DEVELOPING RESEARCH AND PRACTICE

Evaluating the clinical appropriateness of nurses' prescribing practice: method development and findings from an expert panel analysis

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Background: The number of nurses independently prescribing medicines in England is rising steadily. There had been no attempt systematically to evaluate the clinical appropriateness of nurses' prescribing decisions.
Aims: (i) To establish a method of assessing the clinical appropriateness of nurses' prescribing decisions; (ii) to evaluate the prescribing decisions of a sample of nurses, using this method.
Method: A modified version of the Medication Appropriateness Index (MAI) was developed, piloted and subsequently used by seven medical prescribing experts to rate transcripts of 12 nurse prescriber consultations selected from a larger database of 118 audio-recorded consultations collected as part of a national evaluation. Experts were also able to give written qualitative comments on each of the MAI dimensions applied to each of the consultations.
Analysis: Experts' ratings were analysed using descriptive statistics. Qualitative comments were subjected to a process of content analysis to identify themes within and across both MAI items and consultations.
Results: Experts' application of the modified MAI to transcripts of nurse prescriber consultations demonstrated validity and feasibility as a method of assessing the clinical appropriateness of nurses' prescribing decisions. In the majority of assessments made by the expert panel, nurses' prescribing decisions were rated as clinically appropriate on all nine items in the MAI.
Conclusion: A valid and feasible method of assessing the clinical appropriateness of nurses' prescribing practice has been developed using a modified MAI and transcripts of audio-recorded consultations sent to a panel of prescribing experts. Prescribing nurses in this study were generally considered to be making clinically appropriate prescribing decisions. This approach to measuring prescribing appropriateness could be used as part of quality assurance in routine practice, as a method of identifying continuing professional development needs, or in future research as the expansion of non-medical prescribing continues.

Health service policy directives in the UK emphasise the need for modernisation of the National Health Service (NHS) to ensure its capacity to deliver accessible and high quality care to patients. Increasing patient access to medicines through diversifying the routes by which they are prescribed, supplied and administered is a key element of this modernisation process.[1] The extension of prescribing authority to nurses is intended to provide patients with quicker and more efficient access to medicines and to make the best use of nursing skills, while ensuring that patient safety is paramount.[2] Since 2002, the numbers of nurses able to independently prescribe medicines in the UK has been steadily rising, and, at the end of 2006, over 7000 nurses in the UK were qualified as nurse independent prescribers.[3] This growth in non-medical prescribing is an international practice development: legislation to allow nurse prescribing has been in place for many years in Sweden, the USA, Canada, Australia and New Zealand. Independent prescribing in the UK is defined as where ''the prescriber takes responsibility for the clinical assessment of the patient, establishing a diagnosis and the clinical management required, as well as responsibility for prescribing where necessary, and the appropriateness of any prescription.''[4] The number of medicines available to nurses to prescribe from the *Nurse prescribers' extended formulary* (*NPEF*) has continued to grow over the past few years.[5] Since May 2005, qualified independent nurse prescribers were prescribing from a list of about 240 prescription-only medicines and all general sales list and pharmacy medicines for about 110 clinical conditions listed in the *NPEF*. In May 2006, appropriately qualified nurses and pharmacists were given authority to independently prescribe *all* licensed drugs, with the exception of some controlled drugs.

Before the study reported here, research into nurse prescribing (for example, see Luker *et al*[6 7] and Otway[8]) was largely confined to descriptive accounts of views of district nurses and heath visitors trained to prescribe a few medicines from a nurse prescribers' formulary in the introductory first phase of nurse prescribing between 1996 and 2002. No previous research directly evaluated the quality or safety of nurses' prescribing practice. An evaluation was therefore needed of the appropriateness of the prescribing practices of the wider group of nurses now being trained in increasing numbers to prescribe independently from the *NPEF*. To be able to this, a suitable method for appraising their prescribing practice required to be developed.

The nature of prescribing ''appropriateness'' is to some extent contested, and broad definitions that move beyond considerations of pharmacological appropriateness alone are recommended.[9 10] We included patients' evaluations of several dimensions of the appropriateness of nurse prescribing consultations as part of the larger study reported elsewhere.[11 12] Nevertheless, in the light of the limited research into nurses' prescribing practice, and the cautions about this initiative that have been voiced in some quarters,[13] it was important to establish the pharmacological or clinical appropriateness of nurse prescribing.

