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Development of the Paediatric Appropriateness Evaluation Protocol for use in the United Kingdom

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Abstract

Background This paper describes a study to develop and test an instrument to measure the level of appropriate admissions and days of care in the paediatric hospital population.

Methods The American version of the Paediatric Appropriateness Evaluation Protocol (PAEP) was modified by the consensus views of a panel of paediatricians and general practitioners. Reliability was tested in a pilot study in a random sample of 47 admissions from two district general hospitals.

Results The agreement beyond chance for the raters using the PAEP for admission criteria was excellent ($\kappa = 0.848$). It was poor ($\kappa = 0.345$) for clinicians using subjective judgement. The agreement beyond chance for the day of care criteria was good ($\kappa = 0.54$). Trained reviewers achieved much higher reliability using the PAEP.

Conclusion The modified PAEP achieved high reliability and was judged acceptable by clinicians to retrospectively assess the appropriateness of admissions in the UK setting.

Keywords: PAEP, reliability, validity, admissions

Introduction

The need to assess the appropriateness of paediatric admissions is becoming increasingly topical in the United Kingdom. Evidence that paediatric admissions are increasing,[1,2] together with the suggestion that many admissions may be inappropriate, has renewed interest in the utility of utilization review instruments, which are widely used in North America to assess the appropriateness of admissions. One of the most widely used utilization instruments for assessing paediatric admissions is the Paediatric Appropriateness Evaluation Protocol (PAEP), which was modified by Kreger and Restuccia[3] from the adult version of the same instrument.[4] The adult version has been subject to independent validation and has been used in Europe in several studies.[5–7] Little work has been reported on the use of the paediatric version, although it has undergone a validation process in North America by its developers and other researchers.[3,8] The PAEP has not been used in the United Kingdom, although in an important paper, Werneke *et al.*[9] described the attempted validation of the North American PAEP for use in the NHS. They found that it had limited validity for evaluating British paediatric admissions and pointed out that utilization review tools developed in one health system may not be transferable to another. This paper describes the technique for the modification of the PAEP and the testing of its reliability and validity for use in the United Kingdom.

Methods

The PAEP was modified in a two-stage process, closely following the approach used by its American developers.[3] A consensus panel of eight clinicians [paediatricians and general practitioners (GPs)] chaired by the author, using a nominal group technique, made alterations to the American version of the PAEP so that it had face and content validity for use in the United Kingdom. The modified PAEP was then used by the clinicians and trained researchers in a pilot study to assess the reliability of the modified instrument. This was done on a random selection of case records of 47 admissions from two district hospitals. The case records were summarized by the author for the pilot study. In addition to looking at day of admission details, the panel also looked at criteria for the appropriateness for days of care on 13 of the 47 records where patients stayed in hospital for more than 48 h.

A separate group of two clinicians also examined the 47 case records using their own subjective judgement about the appropriateness of the admissions.

Use of the PAEP

The PAEP is divided into a series of admission criteria, which are applied to the day of admission. A separate set of criteria are applied to days of stay in hospital that are greater than 48 h – these criteria are applied to the day before discharge. Within the

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admission criteria, there is a subdivision of criteria into items related to the severity of illness of the patient and to the intensity of service required by the patient on admission. Within the day of care criteria, the subdivision is into medical services required by the patient, nursing life support services and the condition of the patient. Raters using the PAEP assess the day of admission (or the day before discharge) to ascertain if features in the admission fulfil any of the specified criteria (Appendix 1). An admission is judged appropriate if any of the criteria are fulfilled.

Where a specific criterion was considered sufficiently broad or where there may be ambiguity over what was meant by a specific term, precise instructions were given as to what features in a case history would be required in order for a criterion to be satisfied. For example, in the severity of illness criterion covering persistent fever for more than 48 h, raters were told that there had to be a documented record of a fever in the notes (or transcribed notes in the case of the pilot study). Simple reference to the child being hot/feverish was not considered sufficient if this criterion was to be satisfied. A comment by the GP in a letter that the child had been feverish for 48 h was considered acceptable.

