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Interventions to reduce acute paediatric hospital admissions: a systematic review

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ABSTRACT

Background. Admission rates are rising despite no change to burden of illness and interventions to reduce unscheduled admission to hospital safely may be justified.

Objective. To systematically examine admission prevention strategies and report long-term follow-up of admission prevention initiatives.

Data sources. MEDLINE, Embase, OVID SP, Psych INFO, Science Citation Index Expanded/ISI Web of Science, The Cochrane Library from inception to time of writing. Reference lists were hand searched.

Study eligibility criteria. Randomised controlled trials (RCTs) and before-and-after studies.

Participants. Individuals aged <16 years.

Study appraisal and synthesis methods. Studies were independently screened by two reviewers with final screening by a third. Data extraction and the Critical Appraisals Skills Programme checklist completion (for risk of bias assessment) were performed by one reviewer and checked by a second.

Results. Twenty-eight studies were included of whom 24 were before-and-after studies and four were studies comparing outcomes between non-randomised groups. Interventions included referral pathways, staff reconfiguration, new healthcare facilities and telemedicine. The strongest evidence for admission prevention was seen in asthma specific referral pathways (n=6) showing 34% [95%CI 28-39] reduction, but with evidence of publication bias. Other pathways showed inconsistent results or were insufficient for wider interpretation. Staffing reconfiguration showed reduced admissions in two studies, and shorter length of stay (LOS) in one. Short stay admission units reduced admissions in all studies.

Conclusions and implications. There is little robust evidence to support interventions aimed at preventing paediatric admissions and further research is needed.

PROSPERO registration: CRD42020183282.

Key words: child, patient admission, emergency medical services, health services

INTRODUCTION

There is a rising number of acute paediatric hospital admissions[1,2] despite there being no increased burden of illness[3]. Some children who are admitted may be more appropriately cared for in the community[4,5]. Drivers for rising admissions include changes in parent/carer health seeking behaviour[6], limitations in primary care capacity and capability to assess children[7], and shorter duration of stay potentially leading to increased readmission rates.[6] In some settings, care in the community may be a safe and cost effective alternative to hospital care. [7]

Several initiatives have been developed to safely reduce the need for unscheduled hospital admission[8], including rapid review clinics[9], professional telemedicine support for primary care clinicians[10] and short stay paediatric assessment units (SSPAU).[10] A 2012 systematic review found there was no evidence of any effective intervention which reduces admissions.[11]

Here we address the need for robust evaluation of primary- and secondary-care based interventions to reduce acute paediatric admissions[7,12] by undertaking a recent systematic review of interventions to reduce admissions modifying a previous methodology. Modifications were to include the impact of teleconsulting and to exclude papers published before 1st January 2000 since subsequent changes to healthcare systems were considered likely to reduce the generalisability of interventions described in the last century. As part of the justification for undertaking this systematic review we contacted leads of existing UK-based paediatric admission prevention initiatives[8] to gain understanding of which non-evidence based initiatives were more durable and by implication which were more successful (results presented in the supplement) .

METHODS

Protocol and registration

An earlier review[11] was modified and the Centre for Reviews and Dissemination (CRD) methodology was used. The PROSPERO registration number is CRD42020183282.

Eligibility criteria

Full papers published in English since 2000 with the following characteristics were eligible: randomised controlled trials (RCTs) and before-and-after studies, mean participant age <18 years presenting to unscheduled or emergency care settings. Interventions set in scheduled/elective care settings and letters or abstract only outputs were ineligible. Included studies described outcomes before and after the introduction of any intervention designed to reduce acute paediatric admissions with either simultaneously or historically collected control data. The primary outcome for included studies was admission rates, and how this compared for presentations managed by the intervention relative to no intervention. Secondary outcomes including length of stay and readmissions: studies which reported secondary but not primary outcomes were eligible.

Information sources

Literature search within MEDLINE/OVID (1950-Present), Embase/OVID SP (1980-Present), Psych INFO/OVID SP (1987-Present), Science Citation Index Expanded/ISI Web of Science (1981-Present), The Cochrane Library Database and the Database of Abstracts of Reviews of Effectiveness was initiated on 13th May 2020. The search was updated on 28th April 2021. Reference lists of included papers were hand searched for relevant articles (Figure 1).

Search

The search strategy of Coon *et al*[11] was used with the addition of keywords telemedicine, home care and medical education; the additional keywords were identified from a summary of unscheduled care interventions[8] (Figure S1).

Study selection process

Duplicate titles were removed and each abstract was reviewed by two of the three researchers (SD, CMR, CMF). All papers were independently reviewed by two researchers. Differences of opinion were resolved at a team meeting of all authors.

Data collection process

Data were extracted from full texts using a form from the Cochrane Collaboration's forms for RCTs and non RCTs (https://dplp.cochrane.org/data-extraction-forms) with some adaptations. We did not contact authors for clarification or missing data.

Data items

Data were extracted on pre-agreed outcome variables on study design, interventions, participants, setting (primary or secondary care), period of data collection and measured outcome. Study outcomes were admission, readmission and length of stay.

Quality assessment

Quality appraisal was independently performed by two reviewers (CMR, CMF) using the Critical Appraisals Skills Programme checklist (CASP https://casp-uk.net/wp-content/uploads/2018/03/CASP-Cohort-Study-Checklist-2018_fillable_form.pdf) categorising papers as high, intermediate or low.[13] A conservative approach was taken to differences in categorisations where the lower of the two scores was adopted. Where a paper was categorised as high quality by one reviewer and low quality by other, consensus was agreed through discussion amongst all authors.

Summary measures

The proportion of children admitted to hospital from primary care or the emergency department was the primary outcome (either per unit time or per capita). Secondary outcomes included readmissions and length of stay (LOS).

Synthesis of results

Data extracted from the selected studies were tabulated outlining the Population, Intervention, Comparator and Outcome (PICO) elements of each included study (Table 1) as per the PRISMA reporting items checklist (http://prisma-statement.org/prismastatement/Checklist.aspx). Narrative synthesis was performed following the Synthesis Without Meta-Analysis guidelines[14] due to the heterogeneity within the identified papers in relation to the study design, study settings, types of interventions, population age groups and risk of bias. Studies were grouped according to intervention type. Meta-analysis was performed where adequate data were available for study subgroups, and a funnel plot was used to evaluate evidence of publication bias (REV MAN 5.4).