Abbreviations: MAI, Medication Appropriateness Index; *NPEF*, *Nurse prescribers' extended formulary*

In a paper on the concept of appropriateness applied to prescribing, Buetow *et al*[14] summarised some of the methodological issues that influenced the approach taken in this study for the assessment of appropriateness. In previous research, the quality of evidence made available to rating panels has been variable, and failures to make explicit study aims and how judgments are to be made, and implicit criteria of appropriateness have generally been used to judge appropriateness. A review of related research undertaken as part of the study reported here also highlighted that in most of the small number of studies[9 15–17] attempts to rate clinical appropriateness of prescribing had been undertaken through application to episodes of prescribing recorded in medical records. One other study[18] used transcripts of doctors who had been asked to verbalise their prescribing decisions based on specially designed patient vignettes. The use of scenarios and records has been criticised for being divorced from actual encounters.[14] There has been a lack of research specifically focused on: (1) ratings of *nurses'* prescribing practices and (2) ratings of prescribing based on real consultations.

AIM

The research reported in this paper formed part of a study commissioned by the Policy Research Programme at the Department of Health. The aim of the larger study was to evaluate the expansion of nurse independent prescribing in England to inform future developments for prescribing in nursing and other health professions. The components of the larger study reported in this paper aimed to:

- establish a method of assessing the appropriateness of nurse prescribing;
- evaluate the clinical appropriateness of a sample of nurse prescribing decisions.

METHODS

Selecting a measure for assessing appropriateness of prescribing

Buetow *et al*[14] recommend that assessments of appropriateness are potentially useful if the evidence, value judgments and criteria used to guide them are made as explicit as possible. We reviewed the tools used to measure prescribing appropriateness to provide explicit criteria on which experts could base their judgments. Two such tools were rejected. The appropriateness of prescribing indicators (Prescribing Appropriateness Index)[17] was developed specifically to measure appropriateness of *long-term* prescribing by doctors, and many of the indicators could not be applied to nurses prescribing from a limited range of medicines for mostly short-term conditions. (At the time of the study, nurses were restricted to prescribing about 180 prescription-only medicines and all general sales list and pharmacy medicines for approximately 80 conditions.) The Pharmacological Appropriateness Ratings of Medicines (PARM)[9] was also considered unsuitable, as evidence of its reliability and validity had not been published, and details of the technique of its application to more than one medicine in a consultation were unclear.

The only prescribing appropriateness tool with published evidence of reliability and validity, and which was applicable to the current study, was the Medication Appropriateness Index (MAI) developed by Hanlon *et al*.[15] This consists of a 10-item instrument that had been used successfully by both doctors and pharmacists to rate appropriateness of prescribed drugs when applied to patients' records. Good inter-rater and intra-rater reliability coefficients were recorded in preliminary research.[15] The reliability of the MAI was further reported by Samsa *et al*[16] as well as satisfactory estimates of its content validity. Buetow *et al*[14] concluded from their review of prescribing appropriateness that the MAI is shown to provide a solid foundation for identifying dimensions of prescribing appropriateness.

Two minor modifications were made to the MAI prior to piloting in this study: an item on rating the comparative cost of the prescribed medicine was not considered applicable to assessments of nurse prescribing due to the restricted choice of medicines available to them in the *NPEF* at the time of the study. The original three-point Likert scale used by Hanlon *et al*[15] was also converted to a two-point scale as the original mid-point (labelled, for example, as ''marginally appropriate'') was considered to be slightly ambiguous. In addition, this had previously been combined into a two-point scale by Hanlon *et al*[15] during analysis of ratings in their research. (For an outline of items and response options in the modified MAI see table 3 in the Results section.)

Selection of experts

The evaluation of clinical appropriateness required judgments based on established and recognised prescribing expertise. Potential prescribing experts were initially identified using national networks of contacts that had been established during the lifetime of the project. The seven experts comprised five general practitioners (GPs) and two physicians/clinical pharmacologists. Of the GPs, two were in senior positions in academic departments of primary care in universities, two were in general practices, and one was a director of a national prescribing organisation; one physician/clinical pharmacologist was a senior academic based in a pharmacology department in a university and the other was employed as a consultant at a large teaching hospital. All of the experts were known nationally for either research into medical prescribing, clinical expertise in prescribing and/or were in leadership positions in national or regional prescribing-related organisations.