The day of care criteria were applied to the day before discharge on all admissions longer than 48 h. The assumptions underlying these criteria were similar to the admission criteria in that children needed to be in hospital if they required services that only could be provided in hospital by either nurses or doctors or their condition was such that they had to be in hospital.

Particular attention is given to the use of the overrides. The use of overrides was incorporated in the PAEP by its developers for several reasons.[3,4] A limit of 30 criteria had been set in the development of the adult AEP, so that it could be readily memorized by reviewers. Gertman and Restuccia realized that such a short list could never be sufficiently comprehensive to be applicable to all patients. They had noted that in previous studies of utilization reviews, physicians and nurses tended to fudge data when faced with criteria that did not cover situations comprehensively. Raters were therefore allowed to override an assessment even though one or more of the criteria were fulfilled.

For example, if the criterion for fever of 48 h was fulfilled but the rater still thought the admission was inappropriate, he/she was allowed to override the final assessment. Similarly, if none of the criteria were fulfilled but the rater thought that the child should have been admitted, then the final assessment although inappropriate could be overridden. The developers of the American PAEP also used the use of overrides as an internal checking procedure to ensure that the instrument was being used correctly. For example, a high use of overrides could suggest that the admission criteria were not sufficient or were incomplete and may have to be redeveloped. They also felt that the use of overrides should not exceed more than 10 per cent of all cases analysed.

Results

The consensus process

The majority of criteria were left unaltered when compared with the American PAEP – particularly those relating to physiological measurements. Because of the important role of general practitioners in the referral process of children to hospital, several criteria were modified with much stricter requirements being defined for admission criteria. For example, in the day of care criteria staying in hospital for the administration of intravenous (i.v.) drugs was not always considered necessary, especially for chronic conditions such as cystic fibrosis. This was therefore made explicit in the wording of the criterion that was finally chosen. Important changes were also made to the criteria for when a child needed to be admitted for investigation of child abuse, with the explicit statement that the non-availability of alternative care would have to be stated if the admission was considered appropriate. This was not stated clearly in the American PAEP. Addition was also made to make allowance for the universal feeling amongst the consensus group that there needed to be a criterion for social admissions, but the circumstances in which these could be allowed were strictly defined. Overall, as far as the admission criteria were concerned, the important changes were related to the criterion dealing with special paediatric problems.

Differences in admission for suspected cases of child abuse were an example where it seems that the norm was that they would automatically be admitted to hospital in the US whereas the British paediatricians would accept this as a reason for admission only if there was no alternative. Most of the debate took place on criterion 14, ‘Special paediatric problems’. This was the section that was most different from the American PAEP. The wording chosen in the United Kingdom required that there be some record by the GP that the reason for referral was that the family could not cope in the present circumstances. However, there was no consideration of the problem of what happens when a GP could not cope – for example because of the demands of daily visiting. Addition of a criterion was also made to the legitimate need for admission for respite care. Similarly, as far as day of care criteria were concerned, those related to the physiological status of the patient remained largely unchanged. A clearer statement was required by the consensus group in several of the criteria that home care was not possible. The need to remain in hospital to be assessed by professionals allied to medicine (for example, physiotherapists, speech therapists, occupational therapists) and social services was considered unacceptable in the UK setting except in the case of respite care.

Results of reliability testing

Table 1 shows the agreement between raters using the modified PAEP admission criteria. Also included in the table is the agreement between two clinical raters (raters 10 and 11) who

Table 1 Percentage agreement between raters using the PAEP admission criteria modified for use in the United Kingdom and clinical raters using their own judgement

									Clinical raters	
PAEP raters	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	95.74	91.49	83.36	95.74	87.23	93.62	95.74	82.92	72.3	65.9
2		91.49	93.62	95.74	87.23	97.87	95.74	82.98	72.3	65.9
3			93.62	91.49	87.23	91.49	91.49	91.49	65.9	65.9
4				91.49	89.36	91.49	93.62	93.62	68.0	68.0
5					91.49	93.62	100	87.23	70.2	68.0
6						89.36	91.49	95.74	68.0	65.9
7							95.74	89.36	65.9	68.0
8								87.23	68.0	68.0
9									65.9	68.0
10										59.5

