

1 Did we do everything we could have? Nurses' contributions to 2 medicines optimisation: 3 a mixed methods study 4

5 ABSTRACT:

6 AIM: To explore UK professionals' interpretations of medicines optimisation and expansion
7 of nurses' roles.

8 DESIGN: This mixed-methods study sought professionals' views on nurses' involvement,
9 competency, and engagement in: monitoring patients for adverse effects of medicines,
10 monitoring adherence, prescribing, and patient education.

11 METHOD: An online survey and interviews were undertaken with nurses, doctors and
12 pharmacists in Wales and England, May 2018 to July 2019.

13 RESULTS: In all, 220 nurses, 17 doctors and 62 pharmacists responded to the online survey,
14 and 24 professionals were interviewed. Nurses were divided over extending their roles, with
15 123/220 (55.9%) wishing to extend roles in monitoring patients for possible adverse drug
16 reactions (ADRs), 111/220 (50.5%) in adherence monitoring, 121/220 (55.0%) in prescribing,
17 and 122/220 (55.4%) in patient education. The best-qualified nurses were the most willing
18 to increase involvement in monitoring patients for ADRs (aOR 13.00, 1.56-108.01).

19 Interviews revealed that both nurses and doctors assumed the other profession was
20 undertaking this monitoring. Respondents agreed that increasing nurses' involvement in
21 medicines optimisation would improve patient care, but expressed reservations regarding
22 nurses' competencies. Collaboration between nurses and doctors was suboptimal (rated
23 7/10 at best), and between nurses and pharmacists even more so (6/10 at best).

24 CONCLUSION: Juxtaposition of datasets identified problems with medicines optimisation:
25 although most respondents agreed that increasing nurses' involvement would positively
26 impact practice, their educational preparation was a barrier. Only ~50% of nurses were
27 willing to expand their roles to fill the hiatus in care identified and ensure that at least one
28 profession was taking responsibility for ADR monitoring.

29 IMPACT: To improve multi-professional team-working and promote patient safety, nurse
30 leaders should ensure patients are monitored for possible ADRs by at least one profession.
31 Initiatives expanding nurses' roles in medicines optimisation and prescribing might be best
32 targeted towards the more educated nurses, who have multidisciplinary support.

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3 KEYWORDS: patient safety, drug-related side effects and adverse reactions, nurses, interdisciplinary
4 communication, pharmaceutical care, knowledge, "care gaps"

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Nurses' contributions to medicines optimisation: a mixed methods study

1 | INTRODUCTION

The scale and complexity of inadvertent iatrogenic harm from the use and misuse of medicines underlie the World Health Organisation's (WHO) Third Global Patient Safety Challenge - to reduce avoidable medication-related harm by 50% by 2022 (WHO, 2017). To address this issue, medicines management, optimisation and pharmaceutical care must be prioritised. This study explores professionals' interpretations of 4 key aspects of medicines management and potential expansion of nurses' roles in the UK.

2 | BACKGROUND

Preventable adverse drug reactions and events (ADRs/ ADEs) have proved an intractable problem over the last decade, causing 5-8% of unplanned hospital admissions (National Institute for Clinical Excellence (NICE), 2015), rising to ~10-15% amongst older adults (Oscanoa, Lizaraso, & Carvajal, 2017), costing the UK NHS £1bn-2.5bn each year. Higher prevalence in larger, prospective studies (Alhawassi, Krass, Bajorek, & Pont, 2014), and non-recognition of ~60% events suggest that these figures may be an underestimate (Roulet et al., 2014) and prevalences of 11% and 18% are quoted (Kongkaew et al., 2013, Rydberg et al., 2016). The problem is at least as extensive in developing countries, at ~10% of admissions (WHO, 2009), rising to 20% amongst older adults in Africa (Oscanoa et al, 2017).

Most ADEs, ADRs (up to 92%), and medicines' mismanagement (including errors by patients and professionals) are preventable (NICE, 2015), particularly with additional enhanced monitoring (Gabe et al, 2011; Gandhi et al., 2010). Outside hospital, 15 preventable ADEs occur each 1000 person-years, and 25% of these are serious (Gandhi et al., 2010). In hospitals, preventable, mainly dose-dependent and moderately severe, ADRs affect 3.13 in each 100 patients (95% CI 2.87-3.38, full range 0.006 to 13.3), with lower rates in studies relying on voluntary reporting (Oscanoa et al., 2017, Wolfe et al., 2018).

Medicines optimisation (NICE, 2015) is a patient-focused approach to getting the best from investment in and use of medicines that requires a holistic approach, an enhanced level of patient centred professionalism, and partnership between clinical professionals and

1 patients. Medicines optimisation and pharmaceutical care require multidisciplinary team
2 working to an extent not previously encountered. Healthcare professionals need to work
3 together to individualise care, monitor outcomes more carefully, review medicines more
4 frequently and support patients (Royal Pharmacological Society (RPS), 2013). However,
5 nurses' contributions to medicines optimisation and pharmaceutical care remain
6 unexplored.

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8 **3 | THE STUDY**

9 **3.1 | Aims**

10 Building on theories of division of labour (Jordan & Hughes 2002) and 'orphaned tasks'
11 (Jordan 2002), we report on the readiness of nurses, doctors and pharmacists to engage and
12 optimise four specific responsibilities: monitoring patients for adverse effects of their
13 medicines, adherence to prescribed regimens, prescribing and patient education.

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15 **3.2 | Design**

16 We explored nurses', doctors' and pharmacists' interpretations of nurses' roles in medicines
17 optimisation and pharmaceutical care with a pragmatic mixed methods approach (Ford-
18 Gilboe, Cambell & Berman, 1995; Teddlie & Taskhokkori, 2012), comprising a cross-
19 sectional online survey, followed by 24 semi-structured interviews to investigate actual
20 performance, barriers and facilitators (University of California, 2012). We have implemented
21 mixed methods to strengthen the overall study design through triangulation and
22 complementary results of the combined methods (Bryman, 2006). Questions were designed
23 concurrently: neither findings informed the data collection of the other (Jeffries et al, 2019).
24 This paper reports on two UK countries, Wales and England, participating in a pan-European
25 project (De Baetselier et al., 2020). The good reporting guidelines for mixed methods
26 research (O'Cathain, Murphy & Nicholl, 2008; National Institutes of Health (NIH), 2018)
27 were followed (Supporting File 1). All questions are reported.

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29 **3.3 | Sample/participation**

30 We contacted the University Health Boards (UHBs), NHS Trusts and private providers in
31 South West Wales and Southern England: the areas where we plan to implement our
32 findings. The questionnaire was distributed through online links to survey as many

1 healthcare professionals as possible. Interviewees were purposively sampled across acute,
2 domiciliary, residential and mental health settings to explore nurses' roles in practice.