RESULTS

Study selection

Preliminary database searches yielded 6878 results, 61 full-text papers were initially identified as potentially eligible, and four additional papers were added through reference list screening. Twenty-three papers[9,10,15–35] were initially included and 42 excluded (Figure 1). Five papers were identified in the updated search[36–40]. Of the seven papers included in the previous review, two were included in the present review[15,30], three were published prior to 2000, one was published French and one did not meet inclusion criteria. Nineteen studies[9,10,16,17,21,23,24,26,27,31–40] were published after the search in the previous review.[11]

Study characteristics

Thirteen studies were from North America,[16,17,23,24,26,28–30,34–37,39] eight from Europe,[9,10,15,21,22,31,32,38] six from Australia,[18,20,25,27,40,41] and one from Asia.[33] Nineteen studies had a before-and-after design and four[22,32,33,35] compared non-randomised assessment options within the same period. The number of children included ranged from 64[35] to 37219,[33] and the period of assessment was between one

month[28] and five years.[25] Only one study[16] included any participants ≥18 years, and here 87% of participants were aged <13 years. The earliest studies began in 1993[18,29] and the latest in 2017;[36] seven studies began between 1990-1999,[15,18,25,29,30] ten between 2000-2009 [10,16,17,22–24,28,31,35,38] and eleven after 2009.[9,21,26,27,32–34,36,37,39,40]

Outcome measures

Hospital admission was reported in 24 studies,[9,10,15,16,18–20,22,23,25–32,34–36,38–40] readmission in nine,[17,19–21,24,26,39] and length of stay in 15 studies.[10,16,18–21,23,24,26–30,36,37] The primary outcome was presented as odds ratio (OR) or relative risk (RR) of hospital admission[15–17,22,32,34,35,37,39,40] or as a percentage change.[10,18–21,23–31,33,36,38]

Quality assessment

Quality appraisal categorised 14 studies as high[9,17,20,23,26–29,31,34,36–39], ten moderate[10,15,16,19,21,24,25,30,33,40], and four as low[18,22,32,35] quality (Table 2). Reasons for a low categorisation included no information on follow-up period, short follow-up period, inadequately addressed confounding factors, selection bias and lack of generalisability of study results.

Type of intervention

Nineteen studies assessed (Table 1) the impact of a new care pathway for a single[15–17,19,20,22–24,26,28–31,33,34,36,38–40] or two[15,19] clinical presentations. Seventeen were based in Emergency Department (ED)[15,16,19,20,22,23,26,28,30,31,33,34,36–40] and three[17,24,29] on medical wards. Four studies examined the impact of staff reconfiguration,[9,21,25,32] two described the impact of opening a new paediatric facility[18,27] two described telemedicine interventions.[35,37] One study described both a new paediatric facility and telemedicine service.[10] Table S1 describes the interventions more fully.

Care pathways

Asthma care pathways

Six papers reported the number of admissions before and after the introduction of asthma care pathways,[16,19,26,28,34,36] of which three had a prospective design.[16,19,28] Four studies[26,28,34,36] were rated high and two[16,19] moderate quality (Table 2). Meta-analysis of six studies[16,19,26,28,34,36] which included 13,453 presentations, showed that pathways were associated with reduced admissions, OR 0.66 [95% CI 0.61, 0.72] (Figure 2). There was significant heterogeneity between study results (I-square =73%). A funnel plot (Figure S2) was asymmetric, suggesting publication bias. Two additional studies reported readmissions (and not admissions); the first included 763 admissions before and after the intervention and reported reduced admission rates (OR 0.29 [95% CI 0.11, 0.78]);[17] and the second reported that the proportion readmitted fell from 17% to 12% (p = 0.01)[24] after introduction of a care pathway.

Gastroenteritis care pathways

Results for three studies (all moderate quality) evaluating admissions with gastroenteritis before and after a new care pathway was introduced revealed heterogeneous results. One study reported increased admissions,[15] perhaps due to improved and early identification of risks/dehydration, but did report reduced time spent in the ED (102 min vs 78 min, p<0.001).[15] A second study reported no change in admissions but also reported reduced mean (SD) length of stay (1.6 (1.0) days before and 1.3 (1.0) days after, p<0.0001).[30] A third study reported reduced admissions (n=786 before and n=260 after, p=0.001) and reduced length of stay (32.7 hours before and 7.5 hours after, p<0.001)[19].

Care pathways for other conditions

Two studies reporting care pathways for croup were associated with reduced admissions and LOS stay,[19,20] and one describing reduced readmission rates.[19] Seven studies reported care pathways being associated with a fall in admissions for bronchiolitis,[29,40] "influenza-like" illness,[22] febrile illness,[39] viral lower respiratory tract infection,[38] anaphylaxis[23] and syncope,[31] and an eighth found no change in admissions for seizures.[15] One intervention encouraged experienced staff to subjectively

down-triage the emergency department's assessment score (the Japanese Triage and Acuity Scale) and found this was associated with reduced admissions.[33]

Staff reconfiguration

In one study[25] admission rates from Emergency Department (ED) were reduced after consultant presence in the ED increased (pre 26% and post 19%). A second study[21] which did not report on admission rates found that length of stay was not affected by a change where consultants began reviewing patients within 12 hours of admission; the exception was gastroenteritis admissions where length of stay was reduced from 29 hours to 20 hours.[21] A third study introduced a paediatric ED initiative where ER clinicians could refer cases to a rapid review clinic run by a senior paediatric registrar: compared to the two years before implementation, the proportion of ED attendances admitted fell from 30% to 21% ($p<0.001$) in the two years after the initiative started.[9] A fourth study with before-and-after design introduced triage of ED presentations to a GP clinic within a paediatric ED (2-10pm seven days a week) or to ED.[32] The GP group patients were significantly less likely to be admitted in comparison to the ED group (2.2% vs 6.6%, OR=0.32 [95% CI 0.24, 0.44]).[32]

Opening of a new paediatric facility

One study reported a 14% reduction in mean monthly admissions (mean change post-pre intervention of 35 (95% CI 21-48), $p=0.0001$) after a short stay paediatric assessment unit (SSAPU) opened in Plymouth, UK.[10] A study of similar design from New South Wales, Australia, reported a reduction in admissions from ED to the paediatric ward of 14.7% and 10.3% in the two hospitals after short stay wards were opened.[18] A second Australian study[27] found a 16% rise in attendances to a new ED (which included a short stay unit) and a fall of 2% in paediatric unit admissions.