Raters 1 and 8 = trained PAEP raters (researchers): raters 2, 3, 6, 7, 9 and 11 = consultant paediatricians: raters 4, 10 = general practitioners: rater 5 = author.
Overrides and uncertainty: PAEP raters' overrides 26/423 = 6.14%; clinical raters' 'can't decide' 14/94 = 14.8%.
Overall agreement: overall agreement PAEP raters = 82.9%; overall agreement clinical raters = 59.5%.
κ statistic: κ PAEP raters = 0.848, SE = 0.0226, K/SE (k) = 37.54; κ clinical raters = 0.345, SE = 0.1145, K/SE (k) = 3.016; κ researchers = 0.9186, SE = 0.0507, K/SE (k) = 18.11.
Appropriateness: average appropriate ratings by PAEP raters = 57%; average inappropriate ratings by PAEP raters = 42%; total appropriate ratings by clinical raters = 63%; total inappropriate ratings by clinical raters = 46%.

assessed the patient records without the benefit of predefined criteria, but used their subjective judgement.

In nearly 15 per cent of cases, clinicians using their subjective judgement were unable to make a decision on the appropriateness of admission, compared with 6 per cent of cases for clinicians using objective criteria. Overall agreement was higher for raters using the objective criteria of the PAEP (82 per cent) compared with 59 per cent for raters using their subjective judgement. The agreement in terms of reliability of PAEP clinicians was much higher ($\kappa = 0.85$) compared with the reliability of the clinicians using their subjective judgement ($\kappa = 0.35$). The agreement between the researchers ($\kappa = 0.91$) was higher than for both groups and suggests that non-doctors can be trained in the use of the PAEP and produce reliability results as good as doctors.

The PAEP raters assessed an average 57 per cent of admissions as appropriate, compared with 63 per cent for the raters using their subjective judgement. The average inappropriate rate for PAEP raters was 42 per cent compared with 46 per cent for raters using their subjective judgement. Table 1 also shows that the agreement between clinical raters and PAEP raters was greater than the agreement between clinical raters themselves.

The PAEP is designed to be used on days of admission and days of stay in hospital. The criteria for each of these is different because of the recognition by the developers of the PAEP that admission criteria may influence subsequent days of care in hospital – hence the need to assess them separately. Table 2 shows the assessment of the day of care criteria by the trained PAEP raters.

Unlike the admission criteria, no comparison was made with clinicians using their subjective judgement because the

Table 2 Percentage agreement between raters using PAEP day of care criteria modified for use in the United Kingdom

PAEP raters	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	92.3	69.2	84.6	84.6	84.6	84.6	92.3	84.6
2		76.9	76.9	76.9	92.3	76.9	84.6	76.9
3			53.8	69.2	61.5	69.2	84.6	69.2
4				76.9	69.2	84.6	76.9	84.6
5					76.9	84.6	92.3	84.6
6						69.2	76.9	69.2
7							92.3	100
8								92.3

Raters 1 and 8 = trained PAEP raters; raters 2, 3, 6, 7 and 9 = consultant paediatricians PAEP raters; rater 4 = GP; rater 5 = author.
Appropriateness: appropriateness ratings by PAEP raters = 53%; inappropriateness ratings by PAEP raters = 46%.
κ statistic: κ PAEP raters = 0.54300, SE = 0.0309, K/SE (k) = 17.56; κ researchers = 0.847, SE 0.147, K/SE (k) = 5.76.

information available in the transcribed records to assess days of care was much less than that for admissions. This is a reflection of the fact that most of the information relating to a patient is entered on admission to hospital and subsequent information in the notes is very brief.