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4 **3.4 | Data collection**

5 In the 10-minute structured questionnaire, -all questions were closed, either dichotomous
6 or ordinal polychotomous, with Likert-type scales, allowing for neutral responses (Nardi,
7 2018).

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9 For interviews, we sought representative senior NHS practitioners with significant day-to
10 day clinical and managerial responsibility. Private sector participants were sought *via*
11 contact with local Nursing home managers and the associated general practitioners (GPs)
12 and pharmacists. In Wales, we recruited from two UHBs and other networks, in England,
13 one Trust and private sector providers were approached. Participant information was
14 shared with professionals who expressed interest. Participants were asked about their
15 perception of the strengths, weaknesses, opportunities and threats of medicines
16 optimisation (see Supporting File 2 for interview schedule). All interviews were digitally
17 recorded, fully anonymised and professionally transcribed.

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19 **3.5 | Ethical considerations**

20 The survey was approved by the relevant University ethics committees. As we were
21 contacting healthcare professionals, the English NHS Trust required full IRAS (Integrated
22 Research Application System) ethical approval, which was granted 9th February 2018
23 (reference number 239960), and cleared by the University on 15th March. When
24 governance checks had been completed (10th April), approval was sought from the R&D
25 (Research and Development) departments in Wales, and received 11th May 2018. IRAS
26 approval was sought for the interview study by application to Health and Care Research
27 Wales, and approved 24th January 2019 (REC reference 19/HCRW/00).

28 We anticipated minimal physical and emotional risks, as the probability of harm or
29 discomfort was expected to be no higher than ordinarily encountered in participants' daily
30 lives. There were no questions of a personal or sensitive nature, and no identifying
31 information was sought. Participants were informed of the study's rationale, data collection

1 methods and aims, the voluntary nature of participation, and their rights to withdraw
2 consent without penalty. Informed consent was sought (electronically or in person) and
3 opportunity was given to participants to 'phone or email researchers .

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5 We either did not collect, or immediately deleted, all data relating to: names, dates of birth,
6 locations, health, social, racial or ethnic origin, political opinions, religious or philosophical
7 beliefs, or trade union membership. No genetic or biometric data, tissue samples, data
8 concerning health or data concerning a natural person's sex life or sexual orientation were
9 collected (Information Commissioner's Office, 2012; MRC 2018).

10 Throughout data collection and handling the associated risks of disclosure were mitigated
11 in accordance with General Data Protection Regulations (GDPR) 2018 (Medical Research
12 Council, 2018).

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14 **3.6 | Data Analysis**

15 All survey variables were described. Ratings were taken as ordinal and compared using
16 Kruskal Wallis' independent samples tests (Altman, 1991). To explore the predictors of
17 "willingness to extend nurses' roles" in ADR monitoring, adherence, prescribing and
18 education amongst the 220 nurse respondents, binary outcome variables were obtained by
19 combining categories. The relationship between nurses' education and willingness to extend
20 their roles was explored using X^2 for trend (Altman, 1991). Binary logistic regression models
21 were constructed using backwards elimination likelihood ratio to select predictor variables.
22 We accounted for sex, education, area of practice, patient population, country, and the
23 number of pharmacists and doctors contacted daily. Age and length of experience were
24 tested separately, due to their high collinearity. Data were analysed in the Statistical
25 Package for Social Sciences (SPSS), version 25.0.

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27 Qualitative data were coded and emerging themes identified, as a rolling process (Jordan &
28 Hughes 1998). Transcripts were analysed with a thematic approach, based on Braun and
29 Clarke (2006), in six stages: familiarisation with the data; primary coding of data by applying
30 code labels to the text (see Supporting File 3 for examples); identification of themes and
31 patterns; review of themes (with wider research team); detailed analysis and consideration
32 of the relevant themes; and defining outcomes from all data collected. Data analysis and

1 interpretation were discussed by the UK and European teams, and the final analysis reflects
2 joint decisions.

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4 Survey and interview data were integrated around the four responsibilities and the division
5 of labour within these responsibilities, taking a pragmatic perspective of complementary
6 triangulation (Östlund, Kidd, Wengström & Rowa-Dewar, 2011), illustrated in Figure 1. Cross
7 cutting themes from the four responsibilities were derived from the data (NIH, 2018; Foss &
8 Ellefsen, 2002; Denzin, 2012).

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10 **3.7 | Validity and reliability/rigour**

11 The combination of datasets addressing the same question established triangulation of
12 methods (Morse, 2015). Further triangulation across data sources (participants), location
13 (England and Wales) and 2 teams of investigators enhanced transferability. To ensure inter-
14 rater reliability, stability and validity of our qualitative data analysis, one of the authors who
15 was not actively involved in data collection (SJ) periodically compared data collected by
16 other investigators, checking codes, integrity of the analysis and resolving variances through
17 discussion, in a peer debriefing role (Creswell & Miller, 2000). Purposive sampling of
18 practice areas, and congruence of findings with the team's background knowledge of the
19 area enhanced credibility (Polit & Beck 2016).

20 The face validity of the survey questions was established by a consortium of nurse
21 researchers and the survey was piloted with 17 nurses. to check its applicability and
22 comparability in different health systems: no changes were needed. No technical problems
23 were reported. The representativeness of the survey sample was checked against externally
24 sourced demographic information. For responses regarding nurse/doctor collaboration,
25 nurse/pharmacist collaborations, nurses' competence and team communication, Cronbach's
26 alpha coefficients were: 0.90, 0.93, 0.81, and 0.90 respectively, (1 item for each of the 4
27 tasks), indicating high internal consistency. Questionnaires that were <50% complete were
28 excluded, as advised by American Association for public opinion research (AAPOR, 2016).

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30 **4 | RESULTS**

31 **4.1 | Response rate and recruitment**

1 Survey

2 In all, 220 nurses, 17 doctors and 62 pharmacists gave useable responses to the online
3 survey, with primary and secondary care evenly represented. In England 139 professionals
4 responded from 1,978 possible contacts. In Wales, 169 professionals participated from the
5 ~6,000 in the participating UHB and 78 nurses in other networks. Excluding the 47
6 questionnaires that were <50% complete left 299 valid responses (179 in Wales and 120 in
7 England) (Fig 2).

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9 Demographic details are described in Supporting File 4 Table 1. A disproportionately high
10 number of nurse respondents held MScs or PhDs (Wales: 29.5% and 9%, England: 19.5% and
11 3% respectively); 22% (Wales) and 33% (England) of respondents were involved in either
12 research or management.