Telemedicine

Three studies published in 2015, 2018 and 2020 were identified.[10,35,37] One study, assessed as low quality design, reported an association between starting a telemedicine intervention and paediatric

admissions, with the option of telemedicine being at the discretion of the treating physician.[35] Patients receiving telemedicine consultations were less likely to be admitted compared to previous care (59.5% vs 87.5%; $p < 0.05$). In a second study ED patients received a telemedicine medical screening evaluation at triage which was compared to those receiving standard triage.[37] Only those patients falling under four diagnostic cohorts were included (gastroenteritis, psychiatry evaluation, burn injury and extremity fracture). There was a reduction in ED LOS for three of the four cohorts (Gastroenteritis, burn injury and extremity fracture) (Difference of Median MD 0.4 hours, 95% CI 0.3-0.6). A third study which introduced an advice and guidance phone line, in addition to opening an SSPAU, reported a reduction in short stay (<1 day) admissions (8.5% postintervention, p=0.04) but no impact on GP referred attendances or ward admissions.[10]

DISCUSSION

Our systematic review has modified a previous methodology[11] to describe the evidence published since 2000 for interventions which may reduce unscheduled admissions to hospital. The review by Coon *et al,*[11] which described the findings of seven studies, concluded that at that time the relevant literature was limited in size and subject to substantial bias. The first notable finding of our review was that most of the interventions described were associated with reduced number of admissions, readmissions or LOS. A second finding was that there were no RCTs, and the majority of studies had before-and-after designs. The quality of most included studies was moderate or high, but evidence of publication bias was observed for asthma pathways. Collectively these findings suggest that whilst there have been additions to the previously reviewed literature,[11] there remains a deficit in high quality, RCT-based evidence to inform redesign of patient care aiming to reduce the number of unscheduled hospital admissions.

The interventions evaluated were designed to intervene for a specific presentation (i.e. pathways) or to intervene across many different unscheduled presentations by changing the interface between

primary and secondary care (i.e. staff reconfiguration, new hospital facility and telemedicine). The interventions identified in our literature review[15–17,19,20,22–24,26,28–31,33,34] provide evidence that standardisation of care by agreeing care pathways is an effective way to improve patient care, and this principle is likely generalisable to other clinical presentations.

Hospitals are an important part of healthcare services available for children, and an unscheduled admission is not a negative outcome *per se*. The rise in unscheduled paediatric admissions [1,42] in the context of no increase in severity of illness means that interventions to achieve safely reduce admissions, and which do not result in delayed admissions and readmissions may be justified.

Three systematic reviews have previously evaluated this topic, the most recent published in 2012. One systematic review suggested that short stay paediatric assessment units may be an efficient alternative to admission[43] but a second was unable to confirm this.[11] A third systematic review concluded that paediatric home care delivered equivalent clinical outcomes for children compared to hospital care, and did not impose as great a burden on families.[44] RCTs are notable for their absence in the context of unscheduled admissions and this may reflect challenges in delivering interventions in the unscheduled care setting, particularly when complex interventions are being delivered.[8] As an alternative to RCTs, the rigorous evaluation of existing initiatives,[8] ideally involving mixed methods design, may give useful insight into which initiatives work in different clinical settings.

Limitations to the evidence available include the lack of quantity and quality of evidence, and most studies had a before-and-after design. Publication bias was observed for the studies reporting outcomes after the introduction of an asthma pathway; it is possible that other interventions did not improve outcomes and were not submitted for/accepted for publication. All but two interventions[18,36] identified in our review were from single centres and we do not know if the results can be extrapolated to other centres.

Our review has some limitations. We modified a previous search strategy but only identified two studies with an intervention delivered outside the hospital[10,35] and it is possible that there are interventions delivered in primary care, e.g. education, which may not have been included. We also excluded papers not written in English so may have failed to include papers. Finally we excluded papers published before 2000, removing three of seven papers in an earlier review[11], but similar interventions (i.e. asthma pathway, opening observation/short stay assessment units) were described in papers published in 2000 and afterwards.

In summary, we find no substantial evidence upon which to develop interventions aimed at reducing unscheduled admissions to hospital. Interventions which safely reduce the number of children admitted to hospital are needed.[12,45] In addition to learning from lessons from how the COVID pandemic changed health seeking behaviour and health service delivery, and we recommend the development of complex interventions operating across primary and secondary care and which are not condition-specific.

What is already known on this topic

- There is a need for an evidence base to drive interventions which safely halt the rise in unscheduled paediatric admissions.
- There are several initiatives which may safely reduce unscheduled admissions.
- The most recent systematic review of the relevant literature (published in 2012) found no evidence of an optimal strategy for reducing paediatric admission rates.

What this study adds

- Since a review of this literature, published in 2012, there has been a considerable increase in the number of publications describing interventions aimed at reducing unscheduled admissions.

- Despite these welcome additions to the literature, the evidence available lack robust studies (e.g. randomised controlled trials) and is mostly based on single centre experience.
- There is a need for multifaceted and multicentred interventions using resources from health (primary and secondary care) and social care to tackle the increasing admissions.

Author contributions: ST conceived the study. All authors contributed towards the design of the review, were involved in interpretation of the data and critically revised the manuscript for all important intellectual content and approved the final version. In addition SD, CMc and CMac screened the titles, abstracts and full texts. ST and PW resolved any conflicts around the selection process. SD, CMc and CMac carried out the data extraction, quality assessment and also screened the bibliographies of the identified papers during the process. ST, UR and SD carried out the follow-up of the UK-based admission prevention initiatives. ST and SD wrote the first draft of the manuscript.

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Table 1. Details of each study included in this systematic review. ED=Emergency Department, ICU=intensive care unit, LOS=Length of Stay, CPG=Clinical Practice Guidelines, WMH=Westmead Hospital, NCH=New Children's Hospital.

Category of intervention	Study	Country	Age range	Data collection periods	Study design	Number of presentations	Outcome measured	Significant results
Guideline/ care pathway (for diarrhoea or seizure)	Armon *et al.* (2004)	UK	0-15 year olds	Apr-Jul 1997 versus May-Aug 1999	Before and after	504 before and 438 afterwards	Hospital admissions, readmission to ED	Admission rates for diarrhoea attenders increased (RR 1.3, 95% CI 1.25-1.35) (27% to 34%)
Guideline/ care pathway (for asthma)	Bekmezian *et al.* (2015)	US	≤ 21 year olds	Jan 2006- Sep 2011 versus Sep 2011 -Sep 2013	Before and after	870 before and 379 afterwards	Hospital admissions, ED LOS	Hospital admissions decreased post-implementation (13% vs. 21%, OR 0.53; CI 0.37–0.76)
Guideline/ care pathway (for asthma)	Bergert *et al.* (2014)	US	2-18 years olds	Jan 2006-Dec 2007 versus Jan 2008-Jun 2012	Before and after	231 before and 532 afterwards	Readmissions (to hospital) and ED utilization	Reduction (71%) in the readmission rates post-implementation (OR 0.29, 95% CI 0.11-0.78)
Guideline/ care pathway (for asthma, croup or gastroenteritis)	Browne *et al.* (2001)	Australia	Mean age pre implementation 2.73 years; post implementation 2.84 years	Jan-Dec 1996 versus Jan-Dec 1999	Before and after	2680 before and 2854 afterwards	Hospital admissions from ED or observation unit in ED, LOS and representation within 72 hours of discharge.	Admissions reduced from 23.6% to 9.1% post-implementation pathway (p=0.001) and LOS reduced from 33h to 18 h (p<0.001). Unscheduled medical visits following discharge reduced from 4.9% to 3.6% (p=0.001)
Guideline/ care pathway (for croup)	Chin *et al.* (2002)	Australia	6months-10 year olds	Feb-Jul 1999 versus Feb-Jul 2000	Before and after	157 before and 110 afterwards	Hospital admissions to paediatric ward from ED or observation unit attached to ED*, readmissions, LOS. *observations for up to 23 hours before discharge home/admission	Post implementation there were reduced (p<0.05) hospital admissions (52.9% versus 18.0%), intensive care admissions (10.2% versus 0.0%) and LOS in the post intervention group (18.9 h versus 5.2 hrs)