Table 2 shows that agreement amongst PAEP raters for days of care criteria ($\kappa = 0.54$) was lower than that for admission criteria ($\kappa = 0.84$). The trained PAEP researchers had a κ value that was substantially higher ($\kappa = 0.847$) than that of the consultant paediatricians ($\kappa = 0.543$).

Discussion

Problems with using consensus panels

The initial phase of the study was carried out during the preparatory phase for the implementation of the 1990 NHS reforms and there was considerable suspicion and fear about the increasing role of management in limiting clinical freedom. In particular, there was a concern that managers would use the development of criteria for the appropriateness of admissions to restrict the admission of children to hospital if they did not fulfil the criteria. The initial reluctance of clinicians to be involved in this exercise may have resulted in a more conservative development of criteria during the consensus process. This was apparent during the development of criteria for social admissions, with clinicians keen to emphasize the uniqueness of the British child health care system in its treatment of social problems. Although criteria suggesting social admissions were included in the modified PAEP, the issue of whether children with 'social problems' need to be in hospital was never really discussed and challenged. In effect, the methods used to develop the PAEP merely provided a refined way of recording conventional views about the efficacy of hospital intervention. There is a tendency for consensus statements to err on the side of caution and in the view of some commentators[10,11] merely reinforce existing beliefs and prejudices.

An important factor in trying to achieve consensus amongst a group is the role of the chairman of the panel. This has been highlighted by Hicks[10] and it may be true that my role as chairman of the panel enabled me to guide the discussion and focus the panel on important issues. Therefore, if another group was attempting to develop similar criteria the outcome in terms of consensus may be different. An additional problem that may have improved consensus is that because I was responsible for transcribing the notes, I may have been selective in the information that I obtained from the notes. If this did happen then I may have inadvertently improved the reliability of the clinicians' judgement because they were being given selected information. My decision to transcribe the notes was made for pragmatic reasons because I knew that clinicians would not take the time to read complete unabridged clinical records.

Absence of a 'gold standard'

One of the greatest limitations to the assessment of the validity of the PAEP is the absence of a 'gold standard'. The term validity refers to the extent that a measure agrees with truth, or at least another measure that is trusted to accurately measure the target variable.[12,13] In the case of the PAEP there is no absolute indicator of whether the admission of an episode of in-patient care is needed. In the absence of such a 'gold standard' Gertman and Restuccia[4] used concepts such as 'predictive validity' to measure the ability of a nurse reviewer to 'predict' the appropriateness decision that would be made by an expert physician reviewer. They also felt that frequent use of the overrides would undermine validity and used the arbitrary cut-off point of 10 per cent as an indicator of good or poor validity. Face validity was assessed through critical review by physician committees.

Attempts to define validity in terms of the ability of clinicians to be consistent in their use of the PAEP and the comparison of clinicians and nurses are really measures of reliability of two different groups and do not give the instrument any extra validity. Similarly, attempts to define predictive validity on the basis of nurses using the instrument prospectively and then assessing whether the admission was appropriate when the same instrument was used by clinicians again does not deal effectively with the absence of a gold standard. Strumwasser *et al.*[14] attempted to use the majority opinion of clinicians as a gold standard. Such a method was also used by Werneke *et al.*[9] in their attempt to validate the American version of the PAEP for use in the NHS. There are several problems with this approach. The early studies using the AEP showed that clinicians using subjective judgements to assess records had poor reliability compared with clinicians using objective criteria.[4,8] My study confirmed this finding, with clinicians using subjective judgements achieving κ values of 0.34 compared with κ of 0.84 for clinicians using objective criteria. Consequently, using as a test of validity the views of clinicians whose reliability is poor, even under experimental conditions, is questionable.

