concept 2	Key concept 3 OECD countries	Key concept 4
Single service*	Secondary care	Australia	Clinical outcome*
Networked service*	Health care service*	Austria	Patient*
Cross site working	Acute	Belgium	Patient experienc*
Single team*	Hospital	Canada	Access*
Integrated service*	Clinical setting*	Chile	Inequalit*
Integrated hospital*		Czech Republic	Outcome*
Single clinical service*		Denmark	Quality
Multiple single site service*		Estonia	Sustainab*
Collaborative service*		Finland	Impact*
collaborative hospital*		France	Workforce
Hospital chain*		Germany	Staff*
Networked hospital*		Greece	Employee*
Multi-site hospital*		Hungary	Contract*
Centralised adj3 service*		Iceland	Procure*
integrated service model*		Ireland	Commission*
Partnership working		Israel	Financ*
Clinical network*		Italy	
Acute adj3 integrated care		Japan	
Health systems adj3 integrated care		Korea	
Organisational boundar*		Latvia	
Horizontal network*		Luxembourg	
Vertical integration		Mexico	
Horizontal integration		Netherlands	
Multihospital system*		New Zealand	
Multihospital		Norway	
		Poland	
		Portugal	
		Slovak Republic	
		Slovenia	
		Spain	
		Sweden	
		Switzerland	
		Turkey	
		United States	
		UK	
		United Kingdom	
		Great Britain	

		GB	
		England	
		English	
		Wales	
		Welsh	
		Scotland	
		Scottish	
		Ireland	
		Irish	

Appendix C – List of included studies

First Author	Title	Year of Publication	Country of origin	Reference
Agarwal, Smriti	Thrombolysis Delivery by a Regional Telestroke Network— Experience From the UK National Health Service	2014	UK	Agarwal, S., Day, D. J., Sibson, L., Barry, P. J., Collas, D., Metcalf, et al (2014). Thrombolysis Delivery by a Regional Telestroke Network— Experience From the UK National Health Service. <i>Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease</i> , 3(1).
Balinskate, Violeta	Reorganisation of stroke care and impact on mortality in patients admitted during weekends: a national descriptive study based on administrative data	2017	UK	Balinskaite, V., Bottle, A., Shaw, L. J., Majeed, A., & Aylin, P. (2018). Reorganisation of stroke care and impact on mortality in patients admitted during weekends: a national descriptive study based on administrative data. <i>BMJ Qual Saf</i> , 27(8), 611-618.
Fulop, Naomi	Explaining outcomes in major system change: a qualitative study of implementing centralised acute stroke services in 2 large metropolitan regions in England	2016	UK	Fulop, N. J., Ramsay, A. I., Perry, C., Boaden, R. J., McKeivitt, C., Rudd, A. G., et al (2015). Explaining outcomes in major system change: a qualitative study of implementing centralised acute stroke services in 2 large metropolitan regions in England. <i>Implementation Science</i> , 11(1), 80.
Grigg, Celia	Women's experiences of transfer from primary maternity unit to tertiary hospital in New Zealand: part of the prospective cohort Evaluating	2015	New Zealand	Grigg, C. P., Tracy, S. K., Schmied, V., Monk, A., & Tracy, M. B. (2015). Women's experiences of transfer from primary maternity unit to tertiary hospital in New Zealand: part of the prospective cohort Evaluating Maternity Units study. <i>BMC pregnancy and childbirth</i> , 15(1), 339.