13

14 Interviews

15 Between February and July 2019, of 14 invitations issued in England, 12 responded
16 positively & 2 failed to respond (both pharmacists). In Wales, 40 professionals were
17 approached: 25 responded positively & 15 negatively or not at all, despite repeated
18 contacts. One respondent subsequently withdrew, unwell, and a substitute was found. No
19 reasons for declining or not responding were given. We had no responses from the Wales
20 PICRIS practices, who are funded to undertake research (National Institute for Social Care
21 and Health Research, 2014).

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23 Interviewees' experience varied between 30 years (nurse, care home manager) to 3 years
24 (physician – acute care). All interviews were held in private rooms within the participants'
25 working environments. Interviews lasted between 19 and 31 minutes.

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27 **4.2 | Monitoring patients for ADRs: “the bit that’s missing”**

28 Most nurses surveyed felt that monitoring patients for the adverse and therapeutic effects
29 of medications was part of their role, but a third of doctors and pharmacists disagreed
30 (Supporting File 4, Table 2a). Interviews revealed a bleaker picture, more congruent with the
31 high proportion of admissions caused by preventable ADRs. Doctors thought nurses were
32 responsible for monitoring patients:

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“You prescribe that but you would expect that the nurse would not give it if the blood pressure was really low. Just like with things like painkillers, making sure they wouldn’t give it if there were signs of toxicity. ... you’re putting a lot of trust down to the nurse that’s giving the medication that they will make the sensible decision ... a very significant amount of responsibility for it.” (England doctor Acute care).

Whereas, nurses thought this was the doctors’ responsibility:

“I’m a firm believer that if you prescribe a drug, it is your responsibility to follow up to see whether the outcome is of benefit to the patient. So I think the primary responsibility for a follow up should be with the prescriber. (England, Community nurse), and I think the physicians have to provide information and instruction to the nurses.” (Acute nurse Wales).

A few respondents were aware of this hiatus in care and communications: *“I suppose the bit that’s missing is the recording and feeding back part so that any changes can be made.”* (Mental health nurse England) (Table 1).

Nurses gave significantly higher ratings to their collaboration with doctors and pharmacists on monitoring ADRs than did the other professionals (Kruskal-Wallis test, X^2 22.61, df 2, $p < 0.001$ and X^2 10.97, df 2, p 0.005 respectively). Overall, there was broad agreement that nurses’ involvement would have a positive impact on the quality of patients’ care, and nurses’ involvement in monitoring should be extended. However, interviews revealed an important caveat: respondents spontaneously raised nurses’ inadequate preparation in pharmacotherapeutics, congruent with nurses’ assessment of their own competence being significantly higher than that of other healthcare professionals (X^2 28.69, df 2, $p < 0.001$):

“Nurses may lack knowledge, so that is a weakness - their drug knowledge. And the fact that they should be aware of what they’re administering, what they’re giving to the patient, that they should have an idea of what it is.” (Wales, Acute care nurse).

1 Many (n=123/220) nurses felt that their roles should be extended to encompass more
2 patient monitoring for ADRs (Supporting File 4, Table 3a). This willingness was associated
3 with nurses' education level, particularly doctoral qualification (Table 2).

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5 A minority of nurses reported they had never observed ADRs, poor medication adherence or
6 inappropriate prescribing (Table 3). The 14 nurses who had never observed a 'side effect'
7 ranged in experience from 0-45 years. Over a third of nurses and doctors did not work with
8 any pharmacists in their daily clinical practice, and around 1 in 7 nurses could not get the
9 help they needed from doctors and pharmacists. A substantial minority of professionals,
10 particularly doctors, did not think that employers' policies promoted inter-professional
11 medicines management (Table 4).

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13 **4.3 | Monitoring adherence: "Did we do everything we could?"**

14 Nurses gave significantly higher ratings to their collaboration with doctors on monitoring
15 medication adherence than other professionals (χ^2 19.73, df 2, $p < 0.001$). Their assessment
16 of their own competence was also significantly higher, with pharmacists and doctors in
17 Wales having the most reservations (χ^2 14.90, df 2, $p = 0.001$). Most respondents, particularly
18 in mental health, thought more should be done (Table 1, Supporting file 4, Table 3a):

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20 "…the burden of those frequent relapses all because they didn't take their tablets.
21 And did we do everything we could have to prevent that? No we didn't." (Wales,
22 nurse, mental health)

23 Doctors agreed this was a role nurses were able to undertake (Table 1), and involvement in
24 monitoring adherence to medication was viewed positively (Supporting File 4, Tables 2a,
25 3a). The association between willingness to extend roles in monitoring adherence and nurse
26 education did not reach statistical significance in adjusted analyses (Table 2).

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28 **4.4 | Prescribing: "recipe for disaster" or "potentially the answer"?**

29 Nurses gave higher ratings to their collaboration with doctors on prescribing medication
30 than did the other professionals (χ^2 8.15, df 2, $p = 0.02$). Nurses assessed their own
31 competence to prescribe more highly than did others, reaching borderline statistical
32 significance: the differences were more noticeable in Wales than in England (χ^2 6.07, df 2,

1 p=0.05). Comments included: *“sometimes nurse prescribers can get drawn into roles that go*
2 *beyond their competence* (England, doctor, mental health).

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4 In Wales, 27% of nurses, 78% of doctors and 45% of pharmacists did not consider
5 prescribing medicines to be part of nurses’ roles; in England, it was 31.5%, 62% and 35%
6 (Supporting File 4, Table 2b). Although most nurses felt that prescribing was a component of
7 their roles, only a minority were active prescribers (26% & 9% in Wales & England). With the
8 exception of doctors in Wales, only a minority stated that extending nurses’ involvement
9 would not be positive- Most nurses thought that their involvement in prescribing should be
10 extended, while most doctors and pharmacists thought it should remain unchanged
11 (Supporting File 4, Table 3b). Concerns related to the practicalities of multiple prescribers,
12 with no-one in overall control and potential for interactions:

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14 *“Within the prescribing, having several people given free range to prescribe I think is*
15 *the sort of recipe for disaster in general regardless of who it is”* (Wales, nurse, acute)
16 *and “It could become chaotic and therefore unsafe and that we could lose control, is*
17 *the principal fear and therefore lead to prescribing practices that are unregulated,*
18 *unsafe and not monitored.”* (England, doctor, mental health). *“ We lose control of*
19 *prescribing costs.”* (England, doctor, community).