The sample of nurse prescribing consultations

A total of 128 prescribing nurses who took part in a national questionnaire survey in phase 1 of the study indicated that they would be willing to participate in phase 2. Ten prescribing nurses were initially purposively selected from these respondents as the focus for case study sites for phase 2. In purposive sampling, units are selected because they have particular characteristics which will allow investigation and understanding of the central themes and puzzles that the researcher wishes to study.[19] Selected units should both symbolise and represent features of the phenomenon under study and ensure that the sample is as diverse as possible within the parameters of the defined population to optimise the chance of identifying the full range of factors associated with the issue under investigation.[19] The criteria used to select the sample of nurse prescribers included: type of nurse and practice setting, reported prescribing rates above 10 items per week, and regular reported prescribing of antimicrobials. Four additional nurse prescribers practising at four of the ten sites initially selected were recruited into the study using these criteria during the process selection. The final sample consisted of: six nurse practitioners and two practice nurses in general practice settings, two senior nurses in a walk-in centre, two community midwives, a nurse consultant in secondary care and a community palliative care nurse.

Consistent with qualitative sampling principles, the case sites reflected both representativeness and range in clinical settings in which nurses are acting as independent prescribers—for example, in the phase 1 national survey, the largest group of respondents were nurse practitioners (56%, n = 138), whereas practice nurses comprised 10% (n = 25) and nurse specialists 6.5% (n = 16). All of the main clinical contexts in which nurses were independently prescribing at the time of the study were included in the sample selected for the case study sites.

The Thames Valley Multi-Centre Research Ethics Committee gave approval for the study to proceed. We then also obtained approval via research governance procedures in the trusts in which the case sites were located.

At each site, we collected data on between six and 16 of nurses' prescribing consultations via non-participant observation of consultations during sessions such as nurse-led clinics for minor ailments, family planning clinics and some home visits. An assessment of the range of competencies that nurses were using during consultations (eg, assessment and diagnosis skills, communication skills) was undertaken in situ by a member of the research team using a structured observation schedule. Consultations were also audio-recorded for later transcription and analysis.

A sample of 10% (n = 12) of the total number (n = 118) of nurse prescribing consultations recorded across the case study sites was used for the expert panel assessment of clinical appropriateness. A 10% sample of recorded consultations was sufficient to allow recordings from across the range of case study sites to be represented, while remaining a potentially feasible number for each expert to rate. The sample of consultations was purposively selected following an initial stratification by site. Following Ritchie and colleagues'[19] recommendations on representativeness and diversity, the aim of our purposive sampling was that consultations selected should represent the range of nurses in the 10 study sites as far as possible and a representative range of medicines and conditions should be included. A number of pragmatic criteria also influenced the purposive sampling criteria: it was a requirement of the project that a minimum of 50% of the consultations sampled should focus on the prescription of antibiotics; sampling was also influenced by the clarity of the audio-recording which needed to ensure that a full and detailed transcription could be achieved. In addition, where possible, the consultation episode would involve only one prescribed item to simplify the appropriateness rating for each of the consultations.

We first stratified the audio-recorded consultations by site and then the consultations were listened to by two members of the research team until a prescribing consultation meeting the above criteria was found. Each selected audio-recorded consultation was then transcribed, together with brief contextual details about the setting, the nurse and the patient. Details of the patient's age and gender were taken from the researcher's field notes, details of the medicine prescribed were extracted from details of the prescription recorded at the time of data collection, and details of what was recorded in the patient notes by the nurse were also included at the end of the transcript. Table 1 (see Results section) outlines the consultations used in the expert panel analysis.

Pilot study

Three consultations from the case study sites were sampled and transcribed, with details of the prescribed medication and brief contextual details about the setting, the nurse and the patient. These annotated transcripts and copies of the modified MAI were then sent to a GP with expertise in the field of prescribing to pilot the process.

The results indicated that the MAI could readily be applied to annotated transcripts of nurse–patient consultations and yielded data that were relevant in determining the appropriateness of nurse prescribing. Comments from the pilot GP also indicated that the process was feasible and not overly time consuming. However, the pilot study did show that it was not always possible to rate every consultation on all items in the MAI due to the nature of some of the transcriptions. For example, not all aspects of the nurses' assessment processes had been verbalised when electronic records were checked via the computer screen to determine issues such as a patient's past medical history or their current medication. For this reason, ''don't know'' and ''not applicable'' options were added to the modified nine-item MAI for the expert panel raters to use in the main study. Space was included for any qualitative comments that experts wished to make under each of the nine items.

Main study data collection

Following a personal approach by the research team, 12 annotated transcripts of nurse prescribing consultations and MAIs, details about the project, the aims of the rating process, instructions for completion, and a copy of the *NPEF* were sent by post to eight experts in September 2004. One expert declined participation after receiving the transcripts. Therefore completed MAIs from seven experts were received by the research team for analysis.