Guideline/ care pathway (for influenza like illness)	De Marco *et al.* (2005)	Italy	0-18 year old	Dec 2002-Feb 2003	Comparison between non - randomised groups	457 received care from paediatricians trained in CPG, 325 received standard care	Hospital admissions	The admission proportion were lower (20%) in the intervention arm compared to the standard care (26%), p< 0.05
Guideline/ care pathway (for anaphylaxis)	Farbman *et al.* (2017)	US	Median (IQR) age pre implementation 6.7 (3.2-14.0) and post implementation 7.1 (2.7-14.7).	Jan 2008-Sep 2011 versus Oct 2011-Dec 2014	Before and after	438 before and 731 afterwards	Hospital admission from ED or ED observation unit, ED LOS. Children with anaphylaxis were observed for >4 hours.	Admission proportion fell from 54% to 36% (p=0.001) and median ED LOS fell from 244 to 220 min (p=0.003) post-implementation
Guideline/ care pathway (for asthma)	Fassl *et al.* (2012)	US	2-17 year olds	Jan 2005-Dec 2007, versus Apr 2009-Dec 2010	Before and after	754 before and 673 afterwards	Readmissions within 6 months to ED or hospital LOS.	The readmission proportion fell from 17% to 12% (p =0.01) post-implementation
Guideline/ care pathway (for asthma)	Johnson *et al.* (2018)	US	≥2 year olds with a known diagnosis of asthma	May 2012-Apr 2014 versus May 2014-Jun 2016	Before and after	3650 before and 3466 afterwards	ED LOS, inpatient LOS, % ED encounters requiring admissions, ED revisits and readmissions	Post-implementation there were reductions in admissions (24% versus 19%), ICU admissions (23% versus 13%), time seen in ED LOS (3.9 h versus 3.3 h), hospital LOS (1.5 days versus 1.3 days)
Guideline/ care pathway (for asthma)	Norton *et al.*(2007)	Canada	1-18 year olds	Feb 2000- Mar 2000 versus Feb 2002-March 2002	Before and after	193 before and 74 afterwards	Rate of hospitalization from ED (no observation unit), rate of return visit to ED within 14 days.	The proportion admitted reduced 28% to 14% (p= 0.02) and reattendances from 6% to <0% in the intervention group (p=0.05)

Guideline/ care pathway (bronchiolitis)	Perlstein *et al.* (2000)	US	≤ 1 year olds	Jan 1993-Mar 1996 versus Jan 1997-Mar 1999	Before and after	1300 before and 679 afterwards	Number of admissions, admission LOS	Median annual admissions (IQR) pre implementation 325 (261-363) and post implementation 226 (173-282), p<0.001. Mean (SD) LOS pre implementation 2.9 (2.0) and post implementation 2.4 (1.5) p<0.001.
Guideline/ care pathway (for gastroenteritis)	Perlstein *et al.* (2002)	US	2 months to 5 year olds	Dec 1994- May 1997 versus Dec 1998-May 1999	Before and after	8287 before and 3206 afterwards	Mean yearly ED encounters, mean yearly admissions and LOS	Mean (SD) LOS pre-implementation 1.6 (1.0) and 1.3 (1.0) post-implementation, p<0.0001.
Guideline/ care pathway (for syncope)	Raucci *et al.* (2014)	Italy	3 months to 18 year olds	Jan 2004-Dec 2005 versus Jan 2010-Dec 2011	Before and after	470 before and 603 afterwards	Hospital admission rate from ED or short stay observation unit.	The proportion admitted fell from 42% to 19% post implementation (p <0.001)
Guideline/ care pathway (for all presentations)	Takahashi *et al.* (2016)	Japan	< 15 year olds	Jan 2013 - Dec 2013	Comparison between non - randomised groups	37219 (n=17089 Were down-triaged, n=19465 had unchanged triage level and n=665 were up triaged)	Overall admission rates	Admission rates for down-triaged presentations level 1-5 (83%, 33%, 7%, 1% and 3%) compared to standard care (16%, 11%, 6%, 2% and 6%), p<0.001.
Guideline/ care pathway (for asthma)	Walls *et al.* (2017)	US	<18 years olds	Aug 2012-July 2013 versus Aug 2013-Feb 2015	Before and after	289 before and 435 afterwards	Transfer (admission) to hospital	There were fewer admitted post implementation (10% versus 14%, odds ratio 0.63; 95% confidence interval, 0.40–0.99)

Guideline/ care pathway (for asthma)	Desai et al. (2020)	US	2-17 years old	Jan-Dec 2017 versus Jan 2018 to December 2018	Before and after	422 before and 459 afterwards	ED LOS, Hospital admissions	Decrease in ED LOS (Site 1 mean 237-197 mins); Hospital admissions Pre intervention 70/422 (16.59%), Post intervention 68/459 (14.81%), no significant changes in hospital admissions.
Guideline/ care pathway (for Viral Lower respiratory tract infection (VLRTI))	Havdal et al. (2021)	Norway	≤ 24 months of age	January 1, 2009 to November 30, 2012 versus February 2 2013 to December 31 2019	Before and after	1136 before and 2091 afterwards	Hospital admissions	Reduction in hospital admissions after initial ED contact (pre intervention 804/1136, (70.8%) to post intervention1244/2091 (59.5%), p<0.001)
Guideline/ care pathway (for febrile illness)	Mercurio et al. (2020)	US	0-56 days old	Pre implementation April 1, 2015 to April 1 2016; Post Implementation April 1 2017 to April 1 2018	Before and after	201 before and 203 afterwards	Hospital admissions and readmissions	Reduction in number of admissions for both the high risk group infants (OR 0.4, 95% CI 0.22-0.71) and the not at high risk group (OR 0.30, 95% CI 0.15-0.58). No significant change in likelihood of readmissions.
Guideline/ care pathway (for Bronchiolitis)	Yeo et al. (2020)	Australia	0-<12 months old	Pre implementation 1 July to 31 August 2015; post implementation 1 July to 31 August 2017	Before and after	465 before and 343 afterwards	Hospital and paediatric intensive care unit admissions	Significant reduction in hospital admissions from 2015 to 2017 (303 (65.2%) vs. 192 (56%), p=0.008); OR 0.82 (95% CI 0.71-0.95)). No difference I PICU admissions (10 (2.2%) vs. 8(2.3%), p=0.863).