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21 Other reservations concerned existing workloads, and the associated potential for error,
22 whereas support for nurse prescribing-centred on specialist roles (Table 1). Willingness to
23 prescribe was predicted by working with pharmacists, rather than education (Table 2).

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25 **4.4 | Patient education: “some [nurses] don’t know what the medication is used for.”**

26 Nurses gave higher ratings to their collaboration on providing patient education or
27 information about medication use with doctors and pharmacists than did the other
28 professionals (X^2 8.86, df 2, $p=0.01$ and X^2 8.87, df 2, $p=0.01$). Their assessment of their own
29 competence was also significantly higher (X^2 20.75, df 2, $p<0.001$) than experienced by other
30 professionals:

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1 *“Patient education and information varies between individuals and nursing homes,*
2 *how competent the nurse is on that. Some of them don’t even know what the*
3 *medication is used for so they wouldn’t be in a good position to. But all I can say, it*
4 *varies, it all depends on individual, but the majority I have come across, I wouldn’t”*
5 (England, pharmacist, nursing home).

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7 Most Welsh (80%) and English (62%) nurses thought that providing patient education or
8 information about medication use was a part of nurses’ roles (Supporting File 4, Table 2b),
9 and 73% of Welsh nurses and 60% of English nurses had provided this in the last month
10 (Table 1). However, only around half (57% and 41%) felt qualified to do this and relied on
11 information from others. Many doctors and pharmacists (44% of doctors and 25% of
12 pharmacists, Supporting File 4, Table 2b) felt patient education was not a component of
13 nurses’ roles. All professionals thought that the involvement of nurses in providing patient
14 education or information about medication use should be extended (Supporting File 4,
15 Table 3b):

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17 *“In terms of education, again I think nurses should, they have an opportunity more*
18 *than doctors do to educate”* (Wales, doctor, community).

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20 The association between willingness to extend roles in patient education and nurse
21 education did not reach statistical significance in adjusted analyses. (Table 2).

22 23 **4.5 | Over-arching themes**

24 Complementary triangulation (Östund et al 2011) revealed cross-cutting themes across the
25 4 tasks examined: care gaps, where no professional is undertaking the task, and each thinks
26 the other does it; inadequate nurses’ education and workload, preventing them from taking
27 on additional roles/education (Table 1).

28 29 **5 | DISCUSSION**

30 The nursing workforce is divided regarding role expansion, and a care gap has opened,
31 leaving the monitoring of patients for possible ADRs, non-adherence and patient education
32 unattended: doctors and nurses each think the other is or should be doing this work, leading

1 to preventable ADRs (Jordan 2002), sometimes necessitating hospitalisation (NICE, 2015;
2 Jordan & Hughes, 2019; George et al, 2019). We identified dissonance in the data: whilst
3 there was consensus that nurses should expand their roles in these domains and tasks, only
4 ~50% nurses were willing to do this. Nurses gave significantly higher ratings than other
5 professionals regarding their own competence and inter-professional collaborations in
6 monitoring, adherence, prescribing and patient education, corroborated by interviewees'
7 concerns over nurses' education and availability.

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9 **5.1 Care gaps: Roles and Relationships “It’s that missing link”**

10 This study exposed gaps in care: essential tasks unfulfilled by any professionals – through
11 practitioners' inadvertent misconceptions and absence of structure in policy and
12 management. This could be rectified by expanding roles of nurses (Dilles et al., 2013; Jordan
13 et al 2015) and pharmacists (RPS 2013) and mandating structure (Jordan et al., 2019).

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15 Compliance with manufacturers' therapeutic monitoring recommendations falls short in up
16 to 73% (n=284) patients (Ramia, & Zeeney 2014), and structured nurse-led patient
17 monitoring addresses this problem (Jordan 2002; Dilles et al 2013; Jordan et al., 2015; Jones,
18 Moyle & Jordan, 2016; Dijkstra et al 2018; Jordan et al., 2019;). Interviews indicated that
19 this gap was, in part, attributable to dissonance in expectations: both doctors and nurses
20 thought the other profession was monitoring patients for ADRs, adherence, and patient
21 education. Pharmacists and doctors were often aware that this left problems unattended,
22 including administration of anti-hypertensives to people with hypotension or laxatives to
23 patients with diarrhoea (Table 1) (Jordan et al., 2019). Most (90%) nurses agreed that
24 monitoring is a component of nursing roles that would benefit patients (95%), and some
25 55% of nurses were willing to address this gap by expanding their roles (Jordan, Logan,
26 Panes, Vaismoradi, & Hughes, 2018).

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28 A similar proportion (55%) of nurses wished to expand their roles to encompass prescribing.
29 Support from pharmacists predicted nurses' willingness to prescribe (Creedon, Byrne,
30 Kennedy, & McCarthy, 2015). Proponents mainly cited prescribing as a component of
31 specialist roles, whereas detractors indicated that risk of errors increases when more than
32 one professional is involved (Assiri et al., 2018), accounting for their reservations.

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As the professionals with the most contact with patients, nurses should engage patients in discussions around their medication regularly (Nursing and Midwifery Council (NMC), 2018a, 2018b; Flanders 2018, Bowen, Rotz, Patterson, & Sen 2017), but only the more educated nurses were willing to monitor or educate patients. Many nurses (38/149, 26%) did not feel qualified to educate patients about their medicines, and their competence was rated no more highly for patient education than for prescribing.

5.2 A workforce divided by education

Although many nurses were willing to expand their roles, some of their colleagues were unconvinced of their competence, particularly in prescribing. Similar discrepancies were reported >40 years ago (Wilson, 1975). Some of these concerns would be allayed by national curricula specifying academic and clinical standards in pharmacology (Jordan, Davies, & Green, 1999) compatible with the needs of service users with multiple comorbidities and associated polypharmacy.

A minority of nurses (6%) had never observed an ADR, despite prevalence of severe preventable events of 0.4% in primary care (Gandhi et al., 2010), 3.13% in secondary care (Oscanoa et al., 2017), and 100% prevalence of medicine-related problems (Jordan et al., 2015; Jordan et al., 2019; Jones et al., 2016). The prevalence of prescribing errors ranges from 2 to 94% of prescriptions (Assiri et al., 2018), so it is surprising that any respondents in the online survey had never seen a prescribing error.

All nurses interviewed and ~50% of nurses responding to the survey felt their roles should be extended to improve medicines optimisation, prevent ADRs and minimise iatrogenic harm, but barriers of education and time constraints were apparent. The 2019 changes in the preregistration nursing curriculum may increase nurses' engagement (Nursing & Midwifery standards 2018; Nursing & Midwifery Council, 2018) ; however, the uptake of current nurse prescribing initiatives is suboptimal (Drennan, Grant & Harris, 2014). Our data indicate that, to succeed, role expansion should be targeted towards better-educated and motivated nurses: role expansion in medicines optimisation may not be for all nurses, and this should be recognised as initiatives are rolled out.