Data analysis

We analysed the data using SPSS version 12.0, and ratings were summarised (i) for each prescribing consultation on all nine MAI items across all seven experts and (ii) for each MAI item across all 12 consultations by all seven experts. Any written qualitative comments received under each item were extracted onto a main sheet and a process of content analysis, as described by Morse and Field,[20] was used to identify recurring issues within and across both the MAI items and each of the consultations. Any qualitative comments were generally limited to a sentence or two, and usually pertained to justification for experts' decisions about certain MAI items applied within the sample consultations. The content analysis procedure was therefore restricted to a process of organising these descriptive comments, initially according to the MAI item they related to. Following this, any recurrent issues both within and across MAI items were identified and quantification of their frequency of occurrence was carried out where appropriate.

RESULTS

Characteristics of the expert panel sample of consultations

Table 1 outlines characteristics and representativeness of the consultations selected from the database of 118 nurse prescriber consultations which were rated by experts using the MAI. Column 4 in table 1 gives details of the representativeness of the expert panel consultations in terms of medicine prescribing frequencies across the 118 prescribing episodes in the 10 case study sites. The medicines in the consultations sent to experts represented just over half (51%) of the medicines prescribed across the case study sites. A wide range of medicines was prescribed by nurses in the case sites (51 in total); all the most frequently prescribed medicines (≥4 times) are represented in the consultations except for Gaviscon liquid for dyspepsia which was prescribed seven times (5.9% of total) in three different case studies, ibuprofen for pain (four times in one site, 3.3% of total) and Senna for constipation (four times in one site, 3.3% of total). Representativeness of the sample of consultations sent to the expert panel is also illustrated with reference to data from the postal questionnaire in phase 1 of the study (246 independent nurse prescriber respondents): the five conditions most commonly prescribed for were: skin conditions (24%, n = 149), family planning (15%, n = 92), soft tissue injury (12%, n = 72) and urinary tract infections (10%, n = 62). Eighty two per cent (n = 202) of nurse prescribers in England prescribed antibiotics. The conditions that antibiotics were most frequently prescribed for included: urinary tract infections (35%, n = 161), skin infections (28%, n = 130), eye infections (10%, n = 48), ear infections (9%, n = 44) (Latter *et al*[12]).

Table 1 Characteristics and representativeness of the sample of consultations sent to the expert panel

Transcript ID no.	Case study site	Medicine prescribed and condition	Frequency prescribed by nurses across all case study site prescribing episodes (n = 118) % (n)
1	Site 1	Aqueous cream for skin rash	1.7 (2) in 2 sites
2	Site 2	Flucloxacillin for impetigo	3.4 (4) in 3 sites
3	Site 3	Chloramphenicol eye drops for conjunctivitis	13.6 (16) in 5 sites
4	Site 3	Chloramphenicol eye drops for conjunctivitis	13.6 (16) in 5 sites
5	Site 4	Clotrimazole and hydrocortisone cream for vulval irritation	0.9 (1)
6	Site 5	Ferrous sulphate for low blood count in pregnancy	2.5 (3) in 1 site
7	Site 7	Microgynon 30 contraceptive pill for family planning	11.9 (14) in 7 sites*
8	Site 8	Fucidic acid for eye infection	5.1 (6) in 4 sites
9	Site 9	Trimethoprim for urinary tract infection	2.5 (3) in 3 sites
10	Site 9	Nitrofurantoin for urinary tract infection	0.9 (1)
11	Site 9	Flumetasone pivalate for ear infection	5.1 (6) in 2 sites
12	Site 10	Clotrimazole pessary for thrush	3.4 (4) in 4 sites

*Fourteen oral contraceptives were prescribed of which five were specifically Microgynon 30 (ethinylestradiol and levonorgestrel; Schering Health).

Validity and reliability of the modified MAI

Seven experts returned assessments on each of the sample consultations using the modified MAI. Both the pilot study and the main study data indicated that the MAI could be readily applied and yielded data that were relevant and meaningful in evaluating the clinical appropriateness of nurses' prescribing decisions. Experts' comments and use of the tool therefore show that the MAI has face and content validity when applied to nurse prescribing consultations. It was not the intention of this study to test the inter-rater or intra-rater reliability of the MAI further—the reliability and validity of the MAI from previous research has been outlined above. As we wanted to use audio-recorded transcripts as the basis for our experts' assessment, this necessarily restricted the consultation sample size. Thus, the design of the study, combined with the overall low number of ''inappropriate'' scores given by experts to dimensions of nurses' consultations (i.e. the lack of variability in the scoring) meant that it was not possible to calculate reliability using κ or analysis of variance. However, consistency of expert opinion for each MAI item and each consultation is summarised in table 2.