Staff reconfiguration (review by consultant within 12 hours)	Cromb *et al.* (2017)	UK	<17 year olds	Sep 2012- Aug 2014 versus Sep 2014- Aug 2015.	Before and after	3386 before and 1981 afterwards	Admission LOS, unplanned readmission rates	The median LOS for acute gastroenteritis was reduced post-implementation (16 hours 23 min versus 15 hours 45 min, p=0.01)
Staff reconfiguration (increased consultant in ED)	Geelhoed *et al.* (2008)	Australia	Not stated	Jan 1997-Dec 2000 versus Jan 2001- Dec 2006	Before and after	Period before increased presence % admissions 26-27 %; period after 19% equivalent to reduction of 2500 admissions	Percentage of ED presentations admitted to hospital	The proportion of admissions decreased (27% to 19%)
Staff reconfiguration (triage to be seen by GP or ED staff)	Smith *et al.* (2018)	UK	4 days 16.6 year olds	Oct 2014 -Mar 2015	Comparison between non - randomised groups	2812 received care from GP and 2402 received standard care	Percentage of ED presentations admitted to hospital, ED LOS	Presentations seen by the GP had a lower proportion of being admitted (2% vs 7%, OR 0.32, 95% CI 0.24 to 0.44) and lower proportion of waiting > 4 h (2% vs 5%, OR 0.45, 95% CI 0.33 to 0.61)
Staff reconfiguration (emergency review clinic)	Rai *et al.* (2016)	Ireland	Not stated	Feb 2010-Jan 2012 versus Feb 2012-Jan 2014	Before and after	9373 before and 11607 afterwards	Admission rates	The number of admissions fell post-initiative (4053 versus 3095, p< 0.0001)

New ward (new short stay ward)	Browne *et al.* (2000)	Australia	No information on upper age limit. 58% <2years of age.	Westmead hospital (WMH) Jan-Dec 1993 versus Apr 1994-Apr 1995 New Children's Hospital (NCH) baseline period not identified versus Nov 1996-Nov 1998	Before and after	WMH (admissions before n=5315, after n=4766) and NCH (admissions before n=8065, after n=6873)	Hospital admission, hospital LOS, readmissions	The proportion admitted fell at WMH (10.3% reduction) and NCH (14% reduction). No p values provided.
New ward (new paediatric short stay ward in ED)	Margolis *et al.* (2016)	Australia	<16 year olds	Oct 2013-Oct 2014 versus Oct 2014-Oct 2015	Before and after	18142 before and 22391 afterwards	admission to hospital ward, ED LOS	The proportion of ED presentations admitted fell from 11% to 9% and the mean (95% CI) LOS fell from 152 (151-154) minutes to 138 (137-140) minutes, p<0.0001 post-implementation.
Telemedicine	Yang *et al.* (2015)	US	<18 years olds	January 2003-May 2012	Comparison between non - randomised groups	74 received telemedicine consultation and 64 received telephone consultation	Hospital admissions	The proportion admitted after telemedicine consult was 60% and after telephone consult was 88% (p < 0.05)

New ward and telemedicine	Husk *et al.* (2018)	UK	<18 year olds	Phone line comparison 2009-2013 versus Apr- Oct 2014. Short Stay Paediatric Assessment Unit comparison Nov 2009-Oct 2012 versus Nov 2014-Oct 2015	Before and after	3045 in 2010 and 2921 in 2014	ward admissions and hospital LOS	The proportion of admissions of <24 h fell after the phone line (difference in means −16.6 (95% CI −0.2 to −32.9); p=0.04) and SSPAU (difference in means (post–pre) −21.7 (95% CI −8.4 to −35.1); p=0.002) were introduced. The mean (SD) number of admissions / months fell 248 (22) to 213 (17), difference in means (post–pre) −34.6 (95% CI −21.3 to −48.0); p=0.0001after the SSPAU opened
Telemedicine	Friedman et al. (2020)	US	0-18 years of age	Pre implementation December 2015 to November 2017; Post implementation December 2017 to November 2019	Before and after	440 before and 440 afterwards	Paediatric Emergency Department LOS	PED LOS Pooled estimate for all three cohorts (Gastroenteritis, Burn injury and extremity fracture) Difference of Median MD 0.4 hours, 95% CI 0.3-0.6

Table 2. Quality control of the papers included.

Study Reference	Did the study address a clearly focussed issue?	Was the cohort recruited in an acceptable way?	Was exposure accurately measured to minimise bias?	Was the outcome accurately measured to minimise bias?	Have the authors identified all important confounding factors?	Have they taken account of the confounding factors in the design and/or analysis?	Was the follow-up of subjects complete enough?	Was the follow up of subjects long enough?	Do you believe the results?	Will the results help locally?	Do the results of this study fit with other available evidence?	Total Score (max= 11)	Rating- %Total Score (67-100=HIGH, 34-66=MED, 0-33=LOW)
Armon	Yes	Yes	Yes	Yes	No	Not stated	Not stated	Not stated	Yes	Yes	Yes	7	MED
Bergert	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not stated	Not stated	9	HIGH
Bekmezian	Yes	Yes	Not stated	Yes	Not stated	Not stated	No	No	Yes	Yes	Yes	6	MED
Browne, 2000	Yes	Not stated	No	Not stated	No	No	Not stated	Not stated	No	No	Not stated	1	LOW
Browne, 2001	Yes	Not stated	Not stated	Yes	Not stated	Not stated	Yes	Not stated	Not stated	Not stated	Yes	4	MED
Chin	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11	HIGH
Cromb	Yes	Yes	Yes	Not stated	No	No	Yes	Yes	Not stated	Not stated	No	5	MED
De Marco	Not stated	Not stated	No	Not stated	Not stated	No	No	No	Not stated	No	Not stated	0	LOW
Desai	Yes	Yes	Yes	Yes	Not stated	Not stated	Yes	Not stated	Yes	Yes	Yes	8	HIGH
Farbman	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	10	HIGH
Fassl	Yes	Yes	Yes	Yes	Not stated	Not stated	Yes	Not stated	Not stated	Yes	Yes	7	MED