Broadly speaking, the PAEP is valid in so far as it has face validity. In the absence of a truly valid measure, such as a gold standard, face validity is the only form of validity that can be commented on.[12,13] The fact that clinical raters using subjective criteria can agree more with clinicians using objective criteria of the PAEP than amongst themselves is a useful addition to the arguments for its validity. Furthermore, the fact that the instrument produces results that are plausible as detailed in the large field study – for example, the finding that younger children are more likely to be admitted inappropriately, that GP admissions are more appropriate, and that admissions for fractures and appendicitis are appropriate – improves its standing as a valid instrument. Validity would be improved if the study was repeated with a panel of clinicians

using the PAEP who were not involved in its development. There are some other serious methodological problems associated with instruments such as the PAEP and these have been well articulated by Phelps.[11]

The difficulty of assessing days of care and the poor reliability of this part of the instrument – (clinical PAEP raters achieved an agreement with a $\kappa = 0.54$) compared with the admission criteria ($\kappa = 0.84$) is a cause for concern. I cannot readily explain the reason for the greater inter-rater agreement for the admission criteria compared with the day of care criteria, although, interestingly, amongst the trained researchers, agreement for both the admission criteria and day of care criteria was excellent. The worry is that the day of care criteria are not valid and that this is reflected by the greater disagreement. However, this is unlikely because the method of validation did not differ between the admission criteria and the day of care criteria. What did differ was the level of training between the clinicians and trained reviewers. In retrospect, the sample in the pilot study to assess the day of care criteria was probably too small and this part of the study should be subjected to further validation, particularly because the findings have a much wider implication.

The fact that a group of clinicians and trained reviewers can reach high levels of reliability is a strength of the instrument and could give it added credibility amongst clinicians, but in terms of its use as a research instrument or audit tool, the reliability achieved by the trained reviewers is probably the most important factor.

In summary, it can be argued that there are serious methodological flaws with the use of the PAEP particularly if an attempt is made to use it prospectively as a 'gold standard' by which to assess admissions. However, its reliability is very high, when used by clinicians and trained reviewers. The stability of this measure during prolonged field testing suggests that, with appropriate training of reviewers, it remains a highly reliable utilization review instrument.

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Appendix 1

Paediatric AEP: admission criteria (UK version)

A. Severity of illness criteria

(1) Sudden onset of unconsciousness (coma or unresponsiveness) or disorientation.
(2) Acute or progressive sensory, motor, circulatory or respiratory embarrassment sufficient to incapacitate the patient (inability to move, feed, breathe, urinate, etc.).
(3) Acute loss of sight or hearing.
(4) Acute loss of ability to move a major body part.
(5) Persistent fever $\geq$37.8°C (100°F) orally or $\geq$38.3°C (101°F) rectally for more than 48 h and where a diagnosis has not been established.
(6) Active bleeding which could lead to circulatory embarrassment if haemostasis is not secured.
(7) Wound dehiscence or evisceration.
(8) Severe electrolyte/acid–base abnormality (any of the following values):

(a) Na $\leq$123 or $\geq$156 mmol/l.
(b) K $\leq$2.5 or $\geq$5.6 mmol/l.
(c) HCO_3 $\leq$14 mmol/l (unless chronically abnormal).
(d) HCO_3 $\geq$ 36 mmol/l (unless chronically abnormal).

(e) Arterial pH ≤7.30 or ≥7.45.
(f) Urea >8 mmol/l.

(9) Haematocrit <30 per cent.
(10) Pulse greater than or less than the following ranges (optimally a sleeping pulse for a <12 years old):

1 month–6 months minus 1 day, 70–170/min
6 months–2 years minus 1 day, 80–160/min
2–6 years, 70–160/min
7–11 years, 60–160/min
≥12 years, 50–140/min.

(11) BP values outside the following ranges:

6 weeks–6 months minus 1 day, 70–110 mmHg (systolic)
6 months–2 years minus 1 day, 70–100/40–85 mmHg
2–6 years, 75–125/40–95 mmHg
7–11 years, 80–130/45–90 mmHg
≥12 years, 90–150/60–120 mmHg.