Overall, table 2 indicates a satisfactory level of agreement between experts using the MAI items applied to the sample of nurse prescribing consultations. In 30 (28%) of the 108 assessments, all experts made the same judgment of appropriateness; in another 34 (31%) assessments there was no disagreement between experts about the judgment of appropriateness. (These 34 (31%) of assessments include those where judgments of ''don't know'' or ''not applicable'' were made, as well as judgements of appropriate prescribing.) In the remainder of assessments where there was inconsistency between experts' assessments of appropriateness, only one expert disagreed with prevailing opinion in 30 (28%) of the assessments made. In only 14 (13%) of the 108 assessments did more than one expert disagree with prevailing opinion. Table 1 indicates that item 4 of the MAI (Are the directions correct?) is the item that attracted most inconsistency in ratings: in five of the consultations, more than one expert disagreed with the prevailing opinion. Item 9 (Is the duration of treatment acceptable?) also demonstrates relative inconsistency in three consultations, with more than one expert disagreeing with the prevailing opinion in these consultations. Checking for consistency of rationale for judgments of appropriateness between experts was only possible where qualitative comments were given by experts who made their reasons transparent. As qualitative comments were not always given, even where a judgment of ''inappropriate'' was made, it was not possible to check this aspect of inter-rater consistency across experts.

Item 2 (Is the medicine effective for the condition?) and item 8 (Is there unnecessary duplication with other medicines?) generated the most consistent agreement on appropriateness. Arguably, items 2 and 8 are relatively straightforward to rate, and are dependent on the pharmacological properties of the medicine, whereas it is possible that the items generating the greatest degree of inconsistency of opinion were those in which a larger number of issues could have influenced the decision to rate the dimension of prescribing as inappropriate. For example, directions for medicines may have many different dimensions that may be present or absent in a consultation. Further statistical testing of the reliability of the MAI applied to nurse prescribing consultations would require a larger sample of audio-recorded consultations and/or application of the MAI to nurse records of prescribing decisions.

Nonetheless, we consider that the findings from this study demonstrate the overall usefulness of the MAI in evaluating nurses' prescribing decisions. The face and content validity of the modified MAI were confirmed, as well as good overall consistency of agreement between experts. The feasibility of its use applied by experts to audio-recordings of real nurse–patient prescribing consultations was also established.

Clinical appropriateness of nurses' prescribing decisions

In the light of the discussion of the reliability and validity of the MAI above, some consideration is now given to the appropriateness of nurses' prescribing practice, through analysing results of the experts' assessments of clinical appropriateness combined across consultations. These are shown in table 3.

Overall, the experts' ratings indicated that the nurses' prescribing decisions were generally clinically appropriate across a range of different dimensions. In the majority of instances, experts considered that there was an indication for the medicine prescribed, that it was effective for the condition, that the dosage was correct and that there was no unnecessary duplication with other medicines. As table 3 shows, in only a few instances did the experts consider that: there was *not* an indication for the medication that the nurse prescribed (8%, n = 7); the medication was *not* effective for the condition (2%, n = 2); the dosage was incorrect (4%, n = 3); there were clinically important medication interactions (10%, n = 8); there were clinically important medication–disease/condition inter-