Friedman*	Yes	Yes	Yes	Yes	Yes	Yes	n/a	n/a	Yes	Not stated	Yes	8	HIGH
Geelhoed	Yes	Not stated	Yes	Not stated	Not stated	Not stated	Yes	Yes	Yes	Yes	Yes	7	MED
Havdal	Yes	Yes	Yes	Yes	Yes	Not stated	Yes	Yes	Yes	Yes	Yes	10	HIGH
Husk	Yes	Not stated	Yes	Yes	Not stated	Not stated	No	No	Yes	Yes	Not stated	5	MED
Johnson	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	9	HIGH
Margolis	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Not stated	8	HIGH
Mercurio	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	10	HIGH
Norton	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11	HIGH
Perlstein, 2000	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	8	HIGH
Perlstein, 2002	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	7	MED
Rai	Yes	Yes	Yes	Not stated	Not stated	Not stated	Yes	Yes	Yes	Yes	Yes	8	HIGH
Raucci	Yes	Yes	Yes	Yes	Not stated	Not stated	Yes	Not stated	Yes	Yes	Yes	8	HIGH
Smith	Yes	Not stated	Not stated	Not stated	Yes	Yes	Not stated	Not stated	Not stated	Not stated	Not stated	3	LOW
Takahashi	Yes	Yes	Not stated	Yes	Not stated	Not stated	Not stated	Not stated	Yes	Yes	Yes	6	MED
Walls	Yes	Yes	Yes	Yes	Not stated	Not stated	Yes	Yes	Yes	Yes	Yes	9	HIGH
Yang	Yes	No	No	Not stated	Not stated	Not stated	No	No	Not stated	Not stated	Not stated	1	LOW
Yeo	Yes	Yes	Yes	Yes	Not stated	Not stated	Not stated	Not stated	Yes	Not stated	Yes	6	MED

*Friedman et al. rated using the CASP sheet for case-control studies

FIGURE LEGENDS

Figure 1. PRISMA flow diagram showing how the 28 papers included in this systematic review were identified. *one paper included an intervention in these two themes.

Figure 2. Forest plot showing results from five studies where the number of admissions with asthma are compared before and after a new care pathway was introduced.

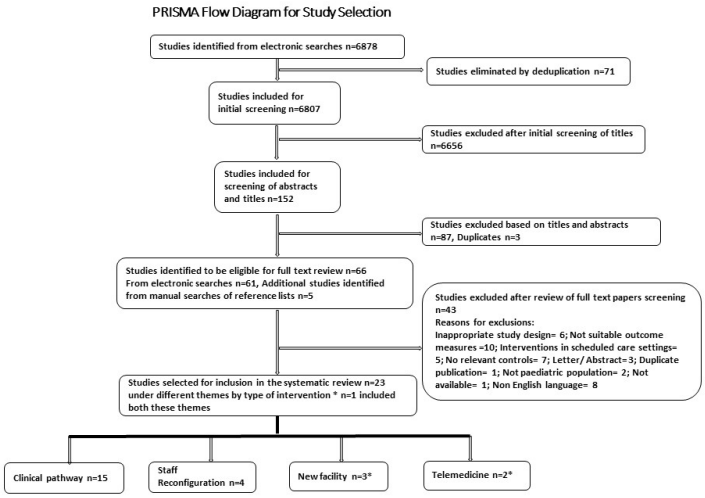

Figure 1. PRISMA flow diagram showing how the 28 papers included in this systematic review were identified. *one paper included an intervention in these two themes.

338x190mm (96 x 96 DPI)

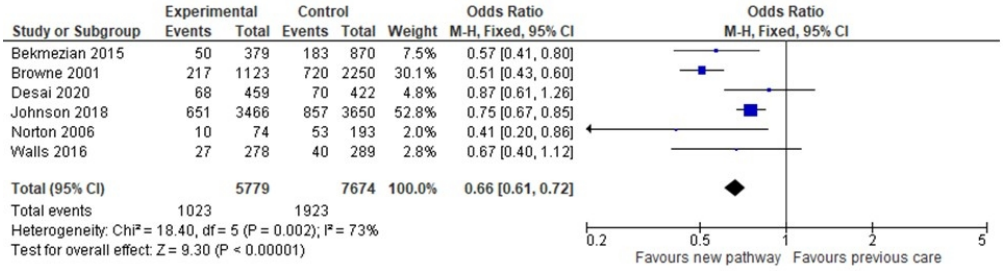

Figure 2. Forest plot showing results from five studies where the number of admissions with asthma are compared before and after a new care pathway was introduced.

254x190mm (96 x 96 DPI)

Supplemental figure one. Terms used in the search strategy for the literature review.

Ovid Medline ® and Epub ahead of print, In process and other non-indexed citations daily and versions (R) 1946 to April 17, 2020

1. (Consultant* adj10 emergency).ti,ab.(376)
2. Consultant led service.ti,ab.(17)
3. (Consultant adj2 review).ti,ab.(72)
4. exp Medical Staff, Hospital/ec, sd [Economics, Supply & Distribution](1834)
5. exp Triage/mt [Methods](3069)
6. (Triage adj2 (evaluat* or scale* or tool* or system* or consultant or telephone)).ti,ab.(2665)
7. (Consultant* and telephone referral*).ti,ab.(2)
8. Assessment unit*.ti,ab.(646)
9. (Ambulatory adj2 (unit* or assessment)).ti,ab.(1017)
10. (Short-stay adj2 (ward* or observation or unit*)).ti,ab.(455)
11. (Rapid access adj2 (clinic* or unit*)).ti,ab.(149)
12. Day unit*.ti,ab.(256)
13. (Fast track adj2 (ward* or observation or unit*)).ti,ab.(34)
14. (Acute adj2 (observation or unit* or clinic)).ti,ab.(3618)
15. (Emergency adj1 (ward* or observation or unit* or clinic*)).ti,ab.(5025)
16. (Guideline* adj2 (evaluat* or implement* or develop* or approach or assess*)).ti,ab. (22325)
17. exp Emergency Medicine/st [Standards](1566)
18. (Checklist adj2 (evaluat* or implement* or develop* or approach or assess*)).ti,ab.(2495)
19. (Algorithm adj2 (evaluat* or implement* or develop* or approach or assess*)).ti,ab.(14866)
20. exp Telemedicine/(27596)
21. Home Care Services/(33157)
22. exp Education, Medical, Continuing/ (24674)
23. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22(142301)

24. Child/(1669680)
25. Infant/(783660)
26. adolescence/(2004315)
27. Infant, Newborn/(598280)
28. exp Infant, Newborn/(601800)
29. exp Child, Preschool/(908133)
30. 24 or 25 or 26 or 27 or 28 or 29(3521807)
31. (child* or paediat* or pediat* or adolesc*).ti,ab.(1660012)
32. 30 or 31(3943341)
33. (Accident adj emergency).ti,ab.(264)
34. 'A&E'.ti,ab.(22427)
35. Emergency room.ti,ab.(17438)
36. Emergency department.ti,ab.(79885)
37. exp Emergency Service, Hospital/(76720)
38. exp Hospitals/(271731)
39. (Hospital adj3 (admission* or admit*)).ti,ab.(86613)
40. ((Doctor or GP or general practitioners) adj5 refer*).ti,ab.(3149)
41. (Emergency adj2 admission*).ti,ab.(4663)
42. Emergency care.ti,ab.(8644)
43. 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42(498813)
44. 32 and 43(114671)
45. 23 and 44(3536)
46. limit 45 to yr="2000-Current"(2812)

Supplemental figure two. Funnel plot comparing effect of interventions where a care pathway for asthma was introduced against a measure of study precision. OR=odds ratio. SE=standard error.