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5.3 The workforce and the health divide

Expansion of nurses' roles might ensure timely access to medicines, reduce waiting times and hospital admissions, and be a more prudent use of healthcare resources and a positive addition to clinical practice (Stenner & Courtenay, 2008; Health Education England, 2018). However, nurse-prescribing depends on support, and strong multi-disciplinary relationships (Creedon et al., 2015, Bowen et al., 2017). These are only available in well-staffed practice areas.

Role expansion has been viewed as the only realistic option to deal with increased demands for healthcare (Department of Health, 2001), mainly for the old and poor. The creation of a distinct class of non-specialist health care professional to administer medicines to the poor, equivalent to the Russian feldsher, has not been openly considered since the formulation of medical registration in 1858 (Hart, 1988). However, a higher proportion of prescription items are initiated by nurses in areas of socio-economic deprivation (ρ 0.19) and where the number of GPs/ 100,000 population falls below 60 (ρ -0.16) (Drennan et al., 2014). However, our data indicate that not all nurses are willing to expand their roles, and *caveats* were raised at interview, including the problem of incompatible medicines from multiple prescribers with no clear overall responsibility. To reassure the public, future work should explore whether burgeoning health inequalities might be related to the disproportionate number of nurse prescribing and expanded-role developments providing services formerly undertaken by doctors in places unattractive to doctors, such as rural areas, former coal-mining communities and other areas of economic deprivation (Jordan, & Griffiths 2004).

5.4 Strengths and limitations

Mixed methods research has a long tradition (Hesse-Biber, 2015), driven, in part, by philosophical pragmatism prioritising solutions to real-world problems (Dewey 1938). The synergy achieved by combining narratives and numbers contributes to understanding social phenomena. This work is framed in pragmatic terms (Misak, 2011): we need a reliable solution to the practical problem of medicines optimisation in a system characterised by shortages and inequalities. Whilst we acknowledge the risks of dissonance in methodological eclecticism (Teddlie & Tashokkori, 2012), and the risks of subverting either

1 data set (O’Cathain et al., 2008), the convergence and complementarity of findings
2 outweigh the constraints of paradigm dissonance (Denzin, 2012).

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4 Like all self-reported data, both survey and interview data were vulnerable to social
5 desirability, recall, and volunteer biases and respondent error (Campanelli, 2008). Our
6 survey response rate was disappointing, and we attribute this to our method of
7 questionnaire distribution (McColl, Jacoby, & Thomas, 2001; Edwards, Roberts, & Clarke,
8 2007; AAPOR, 2016), and the delays in obtaining governance approvals. There were low
9 numbers of respondents in some categories, offering only general indications of trends. The
10 age, sex and length of service of survey respondents are in line with the profile of UK nurses
11 (Royal College of Nursing, 2018). However, respondents were self-selected, and might
12 represent the more highly educated and motivated.

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14 We acknowledge the hazards of multiple testing, and have limited inferential analyses
15 accordingly; however, as all analyses are indicating the same general trend, we are not
16 basing our interpretations on any single P values (Rothman, 1990). We have no reason to
17 assume that our Trusts / UHBs are atypical of non-metropolitan UK, but we make no claim
18 that our respondents represent random samples. We would not wish to make statistical
19 generalisations beyond this sample (Altman 1991), but the data offer signposts and
20 suggestions as to addressing the ‘ADR problem’ that is causing 5-8% of unplanned
21 admissions (NICE, 2015), including notes of caution regarding universal or compulsory
22 expansion of nurses’ roles.

23

24 **6 | CONCLUSION**

25 The scale and complexity of inadvertent iatrogenic harm from the use and misuse of
26 prescribed medicines demand change (WHO 2017) and the closure of the ‘care gaps’
27 pinpointed here. The solution is seen as effective team-working, but workforce and financial
28 constraints suggest this can only be achieved by expanding pharmacists’ and nurses’ roles.
29 However, without structure, patients will continue to be left over-medicated, with
30 preventable ADRs, including hypotension, constipation, sedation, confusion and dyspnoea,
31 as reported here and elsewhere (Jordan et al., 2019).

32

1 If iatrogenic harm (and associated admissions) are to be reduced, medicines optimisation
2 must be prioritised. Targeting well-educated nurses for structured interventions to monitor
3 patients offers a practical solution to suboptimal medicines management. To ensure that
4 this reallocation of the division of labour does not further disadvantage areas of socio-
5 economic deprivation, role expansion must be accompanied by multidisciplinary support
6 and ministry-level programme changes to reduce ADRs, polypharmacy and
7 miscommunication, as recommended by the WHO (2017).

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Figure 1: Illustrating complementary triangulation