Table 2 Inter-rater agreement on MAI items for each consultation

Consultation	MAI item 1 (medication indicated) n (%)	2 (medication effective) n (%)	3 (dose correct) n (%)	4 (directions correct) n (%)	5 (directions practical) n (%)	6 (significant medication interactions) n (%)	7 (significant medic/condition interactions) n (%)	8 (unnecessary duplication) n (%)	9 (duration acceptable) n (%)
1									
Appropriate	6 (86)	6 (86)	6 (86)	4 (57)	5 (71)	4 (57)	5 (71)	7 (100)	6 (86)†
Inappropriate	1 (14)	1 (14)	0*	3 (43)	2 (29)	1 (14)*	0*		
2									
Appropriate	7 (100)	6 (86)	4 (57)	5 (71)	6 (86)	5 (71)	5 (71)	6 (86)	5 (71)
Inappropriate		0*	0‡	1 (14)‡	1 (14)	0‡	0† ‡	1 (14)	2 (29)
3									
Appropriate	5 (71)	6 (86)	7 (100)	5 (71)	6 (86)	4 (57)	4 (57)	7 (100)	6 (86)
Inappropriate	0‡	1 (14)		2 (29)	1 (14)	0‡	1 (14)* ‡		0‡
4									
Appropriate	6 (86)	5 (71)	6 (86)	7 (100)	6 (86)	4 (57)	4 (57)	7 (100)	6 (86)
Inappropriate	0‡	0‡	1 (14)		1 (14)	0‡	1 (14)* ‡		0‡
5									
Appropriate	5 (71)	6 (86)	7 (100)	5 (71)	7 (100)	5 (71)	5 (71)	6 (86)	7 (100)
Inappropriate	2 (29)	0‡		1 (14)‡		0‡	0‡	1 (14)	
6									
Appropriate	6 (86)	6 (86)	5 (71)	4 (57)	5 (71)	3 (43)	5 (71)	7 (100)	6 (86)
Inappropriate	1 (14)	1 (14)	1 (14)‡	3 (43)	2 (29)	4 (57)	1 (14)‡		1 (14)
7									
Appropriate	7 (100)	7 (100)	6 (86)†	4 (57)†	6 (86)	4 (57)†	4 (57)†	6 (86)†	4 (57)†
Inappropriate				2 (29)	1 (14)	0‡	0‡		2 (29)
8									
Appropriate	5 (71)	5 (71)	6 (86)†	5 (71)	5 (71)	5 (71)	5 (71)	6 (86)	5 (71)
Inappropriate	1 (14)‡	0‡		1 (14)‡	0‡	0‡	0* ‡	0*	1 (14)*
9									
Appropriate	7 (100)	6 (86)	7 (100)	7 (100)	7 (100)	3 (43)	4 (57)	7 (100)	6 (86)
Inappropriate		0‡				3 (43)‡	0* ‡		1 (14)
10									
Appropriate	5 (71)	6 (86)	6 (86)	6 (86)	5 (71)	3 (43)†	3 (43)	7 (100)	5 (71)
Inappropriate	1 (14)‡	0*	0‡	0‡	0‡	0‡	3 (43)‡		2 (29)
11									
Appropriate	6 (86)	4 (57)	7 (100)	7 (100)	6 (86)	7 (100)	4 (57)	7 (100)	6 (86)
Inappropriate	0‡	3 (43)			1 (14)		1 (14)*‡		1 (14)
12									
Appropriate	6 (86)	7 (100)	6 (86)	5 (71)	6 (86)	6 (86)	6 (86)	7 (100)	7 (100)
Inappropriate	1 (14)		1 (14)	2 (29)	1 (14)	0*	0*		

*Remaining percentage represents ''not applicable'' ratings.
†Missing assessments were included in the total percentage.
‡Remaining percentage represents ''do not know'' ratings.

actions (8%, n = 7) or there was unnecessary duplication with other medicines (2%, n = 2).

Items 4, 5 and 9 were the only items to generate a rating of inappropriate on 10 or more occasions (15/79 (12%), 10/79 (8%) and 10/80 (8%) ratings, respectively). Possible reasons for this pattern of ratings for these particular items have been suggested above, in relation to the consistency of agreement between experts. Qualitative analysis of any comments given to justify an expert's decision often revealed a variety of reasons for ratings of ''inappropriate'' across consultations and this is perhaps to be expected given the variety of consultations included in the sample. Examples of qualitative comments that revealed justification for a rating of ''inappropriate'' included:

Table 3 Findings from the expert panel analysis of clinical appropriateness of 12 nurse prescribing consultations (percentages are the proportion of assessments made by the experts out of a total possible number of 84 assessments for each item across all 12 consultations)