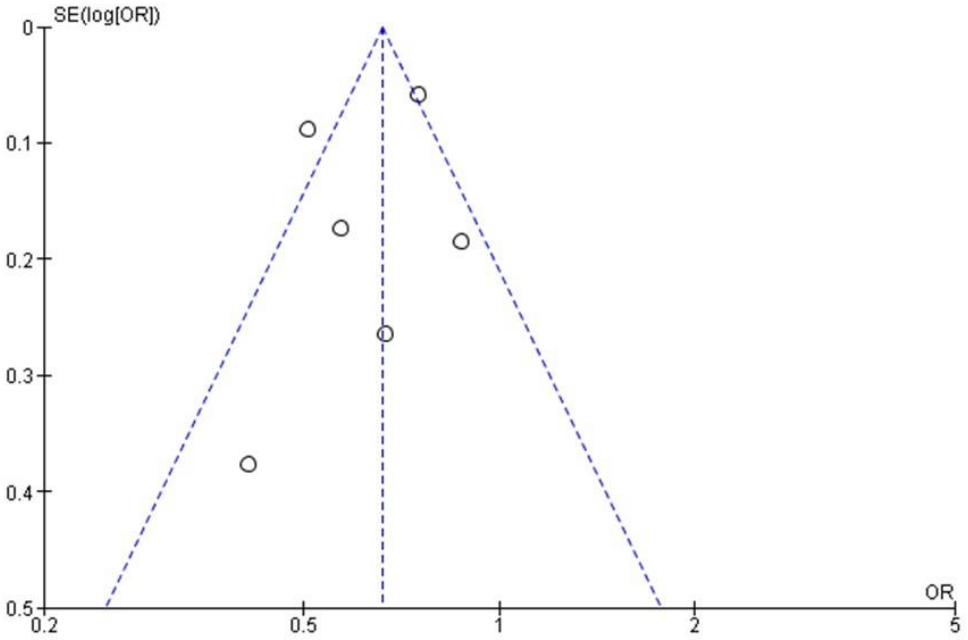

Table S1. Details of interventions in papers included in this review.

Category of intervention	Study	Country	Study design	Intervention
Guideline/ care pathway (for diarrhoea or seizure)	Armon *et al.* (2004)	UK	Before and after	Implementation of a care pathway for managing children with diarrhoea or seizure presenting to the paediatric A&E department. The pathways contained boxed areas for the initial recording of observations and historical and examination findings to facilitate documentation of important signs and symptoms. Comparator was the admission rate in the period before care pathway implementation
Guideline/ care pathway (for asthma)	Bekmezian *et al.* (2015)	US	Before and after	Implementation of an asthma clinical pathway which included clinical decision support tools for rapid assessment of exacerbation severity, response to treatment and designation of the timing and sequence of intervention for patients according to severity. Comparison with historical records from pre implementation period.
Guideline/ care pathway (for asthma)	Bergert *et al.* (2014)	US	Before and after	Evaluation of compliance with Children's Asthma Care measures in children hospitalized with a primary diagnosis of asthma. Readmission and Emergency Department utilization rates compared between pre and post implementation periods.
Guideline/ care pathway (for asthma, croup or gastroenteritis)	Browne *et al.* (2001)	Australia	Before and after	Implementation of clinical pathways for management of asthma, croup and gastroenteritis in the emergency department (ED) which included a short stay ward. Pre implementation period.
Guideline/ care pathway (for croup)	Chin *et al.* (2002)	Australia	Before and after	Implementation of croup clinical pathway in the ED. The ED had a short stay ward supervised by paediatric emergency physicians. Before implementation of croup clinical pathway
Guideline/ care pathway (for influenza like illness)	De Marco *et al.* (2005)	Italy	Comparison between non - randomised groups	Children treated by paediatricians trained in clinical practice guidelines for Influenza like illness. Children treated by paediatricians not trained in clinical practice guidelines for Influenza like illness.
Guideline/ care pathway (for anaphylaxis)	Farbman *et al.* (2017)	US	Before and after	This was a quality improvement intervention consisting of Implementation of evidence based guideline on management of anaphylaxis. Pre implementation period.
Guideline/ care pathway (for asthma)	Fassl *et al.* (2012)	US	Before and after	Implementation of asthma care process model to standardize care and improve quality. Pre implementation period.

Guideline/ care pathway (for asthma)	Johnson *et al.* (2018)	US	Before and after	Implementation of asthma care guideline to standardize care from ED arrival. Period pre asthma care guideline implementation.
Guideline/ care pathway (for asthma)	Norton *et al.*(2007)	Canada	Before and after	Clinical pathway for emergency care of children with asthma. Two independent cohort groups of children with acute asthma.
Guideline/ care pathway (bronchiolitis)	Perlstein *et al.* (2000)	US	Before and after	Implementation of a clinical practice guideline for care of infants admitted with first episode of bronchiolitis Similar patients discharged from hospital in the pre guideline implementation period Patients with patients seen during peak gastroenteritis period before guideline implementation
Guideline/ care pathway (for gastroenteritis)	Perlstein *et al.* (2002)	US	Before and after	Implementation of clinical practice guideline for preventing and treating acute gastroenteritis. Patients with patients seen during peak gastroenteritis period before guideline implementation
Guideline/ care pathway (for syncope)	Raucci *et al.* (2014)	Italy	Before and after	Implementation of guideline for management of children presenting to the ED with a primary complaint of syncope. Children presenting to the ED with a primary complaint of syncope in the 2 year period before guideline implementation
Guideline/ care pathway (for all presentations)	Takahashi *et al.* (2016)	Japan	Comparison between non - randomised groups	Implementation of the modified Japanese Triage and Acuity Scale (JTAS). Admission rates before down triage (using initial JTAS)
Guideline/ care pathway (for asthma)	Walls *et al.* (2017)	US	Before and after	Implementation of an evidence based pediatric asthma guideline. Comparator was data from patients seen 12 months before guideline implementation
Guideline/ care pathway (for asthma)	Desai et al. (2020)	US	Before and after	Implementation of a pediatric asthma pathway in both ED and inpatient wards of two community hospitals. Pre implementation period.

