Quality in Primary Care
ISSN: 1479-1064

Open access Research Article

'Something that Facilitates Our Work…rather than a Hindrance': Clinical Pharmacist Perspectives on the Use of Data Analytics to Support Polypharmacy Medication reviews in Primary Care

Ruth Hurley[1*], Francine Jury[2], Tjeerd P. Van Staa[2], Victoria Palin[2], Christopher J. Armitage[1]

[1]*Department of Psychology and Mental Health, The University of Manchester, UK*
[2]*Department of Informatics, Imaging and Data Science, The University of Manchester, UK*

ABSTRACT

Background: Polypharmacy and overprescribing pose an enormous challenge to safe healthcare and efficient use of resources. Patient record data could inform safer prescribing and deprescribing, but it is unclear how these complex data should be summarized and displayed to clinicians. The current study examined the perspectives of clinical pharmacists (CPs), a newly expanding workforce of primary care medication specialists, to explore ways that novel analytics could help improve health outcomes for frail and elderly (>65 yrs) patients.
Methods: The utility of novel analytics interventions were discussed in an exploratory scoping workshop. Health risk data for frail and elderly patients with polypharmacy (modelled from extensive national datasets) were presented to primary care clinical pharmacists (n=14). Verbal and textual comments were thematically analyzed using the framework method (exploratory content analysis) combining inductive and deductive approaches.
Results: Overarching themes of data use, data reservations and digital tools acceptance factors were identified. Respondents highlighted several uses for polypharmacy analytics interventions, including increased knowledge of clinical effects of drug-drug interactions, the ability to priorities high-risk patients for reviews and medication to deprescribing (e.g., highlighting cumulative medication risk). Data reservations were linked to existing barriers (such as cognitive overload from existing systems and patient explainability) meaning that CPs' acceptance of digital analytics tools is heavily contingent on facilitators such as ease of use, clear targeted purpose and the ability to support clinicians' understanding and confidence in evaluation of analytics for patient care decisions.
Conclusion: The workshop helped to identify promising analytics and features for polypharmacy intervention development. Patient record data could help address a concerning deficit in evidence of real-world medication interactions, and help clinicians prioritize medication reviews. Barriers to use of digital tools for novel analytics must be addressed and criteria for acceptable user-focused tools are suggested.

Keywords: User-centred; Clinical pharmacy; Polypharmacy; Thematic analysis; Frail elderly; Digital tools

ABBREVIATIONS

(ANP) Advanced Nurse Practitioner; (ACB) Anticholinergic Burden; (BNF) British National Formulary; (CP) Clinical Pharmacist; (DHSC) Department for Health and Social Care; (HER) Electronic Health Record; (GORD) Gastro-oesophageal Reflux Disease; (GP) General Practice or Practitioner; (IT) Information Technology; (NHS) National Health Service; (OCoP)Online Community of Practice; (PPI) Proton Pump Inhibitor; (PIP) Potentially inappropriate prescribing; (RCT) Randomised Controlled Trial; (SMR) Structured Medication Review

Received:	30-November-2022	**Manuscript No:**	IPQPC-22-15297
Editor assigned:	02-December-2022	**PreQC No:**	IPQPC-22-15297 (PQ)
Reviewed:	16-December-2022	**QC No:**	IPQPC-22-15297
Revised:	21-December-2022	**Manuscript No:**	IPQPC-22-15297 (R)
Published:	28-December-2022	**DOI:**	10.36648/14791064.22.30.107-115

Corresponding author Ruth Hurley, Department of Psychology and Mental Health, The University of Manchester, UK, E-mail: hurleyruth7@gmail.com

Citation Hurley R, Jury F, Staa TVP, Palin V, Armitage CJ (2022) 'Something that Facilitates Our Work…rather than a Hindrance': Clinical Pharmacist Perspectives on the Use of Data Analytics to Support Polypharmacy Medication reviews in Primary Care. Qual Prim Care. 30:41852.

INTRODUCTION

Polypharmacy (variously defined as taking five or more medications daily [1]) is one of the NHS's biggest challenges [2-4]. A recent UK government report on overprescribing suggests that 10% of items prescribed each year are not serving patients' needs effectively, being items they "don't need or want, or where harm outweighs benefits" [5]; p11). Frail and elderly people are more likely to experience multi-morbidity [6], and are at higher risk of potentially inappropriate prescribing (PIP). Apart from a large projected waste of resources, long complex medication lists are a potential source of harm through drug interactions and adverse reactions [7]. Clinical Pharmacists (CPs) have been introduced into primary care over the last decade to optimize prescribing, primarily by carrying out Structured Medication Reviews (SMRs) [8]. Existing guidelines to support medication review are often based on theoretical knowledge of drug:drug interactions [9] and adverse drug events in single medication trials. Despite well-regarded expert consultations to address PIP, there remains a lack of underpinning clinical evidence of drug safety and effectiveness for elderly and frail people [10-12], much less for those with polypharmacy. Novel methods are required to gather evidence of the clinical effects of taking multiple medications for this high-risk group.