No.	Item	Appropriate prescribing, % (n)	Inappropriate prescribing, % (n)	Don't know, % (n)	Not applicable, % (n)	Missing data, % (n)	Total, % (n)
1	Is there an indication for the medication?	Indicated: 84 (70)	Not indicated: 8 (7)	7 (6)	–	1 (1)	100 (84)
2	Is the medication effective for the condition?	Effective: 83 (69)	Ineffective: 2 (2)	12 (10)	2 (2)	1 (1)	100 (84)
3	Is the dosage correct?	Correct: 87 (73)	Incorrect: 4 (3)	6 (5)	1 (1)	2 (2)	100 (84)
4	Are the directions correct?	Correct: 76 (64)	Incorrect: 18 (15)	5 (4)	–	1 (1)	100 (84)
5	Are the directions practical?	Practical: 84 (70)	Impractical: 12 (10)	2 (2)	–	2 (2)	100 (84)
6	Are there clinically significant medication interactions?	Insignificant: 63 (53)	Significant: 10 (8)	22 (18)	3 (3)	2 (2)	100 (84)
7	Are there clinically significant medication disease/condition interactions?	Insignificant 64 (54)	Significant: 8 (7)	16 (13)	11 (9)	1 (1)	100 (84)
8	Is there unnecessary duplication with other medication(s)?	None apparent: 96 (80)	Unnecessary duplication: 2 (2)	–	1 (1)	1 (1)	100 (84)
9	Is the duration of therapy acceptable?	Acceptable: 81 (68)	Unacceptable: 12 (10)	2 (2)	1 (1)	4 (3)	100 (84)

Transcript ID No. 1, MAI item 4 (Are the directions correct?):

> ''10–15 times per day!'' (Expert 06)
> ''best not to put 'as directed' on script.'' (Expert 04)

Transcript ID No. 6 MAI item 4 (Are the directions correct?):

> ''30–60 minutes separation from Gaviscon probably not enough'' (Expert 07)

> ''best taken on an empty stomach, not with food.'' (Expert 06)

In addition, judgments about the nurses' assessment and diagnosis skills attracted some negative qualitative comments. Item 1 asked experts to consider whether there was an indication for the medication—this item therefore reflects an evaluation of the history taking, assessment and diagnostic skills apparent in the consultations, as well as the final diagnosis reached and its relationship to the medicine prescribed. Although table 3 shows that in 84% (n = 70) of instances, experts considered that there was an indication for the medication prescribed, all seven experts made at least one written comment on the assessment and diagnosis aspects of the 12 consultations, and in total 20 comments on possible deficiencies of this aspect of nurses' consultations were made. For example, all three experts who made comments on the assessment and diagnosis skills of the nurse in consultation no. 10 suggested that a mid-stream specimen of urine should have been sent first to confirm the diagnosis of urinary tact infection.

Some of the ostensible deficiencies in nurses' assessment skills may be because not all nurses' assessment and decision making processes were verbalised. Experts rated a greater proportion of ''don't knows'' for MAI item 6 (Are there clinically significant medication interactions?) and MAI item 7 (Are there clinically significant medication—disease/condition interactions?) across the 12 consultations. This indicates the information required to rate these aspects was absent from the transcript. This may well be because information about these aspects was obtained by the nurse during the consultation from electronic data, and not from asking the patient. The observation that nurses checked the on-screen electronic patient records for information about, for example, past medical history and current medication, was noted by members of the research team who observed and recorded consultations in situ. Nurses' non-verbal assessment processes were not captured in the transcript, therefore making the rating process difficult and/or underestimating the skills that the nurses had used. Nonetheless, this finding concerning the comprehensiveness and accuracy of nurses' assessment and diagnostic skills deserves further investigation in future studies of the quality and safety of nurse prescribing.

Overall, the findings indicate that in a minority of instances, some experts disputed some elements of the clinical appropriateness of nurses' prescribing consultations. However, it should be noted that in only one dimension of one consultation (ID 06, item 6) did the *balance* of expert opinion suggest that the nurse's decision was clinically inappropriate (and in this particular instance the potential for medication interaction was acknowledged and dealt with by the midwife prescriber within the consultation). In all other instances, the majority of experts rated nurse prescribers' decisions as clinically appropriate on all nine dimensions of the MAI across all 12 sample consultations.

DISCUSSION

Measurement of nurse prescribing appropriateness

Overall, the study showed that using a modified nine-tem MAI and annotated transcripts of real-life audio-recorded prescribing consultations distributed to a panel of experts is a feasible way of assessing the clinical appropriateness of nurses' prescribing consultations. The completeness and validity of the data returned by the experts indicated that the modified MAI, instructions given and the annotated transcripts were clear and easy to use. The systematic content analysis of qualitative comments provided by experts added a further dimension to the usefulness of the MAI as a method of assessing prescribing appropriateness. In addition, the degree of detail offered by real-life consultation transcripts may well be superior to the previously used practice of assessments made using patients' records, which may not accurately or completely reflect all the elements of a clinician's judgments used in a prescribing decision. We therefore argue that the method described here has face and content validity as a method of assessing the appropriateness of prescribing decisions. Although statistical estimates of the reliability of the rating process were not possible due to a priori decisions about the design of the study, our analysis shows a good level of consistency of agreement between experts using the individual items applied to consultations. This suggests that the method is also a reliable way of assessing prescribing appropriateness. Previous research[15 16 21] using the MAI has focused on evaluating the prescribing decisions of doctors and pharmacists; our analysis suggests that the modified MAI is also a valid and reliable method of measuring prescribing appropriateness in nurses' practice.