(12) Need for lumbar puncture, where this procedure is not done routinely on an out-patient basis.
(13) Any of the following procedures not responding to out-patient (including A&E and GP) management:

(a) Seizures.
(b) Cardiac arrhythmia.
(c) Bronchial asthma or croup.
(d) Dehydration.
(e) Persistent vomiting or diarrhoea which needs in-patient assessment.
(f) Abdominal pain which has been assessed either in out-patients or by the GP and which requires further in-patient assessment.

(14) Special paediatric problems:

(a) Child abuse where severity of injuries necessitates admission or a suitable safe placement is not available.
(b) Noncompliance with a therapeutic regimen where failure to comply amounts to neglect of the child which puts the child's immediate health or safety at risk.
(c) Need for special observation or close monitoring of behaviour, including calorie intake in cases of failure to thrive.
(d) Referred by GP because of inability to cope by carer and absence of any alternatives/social support.
(e) Respite care where no alternatives exist.

B. Intensity of service

(1) Surgery or procedure scheduled within 24 h necessitating

(a) general or regional anaesthesia; or
(b) use of equipment, facilities or procedure only available in a hospital.

(2) Treatment in an intensive care unit.
(3) Vital sign monitoring every 2 h or more often (may include bedside cardiac monitor).
(4) i.v. medications and/or fluid replacement (does not include tube feeding).
(5) Chemotherapeutic agents that require continuous observation for life-threatening toxic reaction.
(6) Intermittent nebulizer use at least every 4 h.

Appendix 2

Paediatric AEP: day of care criteria (UK version)

A. Medical services

(1) Procedure in operating room that day, if procedure is usually done on an in-patient basis in this situation.
(2) Procedure scheduled in operating room within 24 h, (48 h for bowel surgery) and which needs preoperative preparation requiring hospital facilities/personnel in 24 h (48 h for bowel surgery) prior to operation.
(3) Cardiac catheterization that day.
(4) Angiography, venography or lymphangiography that day.
(5) Invasive diagnostic/therapeutic procedure that day including biopsy of internal organ (not bone marrow), thoracentesis, paracentesis, cysternal or ventricular tap (not lumbar puncture).
(6) Any test requiring either

(a) strict dietary control for the duration of the test; or
(b) collection of a timed sample, lasting 8 h or more where this cannot be done at home.

(7) Documented medical monitoring by physicians on at least three separate occasions that day.

B. Nursing/life support services

(1) Respiratory care – any respirator use, mist tent, or three or more treatments with inhalation therapy, intermittent positive pressure breathing or chest physical therapy (percussion and drainage) where the carer has not been trained to do this at home.
(2) Parenteral (intravenous) therapy for at least 8 h that day where the carer has not been trained to do this at home.
(3) Continuous monitoring of vital signs OR at least every 30 min for at least 4 h or 24 h after such monitoring where this cannot be done at home.
(4) i.v. and/or subcutaneous injections (excluding insulin) on at least three separate occasions that day and where carer not trained to do this at home.
(5) Strict intake and output measurements and/or calorie counts that day, under doctor's orders and when this cannot be done at home.

(6) Major surgical wound or drainage care (e.g. chest tubes, tubes, Haemovacs).
(7) Traction for fractures, dislocations, congenital deformities or other orthopaedic conditions when this cannot be done at home.
(8) Close medical monitoring (vital signs, neurological checks or extremity checks) at least three times daily under doctor's orders.
(9) Respite care where there is no alternative.

C. Patient condition

Within 24 h of the day reviewed:

(1) Acute inability to void urine.
(2) Transfusion due to acute blood loss.
(3) Physician suspicion of suicide attempt so that a psychiatric opinion is requested.
(4) Physician suspicion of child abuse or neglect and where suitable alternative placement not available.

Within 48 h of the day reviewed:

(5) Temperature of least 38.3°C (101°F) rectally [at least 37.8°C (100°F) orally, if patient admitted for reason other than fever].
(6) Coma; unresponsiveness for at least 1 h.
(7) Acute confusional state.
(8) Acute haematological disorder (e.g. neutropenia, anaemia, thrombocytopenia).
(9) Progressive, acute neurological difficulties.

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