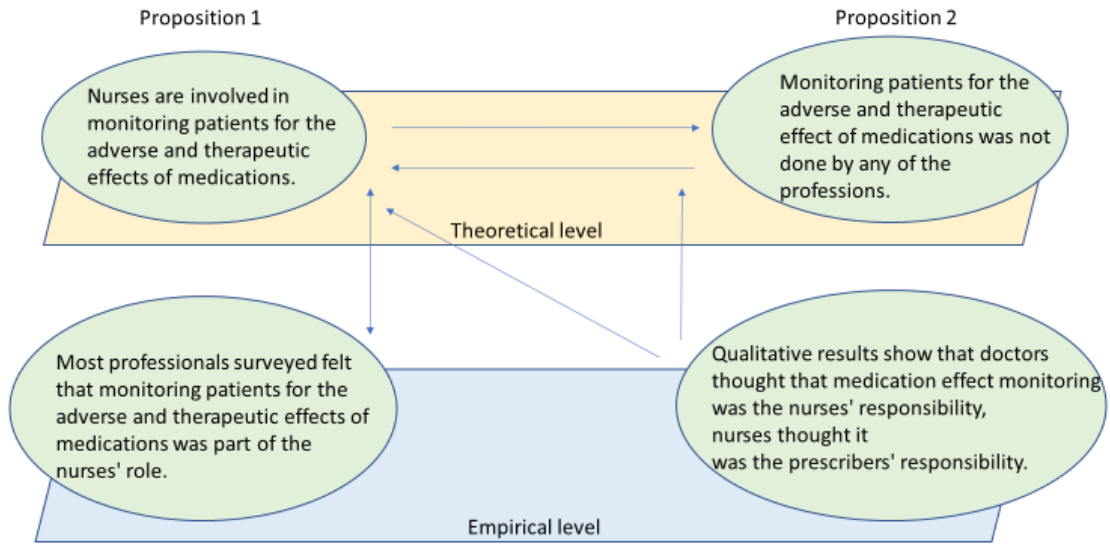
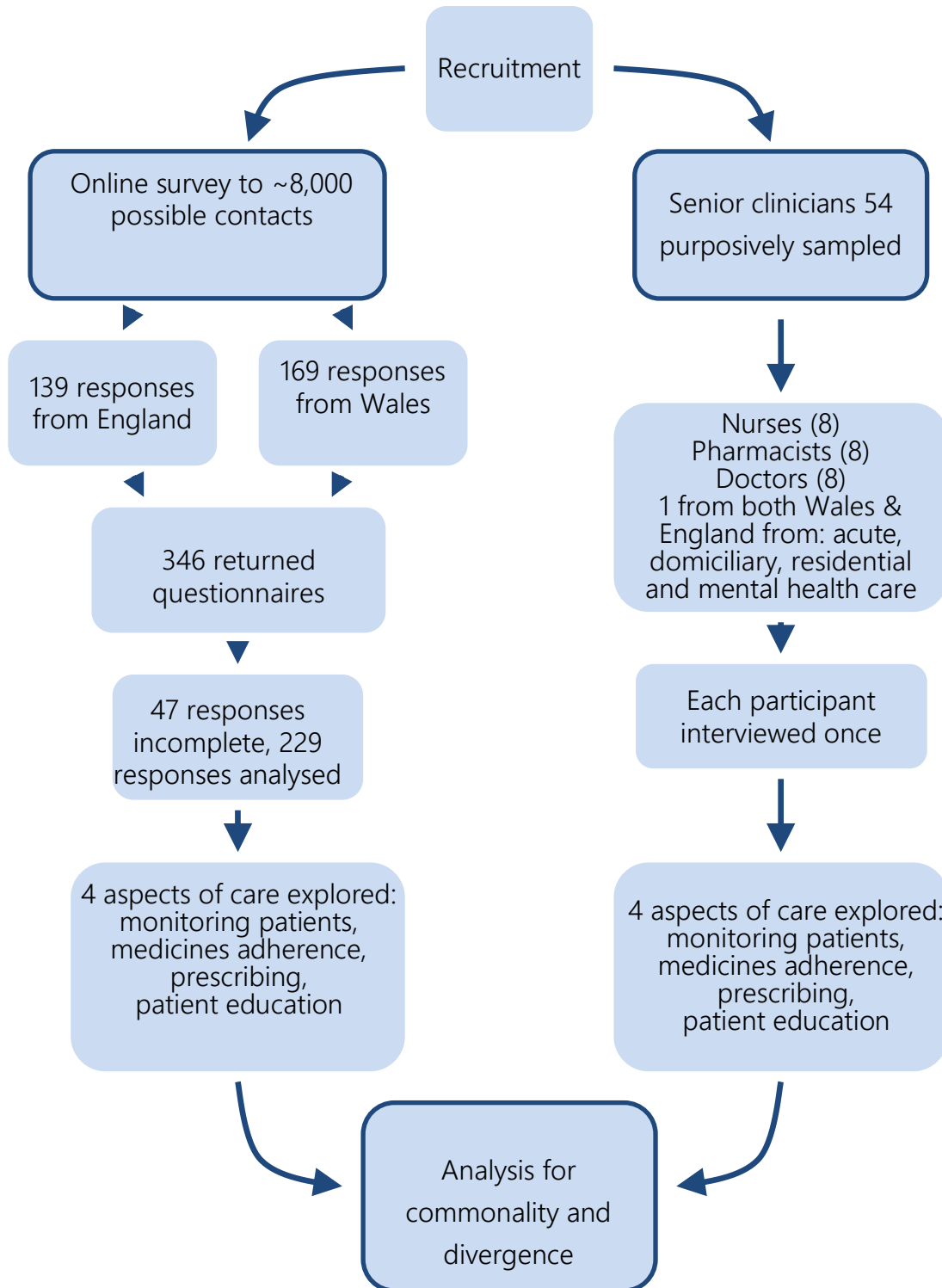


Figure 1: Illustrating the complementary triangulation (adapted from Östlund et al, 2011).

Figure 2: Participant Flow Diagram



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TABLE 1: THEMATIC ANALYSIS (Quotations selected to illustrate data themes)

	Themes		
Tasks	Unoccupied professional territory, and need for change	Nurse education as a barrier	Workloads and time pressures as a barrier
ADR monitoring	<p>Doctors think nurses monitor: “You prescribe that but you would expect that the nurse would not give it if the blood pressure was really low. Just like with things like painkillers, making sure they wouldn’t give it if there were signs of toxicity. ... you’re putting a lot of trust down to the nurse that’s giving the medication that they will make the sensible decision ... a very significant amount of responsibility for it.” (England doctor Acute). “If I’ve started a medication I expect them [nurses] to tell me if it has made any difference” (England, doctor, nursing home)</p> <p>Pharmacists felt nurses should be monitoring: “They [nurses] should be looking for adverse effects and making sure the medicines are working for the patients” (England, pharmacist, nursing homes)</p> <p>Nurse thinks doctors monitor: “I’m a firm believer that if you prescribe a drug, it is your responsibility to follow up to see whether the outcome is of benefit to the patient. So I think the primary responsibility for a follow up should be with the prescriber.” (England, Community nurse), “I think the physicians have to provide information and instruction to the nurses. (Acute nurse Wales).</p> <p>And it’s not done: “Some of the nurses, they take all the vital signs, the blood pressure, the weight, the MUST scores and they do nothing with it. (...) take those residents with very high blood pressure, and I’m like so what have you done</p>	<p>“Nurses may lack knowledge, so that is a weakness - their drug knowledge. And the fact that they should be aware of what they’re administering, what they’re giving to the patient, that they should have an idea of what it is” (...) Weaknesses of the nurses’ roles in medication management is their knowledge. ... nurses aren’t as knowledgeable when they’re coming into practice. ... they’re coming into practice having to learn. So whilst I might have learnt and trained many years ago, I felt I came out with a very good basic knowledge. ... nurses may lack that knowledge, and they really should be aware of what they’re giving to that patient. They should have an idea about what it is. ... there’s no reason why this can’t happen in the university.” (Acute nurse Wales)</p> <p>Results of inadequate education: “I went into a nursing home and they hadn’t given Macrogol®, which is a laxative, originally on the medication administration record as PRN, so they hadn’t given the Macrogol® for 10 days, they just kept writing not required, not required. And then on the 11th day they give an enema. (...) then you see things like loperamide on the MAR chart and you see Movicol® on the MAR chart, ‘cause maybe the patient had an issue once and they were given loperamide out of hours, they carried on over and over -.” (England, pharmacist, Nursing home)</p>	<p>“I think nurses do struggle sometimes to access ongoing education because they’re busy and can’t be let off practice.” (England, Pharmacist, community)</p> <p>“I think they would benefit from some kind of annual teaching on medications” (England, pharmacist, mental health).</p> <p>Time pressures in the nursing curriculum: “bigger part of their [nurses] training being based on pharmacology” (England, doctor, acute)</p>