Two possible limitations of using consultation transcripts should be noted, however: as not all assessments and decisions are verbalised, this will have implications for the completeness of an audio-recording as a means of capturing the entirety of skills used during the consultation. For example, we noted that in healthcare settings in which patient records are stored electronically, clinicians may rely on checking patient data via a computer screen during a consultation to assess dimensions of a patient's history such as previous medical history and current medication. This in turn may influence the ability of raters to make accurate judgments of prescribing appropriateness through audio-recorded transcripts. The inclusion with the transcript of details of the consultation recorded in the patient notes may have helped to offset the lack of some details verbalised during the consultation itself, but the number of ''don't knows'' recorded against these MAI items was likely to have been because nurses in the consultations often relied on computer-held data for checking both current medication and the medical history of the patient. The second possible limitation of the use of transcripts to assess prescribing appropriateness concerns the quality of the audio-recording itself—in everyday healthcare settings, background noise and/or the movements of healthcare professionals and patients during the consultation—for example, during investigative procedures—may interfere with the ability to transcribe a reliable account of the consultation.

Clinical appropriateness of nurse prescribing

Findings from the expert panel analysis process highlight that, in the main, nurses in the sample of consultations were generally making prescribing decisions that were clinically appropriate across a number of established indicators. This positive finding is an important addition to the evidence on nurse prescribing, at a time in the UK when the number of nurse prescribers is increasing steadily, and the range of medicines that they have access to has recently been significantly expanded. The sampling strategy for (i) nurse prescribers in our study and (ii) the consultations sent to the

expert panel was designed to ensure that the consultations were representative of those that nurse prescribers were engaged in at the time of the study. Nevertheless, one of the study limitations was the number of consultations that we were able to include in the expert panel analysis process; in addition, it is possible that the requirement of the study to include a 50% sample of antibiotic prescriptions in the expert panel sample may have restricted the extent to which we were able to fully operationalise the key purposive sampling characteristic of diversity (of medicines) in our sample. We recommend further research with a larger sample of consultations as one further avenue of enquiry.

Some comparisons of the clinical appropriateness of nurses' prescribing consultations can be drawn with evaluations of other professionals' prescribing decisions using the MAI. For example, Hanlon *et al*[21] recently evaluated doctor prescribing in a sample of 365 elderly inpatients in the USA and found that—for example, 55.2% had received impractical directions (MAI item 5) and 50.9% had received incorrect dosages (MAI item 3), as rated by doctors and pharmacists using the MAI. Britten *et al*[9] found lower rates of inappropriate prescribing, comparable with that of nurses in this study, with only 4 of 92 independent assessments of the pharmacological appropriateness of prescriptions issued by 24 GPs judged as inappropriate. Although this suggests that nurses' prescribing decisions are overall no less clinically appropriate than those of doctors, any comparison between nurse and doctor prescribing needs to be viewed in the light of the small sample used in this study and the limited formulary from which nurses were able to prescribe at the time that the study was undertaken—that is, the medicines and conditions listed in the *NPEF* were largely restricted to those classified as minor ailments, minor injuries, health promotion and a small number of palliative care medicines. As further expansion of the number and types of medicines and conditions has become available to nurses, further research into the appropriateness of nurse prescribing and more specific cross-professional comparisons would be of value.

We recommend that the measurement of prescribing appropriateness used in this study may be further developed in several ways. Further research into the inter-rater and intra-rater reliability of the MAI applied to nurses' prescribing consultations would add to conclusions about its usefulness as a measure of assessing the appropriateness of nurses' prescribing. As indicated above, further application of the MAI to nurses prescribing the wider range of potentially more major medicines that they are now authorised to prescribe, would be a useful avenue of research inquiry which would allow more comparable ratings of nurses' prescribing quality with those of doctors. In routine practice, the application of the modified MAI during the process of a prescribing consultation may also be of use as a measure of prescribing practice quality. It could be used by a mentor or peer as part of continuing professional development processes and/or as part of clinical governance and other quality assurance processes to evaluate quality and safety in the prescribing practice of nurses and/or other health professionals. Further research into these important areas is required.

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