	Maternity Units study			
Haire, K	Integrated Cancer System: a perspective on developing an integrated system for cancer services in London	2013	UK	Haire, K., Burton, C., Park, R., Reynolds, J., Stewart, D., & Purushotham, A. D. (2013). Integrated Cancer System: a perspective on developing an integrated system for cancer services in London. <i>London Journal of Primary Care</i> , 5(1), 29-34.
Imison, Candace	Insights from the clinical assurance of service reconfiguration in the NHS: the drivers of reconfiguration and the evidence that underpins it – a mixed-methods study	2015	UK	Imison, C., Sonola, L., Honeyman, M., Ross, S., & Edwards, N. (2015). Insights from the clinical assurance of service reconfiguration in the NHS: the drivers of reconfiguration and the evidence that underpins it—a mixed-methods study. <i>NIHR Journal Library: Health Services and Delivery Research</i> , No. 3.9 Available from https://njl-admin.nihr.ac.uk/document/download/2004024 . Date accessed 01.03.19
Kash, Bitab Arbab	Success Factors for Strategic Change Initiatives: A Qualitative Study of Healthcare Administrators' Perspectives	2014	USA	Kash, B. A., Spaulding, A., Johnson, C. E., & Gamm, L. (2014). Success factors for strategic change initiatives: A qualitative study of healthcare administrators' perspectives. <i>Journal of Healthcare Management</i> , 59(1), 65-81.
Manley, Kim	Using systems thinking to identify workforce enablers for a whole systems approach to urgent and emergency care delivery: a multiple case study	2016	UK	Manley, K., Martin, A., Jackson, C., & Wright, T. (2016). Using systems thinking to identify workforce enablers for a whole systems approach to urgent and emergency care delivery: a multiple case study. <i>BMC Health Services Research</i> , 16(1), 368.
Moynihan, Barry	User Experience of a Centralized Hyperacute Stroke Service A Prospective Evaluation	2013	UK	Moynihan, B., Paul, S., & Markus, H. S. (2013). User experience of a centralized hyperacute stroke service: a prospective evaluation. <i>Stroke</i> , 44(10), 2743-2747.

O'Sullivan, Belinda	Service distribution and models of rural outreach by specialist doctors in Australia: a national cross-sectional study	2016	Australia	O'Sullivan, B. G., Joyce, C. M., & McGrail, M. R. (2014). Rural outreach by specialist doctors in Australia: a national cross-sectional study of supply and distribution. <i>Human Resources for Health</i> , 12(1), 50.
Proctor, VK	Outcomes of regional transfers of ruptured abdominal aortic aneurysm in a UK vascular network	2017	UK	Proctor, V. K., Lee, M. J., & Nassef, A. H. (2017). Outcomes of regional transfers of ruptured abdominal aortic aneurysm in a UK vascular network. <i>The Annals of The Royal College of Surgeons of England</i> , 99(1), 88-92.
Quinn, Liam	Paediatric surgical services in remote northern Australia: an integrated model of care	2017	Australia	Quinn, L., & Read, D. (2017). Paediatric surgical services in remote northern Australia: an integrated model of care. <i>ANZ Journal of Surgery</i> , 87(10), 784-788.
Stub, Dion	Regional Systems of Care to Optimize Outcomes in Patients Undergoing Transcatheter Aortic Valve Replacement	2015	Canada	Stub, D., Lauck, S., Lee, M., Gao, M., Humphries, K., Chan, A., et al (2015). Regional systems of care to optimize outcomes in patients undergoing transcatheter aortic valve replacement. <i>JACC: Cardiovascular Interventions</i> , 8(15), 1944-1951.
Svederud, Ida	Patient perspectives on centralisation of low volume, highly specialised procedures in Sweden	2015	Sweden	Svederud, I., Virhage, M., Medin, E., Grundström, J., Friberg, S., & Ramsberg, J. (2015). Patient perspectives on centralisation of low volume, highly specialised procedures in Sweden. <i>Health Policy</i> , 119(8), 1068-1075.
Tai, D	The Royal Free Hospital 'hub-and-spoke network model' delivers effective care and increased access to liver transplantation	2017	UK	Tai, D., Dhar, A., Yusuf, A., Marshall, A., O'Beirne, J., Patch, D., et al. (2018). The Royal Free Hospital 'hub-and-spoke network model' delivers effective care and increased access to liver transplantation. <i>Public Health</i> , 154, 164-171.
Taylor, Rachel	Scottish outcomes for extra hepatic biliary atresia post-	2013	UK	Taylor, R., Barclay, A. R., Rogers, P., McIntyre, K., Russell, R. K., Devadason, D., et al. (2013). Scottish outcomes for extra hepatic biliary atresia post-rationalisation of services.

	rationalisation of services			<i>Archives of Disease in Childhood</i> , 98(5), 381-383.
Tideman, Philip	Impact of a regionalised clinical cardiac support network on mortality among rural patients with myocardial infarction	2014	Australia	Tideman, P. A., Tirimacco, R., Senior, D. P., Setchell, J. J., Huynh, L. T., Tavella, R., et al. (2014). Impact of a regionalised clinical cardiac support network on mortality among rural patients with myocardial infarction. <i>Medical Journal of Australia</i> , 200(3), 157-160.
Villanueva, Robert	Collaborating Across Multiple Health Care Institutions in an Urban Colorectal Cancer Screening Program	2013	USA	Villanueva, R., Gugel, D., & Dwyer, D. M. (2013). Collaborating across multiple health care institutions in an urban colorectal cancer screening program. <i>Cancer</i> , 119, 2905-2913.