Guideline/ care pathway (for Viral Lower respiratory tract infection (VLRTI))	Havdal et al. (2021)	Norway	Before and after	Implementation of admission guidelines for Viral lower respiratory tract infections (VLRTI). Pre implementation period.
Guideline/ care pathway (for febrile illness)	Mercurio et al. (2020)	US	Before and after	Implementation of Clinical Practice Guidelines for febrile illness. Pre implementation period.
Guideline/ care pathway (for Bronchiolitis)	Yeo et al. (2020)	Australia	Before and after	Implementation of a hospital bronchiolitis guideline. Pre implementation period.
Staff reconfiguration (review by consultant within 12 hours)	Cromb *et al.* (2017)	UK	Before and after	Review of unplanned admissions within 12 hours by the duty consultant paediatrician. Pre implementation unplanned admissions were reviewed within 24 hours
Staff reconfiguration (increased consultant in ED)	Geelhoed *et al.* (2008)	Australia	Before and after	Increased presence of consultant staff in ED. Period before increase in consultant presence
Staff reconfiguration (triage to be seen by GP or ED staff)	Smith *et al.* (2018)	UK	Comparison between non - randomised groups	Patients triaged as GP appropriate seen by the GP. Patients triaged as GP appropriate but seen by ED staff (out with GP hours).
Staff reconfiguration (emergency review clinic)	Rai *et al.* (2016)	Ireland	Before and after	Opening of an emergency review clinic. Period before the opening of the emergency review clinic
New ward (new short stay ward)	Browne *et al.* (2000)	Australia	Before and after	Opening of new short stay ward in the ED of a large pediatric unit. Admission numbers compared with period before opening of the new short stay ward.

New ward (new paediatric short stay ward in ED)	Margolis *et al.* (2016)	Australia	Before and after	Opening of the new paediatric ED. Period before opening of the new paediatric ED when a combined ED was used
Telemedicine	Yang *et al.* (2015)	US	Comparison between non - randomised groups	ED patients receiving telemedicine consultation. ED patients receiving telephone consultation
New ward and telemedicine	Husk *et al.* (2018)	UK	Before and after	Introducing an A&G phoneline and opening of SSPAU. Period before A&G phoneline and opening of SSPAU.
Telemedicine	Friedman et al. (2020)	US	Before and after	ED patients receiving telemedicine medical screening evaluation at triage. Patients receiving standard triage.

FOLLOW UP OF UK INITIATIVES

Methods

The clinical teams involved in initiatives identified in "Healthy London Partnership. Compendium"[10] were contacted excepting initiatives which either primarily reduced the length of stay in hospital or supported parents to self-manage minor illnesses or which focussed on hospital to hospital transfer. The following questions were asked:

1. Does the initiative remain active?
2. If active, has the design of the initiative changed since inception and has a re-evaluation been performed?
3. If inactive, what was the reason (e.g. withdrawal of funding) for discontinuation?

Components of each initiative were categorised by themes analogous to those arising in the systematic review.

Results

At least one of the four approaches, i.e. care pathways, reconfiguration of staff, new facility and telemedicine identified in our literature review was present in 14 of the 24 initiatives described in a document from the "Healthy London Partnership". Details of the 24 initiatives are described in supplemental table one. We identified an additional two themes of primary care/community-based and primary care educational initiatives. Across all 24 initiatives the following themes were identified (some initiatives included more than one theme): clinical pathway n=4, reconfiguration of staff n=2, opening new facility n=3, telemedicine n=9, community-based n=17, education n=7 (Table S1). All 24 initiatives were contacted, and an update was available in 18, of which 13 remain active (range 4-15 years duration, six with one theme, two with two themes and five with more than two themes). Of the five initiatives no longer active, one had one theme, three had two themes and one had three themes (Table S2).

Table S2. Details of the initiatives described in the Healthy London Partnership. Compendium: New Models of Care for Acutely Unwell Children and Young People. 2016

	Model	Years the model was operational	Still Running (Y/N/N/A)*	Theme/s	Intervention based in the ED/ Hospital/ Primary care and/or community†	Number of facets (Mono/ Bi/ Multi)
Models that primarily prevent acute presentation to hospital and prevent admissions	C3	May 2014 to June 2016	N	Education, Primary care/ Community Based	Primary care and community	Bi
	Cambridge	2006 still running with changes	Y	Additional Staff	Hospital	Mono
	CRAFT		N	Telemedicine, Primary care/ Community Based	Community	Bi
	Gloucester	Still running, no changes	Y	Clinical Pathway	Primary care	Mono
	Kingston	Still running no changes	Y	Primary care/ Community Based	Primary care and Community	Mono
	Nottingham	Pilot 2013, Started 2015	N/A	Telemedicine	Primary care and hospital	Mono
	Salford	2011	N	Primary care/ Community Based	Primary care and community	Mono
	Smithdown	2005	N/A	Primary care/ Community Based	Primary care	Mono
	Taunton	Still running with changes	Y	Telemedicine, Additional Staff, Primary care/ Community Based	Hospital and Primary care	Multi
	West Sussex	Discontinued in 2016	N	Clinical Pathway/Primary care/ Community Based	Primary care	Bi
Models that aim to prevent both Emergency Department attendance/ admission to hospital and reduce length of	COAST	2008	N/A	Telemedicine	Primary care	Mono
	Lewisham and Greenwich	Programme still running with changes	Y	Primary care/ Community Based	Community	Mono
	Luton	2014 still running, no changes	Y	Clinical Pathway, New Facility, Telemedicine, Primary care/ Community Based	ED, Hospital, Primary care and Community	Multi
	Manchester		N/A	Primary care/ Community Based	Community	Mono
	South Staffordshire	Still running with changes	Y	Primary care/ Community Based	Community	Mono
	South Tyneside	1998 still running with changes	Y	Clinical Pathway, New Facility, Education, Primary care/ Community Based	Community, Hospital	Multi

stay in hospital	Warrington	2013 still running with changes	Y	Primary care/ Community Based	Community	Mono
	Worcestershire	1996 still running with changes	Y	Education, Primary care/ Community Based	Community	Bi
Models that have a different aim to those above but also impact on acute activity	CC4C	2012	N/A	Education, Telemedicine, Primary care/ Community Based	Primary care and community	Multi
	Evelina	2016 still running with changes	Y	Clinical pathway, Education, Telemedicine, Primary care/ Community based	Primary care and community	Multi
	King's College	2009 still running, no changes	Y	Education, New Facility, Telemedicine, Primary care/ Community Based	Primary care and community, ED, hospital	Multi
	Partners in Paediatrics (PiP)	2010	N/A	Education	Primary care	Mono
	Rotherham	1995 still running with changes	Y	New Facility	Hospital, ED	Mono
	The Bridge	2014 discontinued 2017	N	Education, Primary care and community	Primary care and community	Bi

*Y=still running, n=13; N=Discontinued, n=5, N/A=Information not available n=6. †Primary care, community or primary care and community depending on where the intervention was delivered, e.g. Gloucester delivered in primary care, CRAFT delivered in children's homes, CC4C included teams from primary care and social services.