	Themes		
Tasks	Unoccupied professional territory, and need for change	Nurse education as a barrier	Workloads and time pressures as a barrier
	<p>about this, have you let the GP know? Oh no, not yet. And then so why do you bother taking the blood pressure readings if you don't--, if you don't have anything to do with it--, if you're not going to do anything with it?" (England, pharmacist, nursing homes)</p> <ul style="list-style-type: none"> • "Its a fundamentally important job and one that's all too often missed particularly on the health promotion side" (Wales, nurse, mental health) • "As doctors we hand it out for hypertension and then we don't hear about the side effects. And then the nurse will say, oh such and such is having problems with her feet, such and such is having problems with her shoes. It's that missing link, you know, there's a side effect, should we be changing our prescription based on those findings? and then you would say who would find those things out? And it would tend to be the nursing staff" (Wales, doctor, acute) 	<p>"...nebulisers when people are wheezy. The amount of times I've got called and then you just think, okay they're wheezy, they need a nebuliser - but the nurses being able to identify that ... an area for improvement." (England, doctor, acute)</p> <p>"Most times they just give what is on the list and the patient might be suffering from a side effect of the medication. I would say nine times out of ten, they don't pick up that they shouldn't still be giving this medication." (England, pharmacist, Nursing home)</p>	
Adherence monitoring	<p>A problem raised in mental health: "I see people coming back to my ward time and time again, very, very unwell. It's very distressing for them and their family, lost years of their lives, and the ongoing burden of increased treatment [high] doses, not to mention the burden of those frequent relapses all because they didn't take their tablets. And did we do everything we could have to prevent that? No we didn't." (Wales, nurse, mental health)</p>	<p>"I am aware that there are actually standardised approaches to talking to patients to improve their adherence to prescribed medication regimes. But, it's within the competence of any trained nurse to do that work" (England, doctor, mental health)</p>	No comments
Nurse prescribing	<p>Where nurses were working in previously unoccupied professional territory, prescribing was an important component: "if your in a specialist role or you're an advanced nurse practitioner, you know independent prescribing is a real key to your success" (Wales, nurse, acute care)</p>	<p>"some of them [nurses] I believe are not very confident with medication" (England, Pharmacist, nursing home)</p> <p>"Sometimes nurse prescribers can get drawn into roles that go beyond their competence. For example, I supervise a nurse prescriber in my community</p>	<p>"Actually having nurse prescribers is potentially the answer [to current lack of medical staff] but that takes them away from their current duties" (England, doctor, mental health)</p>

	Themes		
Tasks	Unoccupied professional territory, and need for change	Nurse education as a barrier	Workloads and time pressures as a barrier
	<p>“with independent nurse prescribing you generally have a nurse who’s prescribing and been in that set role, or is very mature in practice, or has been in that role for several years so they have lots to add in terms of skillset.” (Wales, nurse, acute)</p> <p>Role confusion centred on overcrowding of professional territory, rather than a gap: “Within prescribing, having several people given free range to prescribe, is the sort of recipe for disaster in general, regardless of who it is” (Wales, nurse, acute) “It could become chaotic and therefore unsafe and we could lose control, is the principal fear and therefore lead to prescribing practices that are unregulated, unsafe and not monitored.” (England, doctor, mental health) “We lose control of prescribing costs.” (England, doctor, community).</p> <p>“The GPs, when you speak with them, they are furious and like - can you imagine a nurse calling me to give conjunctivitis drops --, which you can buy over the counter. So the GPs moan, the nurses moan that GPs are not responding fast, and find it ridiculous.” (England, pharmacist, nursing home)</p>	<p>mental health team and one thing I often check are people asking you to do things like provide a diagnosis, provide a risk assessment, because actually if a nurse is asking you to do that you are [supposedly] no more trained to do that than they are.” (England, doctor, mental health)</p>	<p>“Nurses are already pretty busy with their own roles at the moment and they may not want to take on an additional role” (Wales, doctor, Community) “actually having enough nurses to cover the essentials before they take on these extended roles” (England, Pharmacist, mental health)</p> <p>“... when you’re interrupted constantly, you’re trying to write a drug chart, you’re trying to re write a drug chart, trying to prescribe, you’re in a pressured environment that can obviously happen sometimes, errors can be made” (England, nurse, acute)</p>
Patient education	<p>“when you’r giving out medication its making sure that you do tell the patient what they are, what drugs they are taking, often I think we forget to do that so, yeah, making sure, because they [patients] question” (England, nurse, acute)</p>	<p>Nurses lacked the knowledge themselves: “They [nurses] don’t seem to have much knowledge about individual drugs when they come out of university so it’s probably a steep learning curve for them when they start as a newly qualified nurse.” (England, pharmacist, acute)</p>	<p>“In terms of education, again I think nurses should, they have an opportunity, more than doctors, to educate” (Wales, doctor, community)</p>

	Themes		
Tasks	Unoccupied professional territory, and need for change	Nurse education as a barrier	Workloads and time pressures as a barrier
	<p>“I think there are a lot of nurses out there who don’t go far enough” (Wales, doctor, community)</p>	<p>“Patient education and information varies between individuals and nursing homes, how competent the nurse is on that. Some of them don’t even know what the medication is used for so they wouldn’t be in a good position to. But all I can say, it varies, it all depends on individual, but the majority I have come across, I wouldn’t... (...) Certainly they [nurses] need to be able to know what medicines are for, what side effects they have and give that information when they speak to patients.” (England, pharmacist, nursing home)</p> <p>“If they [patients] ask them [nurses] why they are taking medications they [nurses] should be able to say why” (England, doctor, nursing home)</p>	

Note: From 2019, nurse prescribing will be taught in the UK within the preregistration education programme (Nursing & Midwifery standards, 2018). Newly qualified nurses and midwives will be deemed “prescriber ready”, and, if working in areas of clinical need, able to access post-registration prescribing programmes, including Community Nurse Prescribing (V150), and Independent Prescribing (V300) within one year of qualification (Nursing & Midwifery Council, 2018).