Appendix D – Summary of quality assessment results

Study	Does study address a topic relevant to issue under investigation?	Is the study presented clearly?	Are the research methodology and results clearly described?	Are ethics procedures described?	Is the study methodology appropriate for scope of research?	Is the research methodology free from bias?	Are the conclusions explicit and transparent?	Is there confidence in the findings?	Can the result be applied within the scope of public health?
Agrawal et al	Yes	Yes	Yes	Yes	Yes – but no controls used or long term clinical outcomes reported	Yes	Yes	Yes	Yes
Balinskate et al	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fulop et al	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grigg et al	Yes	Yes	Yes	Yes	Yes	Unclear – potential for recall bias	Yes	Yes	Yes

Establishing the evidence base for 'multiple site single service' (MSSS) models of care

Haire et al	Yes	Unclear – study design not clear	Unclear – methods not clearly stated	No	Unclear – combination of literature review and 'expert opinion'	No – 'expert opinion' reported in study	Unclear	Unclear	Unclear
Imison et al	Yes	Yes	Yes	Yes – authors state meets NIHR ethical standards	Yes	Yes	Yes	Yes	Yes
Kash et al	Yes	Yes – but no conflict declaration	Yes	No	Yes	Unclear – limited diversity of questionnaire participants, no systematic approach to literature review	Yes	Unclear – given limitations of methods	Yes
Manley et al	Yes	Yes – but no conflict declaration	Yes	No	Yes	Unclear – lack of systematic approach to literature review	Yes	Yes	Yes
Moynihan et al	Yes	Yes	Yes	No	Yes	Unclear – lack of data relating to patient experience of hub and spoke model of delivery	Yes	Yes	Yes
O'Sullivan et al	Yes	Yes – but no conflict declaration	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Establishing the evidence base for 'multiple site single service' (MSSS) models of care

Proctor et al	Yes	Yes – but no conflict declaration	Yes	Unclear – no reference to formal ethical approval	Unclear – not all patient data relevant to central research question is included	Unclear – potential bias exists in method of patient referral and acceptance	Yes	Yes – although unclear how results compare to other centres or published literature	Yes
Quinn et al	Yes	Yes	Yes	Yes	Unclear – more robust methodology could have been employed	Unclear – potential confounders (such as surgeon experience/skill and time to presentation) not adequately reported	Unclear – results of study compared favourably to other studies of unclear methodology, therefore basis for conclusions is uncertain	Unclear – due to methodological limitations	Yes – if limitations of study are recognised
Stub et al	Yes	Yes – but no conflict declaration	Yes	Unclear – ethicist included in planning group but no reference to formal ethical approval	Yes	Unclear – complete data not presented, potential for comparator data to differ significantly due to case-mix and health system	Yes	Unclear – potential for other confounders which have not been identified	Yes
Svederud et al	Yes	Yes – but no conflict declaration	Yes – although no formal analysis of qualitative data	No	Yes	Unclear – lack of diversity in study participants	Yes	Unclear – due to lack of diversity of participants and lack of formal analysis	Yes
Tai et al	Yes	Yes	Yes	Yes (N/A)	Yes – but no controls	Yes	Yes	Yes	Yes

Establishing the evidence base for 'multiple site single service' (MSSS) models of care

Taylor et al	Yes	Yes	Methods unclear	Yes (N/A)	Unclear – more robust methodology could have been employed	Yes	Yes	Unclear – due to methodological limitations and sample size	Yes
Tideman et al	Yes	Yes	Yes	Yes (N/A)	Yes – but no controls	Yes	Yes	Yes	Yes
Villanueva et al	Yes	Unclear	Unclear	Unclear	Unclear – not enough detail on methods provided	Unclear – no clear controls, results not described in detail	No	No	No