Table 2: Medicines optimisation roles and nurse education

Nurses' involvement should be extended in:	What is your highest educational level as a nurse?				Total n(%)	Unadjusted analysis		Adjusted analyses			Other significant variables
	Diploma or below n(%)	Bachelors n(%)	Masters n(%)	PhD n(%)		χ^2 df 1	P value	aOR (95% CI) Bachelors	aOR (95% CI) Maters	aOR (95% CI) PhD	
ADR monitoring	22/ 44 (50)	54/ 100 (54)	33/52 (63.5)	13/14 (92.9)	122/210 (58.1)	7.25	0.01	1.18 (0.58-2.41)	1.67 (0.73-3.83)	13.00 (1.56-108.01)	none
Medication adherence	20/ 39 (51.3)	48/94 (51.1)	31/48 (64.6)	11/14 (78.6)	110/195 (56.4)	4.38	0.04	1.13 (0.53-2.44)	1.83 (0.75-4.45)	3.55 (0.84-14.97)	Gender female 0.28 (0.08-1.04)
Prescribing	24/34 (70.6)	52/88 (59.1)	33/46 (71.7)	11/13 (84.6)	120/181 (66.3)	1.21	0.27	0.60 (0.24-1.48) ^a	0.94 (0.32-2.71) ^a	3.10 (0.54-17.59) ^a	Working with: 1-4 pharmacists 2.10 (1.09-4.03): >4 pharmacists 3.14 (0.33-29.58)
Patient education	23/35 (65.7)	51/87(58.6)	35/46 (76.1)	12/13 (92.3)	121/181 (66.9)	4.54	0.03	0.79 (0.35-1.80)	1.72 (0.68-4.65)	6.26 (0.73-54.08)	none

ADR adverse drug reaction, aOR, adjusted odds ratio, CI confidence interval, LL log likelihood

^a not in final model

note: not all respondents gave their education achievements in the 4 categories analysed, and could not be included in these analyses.

Table 3: Nurses' experience of medicines monitoring

	Wales n(%)	England n(%)	Wales n(%)	England n(%)	Wales n(%)	England n(%)		Wales n(%)	England n(%)
	Did you monitor any patients for side effects and therapeutic effects during the last month?		Did you monitor medication adherence for any patients during the last month?		Did you prescribe medication for any patients during last the month?			Did you provide patient education/information about medication use during the last month?	
Yes	89 (69.5)	61 (66.3)	86 (67.2)	52 (56.5)	33 (25.8)	8 (8.7)		94 (73.4)	55 (59.8)
No	34 (26.6)	27 (29.3)	32 (25.0)	26 (28.3)	78 (60.9)	62 (67.4)		17 (13.3)	16 (17.4)
No answer	5 (3.9)	4 (4.3)	10 (7.8)	14 (15.2)	17 (13.3)	22 (23.9)		17 (13.3)	21 (22.8)
If yes, which statements apply?	Last time you observed a side effect, what did you do (more answers possible): n(%)		Last time you observed a side effect, what did you do (more answers possible): n(%)		Last time you observed non-adherence in a patient, what did you do? (more answers possible): n(%)		Questions relating to patient education. If yes, which statements apply?		
I discussed it with a doctor	103 (80.5)	69 (75)	92 (71.8)	57 (62.0)	76 (59.4)	49 (53.3)	Pharmacists, physicians and nurses were well aware of patient education/information provided by each team member	38 (29.7)	20 (21.7)
I discussed it with a pharmacist	35 (27.3)	16 (17.4)	22 (17.2)	14 (15.2)	35 (27.4)	19 (20.6)	I felt qualified to provide patient education or information about medication use	73 (57)	38 (41.3)
I discussed it with a nurse	48 (37.5)	34 (36.9)	38 (29.7)	34 (37.0)	36 (28.1)	24 (26.1)	I received enough information from the doctor to provide patient education or information about medication use	26 (20.3)	17 (18.5)
I discussed it with a patient	67 (52.3)	42 (45.6)	78 (60.9)	48 (52.2)	29 (22.7)	17 (18.5)	I feel other professionals would have given better patient education or information about medication use	20 (15.6)	6 (6.5)
I reported it in the patient file	68 (53.1)	38 (41.3)	68 (53.1)	38 (41.3)	35 (27.3)	15 (16.3)	None of the above answers	4 (3.1)	0
I intervened on my own initiative (eg. Stopping medication administration)	47 (36.7)	27 (29.4)	24 (18.8)	20 (21.7)	23 (18.0)	8 (8.7)			
I did nothing	0	1 (1.1)	1 (0.8)	0	3 (2.3)	2 (2.2)			
I have never observed a side effect	7 (5.5)	7 (7.6)	9 (7.0)	8 (8.7)	21 (16.4)	14 (15.2)			

Table 4: The current situation in medicines monitoring

			Agree strongly n(%)	Agree n(%)	Don't Know n(%)	Disagree n(%)	Disagree strongly n(%)	No response n(%)
If I need a <u>doctor</u> to discuss a patient's medicines management /optimisation or pharmaceutical care, he/she is easily available for collaboration/ discussion (Question only for nurses)	Wales	Nurses	32 (25)	69 (53.9)	4 (3.1)	13 (10.2)	5 (3.9)	5 (3.9)
	England	Nurses	24 (26.1)	45 (48.9)	5 (5.4)	11 (11.9)	3 (3.3)	4 (4.3)
If I need a <u>pharmacist</u> to discuss a patient's medicines management / optimisation or pharmaceutical care, he/she is easily available for collaboration/ discussion.	Wales	Nurses	31 (24.2)	69 (53.9)	7 (5.5)	13 (10.1)	3 (2.3)	5 (3.9)
	England	Nurses	13 (14.1)	46 (50)	16 (17.4)	6 (6.5)	7 (7.6)	4 (4.3)
My employers' policies stimulate inter-professional medicines management.	Wales	Nurses	21 (16.4)	74 (57.8)	14 (10.9)	12 (9.4)	2 (1.6)	5 (3.9)
		Doctors	1 (11.1)	3 (33.3)	3 (33.3)	2 (22.2)	0	0
		Pharmacists	10 (23.8)	25 (59.5)	3 (7.1)	4 (9.5)	0	0
	England	Nurses	10 (10.9)	52 (56.5)	12 (13.0)	13 (14.1)	1 (1.1)	4 (4.3)
		Doctors	0	3 (37.5)	0	3 (37.5)	1 (12.5)	1 (12.5)
		Pharmacists	10 (50)	4 (20)	1 (5)	5 (25)	0	0