The BetterRx project (Building Rapid Interventions to improve Treatments) has piloted a learning healthcare system approach to optimize prescribing in primary care which may provide support for polypharmacy medication reviews [13]. It combines advanced analysis of 'big data' [14] from large historical patient databases, with current data via a trustworthy research environment. This allows analysis of a wide range of observed patient treatment combinations with their risk of subsequent adverse outcomes (such as hospitalization due to potential drug interaction). Such analytics can be used to provide tailored, up-to-date feedback to general practices about their prescribing and case mix (with 'drill down' to patient level) however the data are complex and need to be shaped to clinician requirements. A Cochrane review of interventions to improve polypharmacy in older adults (including patient outcomes and potentially inappropriate medications) found uncertain effects of polypharmacy care [15]. The review suggests that to achieve meaningful change and patient outcomes in pharmacology care, interventions require improved research quality and documentation. Additionally, greater adherence to Medical Research Council guidelines for complex interventions would support more effective development and evaluation [16]. Participative design and qualitative analysis have been utilized successfully in previous projects to generate creative user-focused solutions and aid intervention development [13,17].

A challenge exists to provide CPs with acceptable tools to support safe and effective polypharmacy prescribing and deprescribing for frail and elderly patients in primary care. The objective of the present study was gather CPs views of on potential use of novel polypharmacy analytics to inform intervention design for the BetterRx project [18,19].

MATERIALS AND METHODS

Research Design Overview

A two-hour online stakeholder workshop was conducted to explore the potential use of polypharmacy data analytics to support medication reviews in elderly and frail patients (**Table 1**).

Table 1: Topic Guide and brief description of the analytics presented.

Presentation Topics	Description of the analytics presented (polypharmacy related outcomes for frail and elderly patients)
Topic 1 Impact of medication reviews	The impact of system-coded medication reviews on patients' average prescribed daily medication dosage for the three months before and after the review.
Topic 2 Prescribing patterns and medication side-effects	Associations between medication patterns and i) adverse drug reaction-related hospital admissions and ii) emergency hospital admissions identified by machine learning algorithms. Odds ratios for the outcomes were separated into deciles allowing assessment of high and low impact combinations. Findings were also presented for emergency hospital admission levels for patients with drug pairings contraindicated on the PINCER tool compared to that of age and disease match controls.
Topic 3 De-prescribing of medication: Outcomes	Further application of odds ratio of hospitalisation presented in Topic 2 for patients where a medication is deprescribed compared to those who continue with the drug.
Topic 4 Drug to Drug (BNF) interaction data	Odds ratios of hospital admission and excess risk (i.e., clinical outcomes) for patients who were prescribed Drug-Drug pairs contraindicated in the BNF compared to that of patients who were only prescribed one of those medications.
Topic 5 Online Community of Practice	Plans for an Online Community of Practice (OCoP; [19] that would provide a means for CPs to access online peer support and data analytics resources.

Note: 1 Where possible control data were matched by disease, sex, age, and coding quality; 2 BNF=British National Formulary [9].

Participants

Total Participants were primary care CPs (n14; male=6; female=8) from a range of English primary care networks including senior CPs (2), prescribing advisors (2), special interface pharmacist (1) unspecified pharmacist (1). Experience ranged from 1 to 15 years (mean=5 years).

Recruitment

Purposive recruitment was conducted electronically via event links sent to professional networks. Sign-ups were accepted from NHS CPs with at least 12 months experience working in primary care. A £ 100 retail e-voucher was sent to participants after the workshop to compensate them for their time.

Data Collection

The workshop comprised 5 short presentations each followed by a short discussion (5-10 minutes). The speaker answered questions and invited clinicians to discuss the potential merits, drawbacks and uses for those data in practice. The automatic recording and transcribing function within the online video conferencing software (Zoom) were used to capture participant contributions. Workshop presentations covered 5 topics (**Table 1**) showing novel analytics derived from extensive patient record databases that could be used to assess patient risk associated with polypharmacy (highlighting medication combinations associated with increased risk of hospital admission compared to matched controls). Indicative questions to participants were generated prior to the session but the discussion was led by the interest and concerns of the participants in relation to their current practice, and how analytics might help them.

Recording and Data Transformation

Audio, automatic transcription and chat comments were extracted from the video conferencing software transcription and chat comments were anonymized. The data files were uploaded, synchronized and corrected in NVivo12+.

Analysis

Qualitative analytic approach: Data were coded thematically in NVivo using Framework analysis in a participant-centric experiential approach following the Framework Method [20,21] led by objectives

- Barriers and facilitators of medication reviews (reported elsewhere).
- Feedback on the BetterRx analytics presented. The initial inductive (first order) coding aimed to summarize salient issues from the participants' perspective. This stage was conducted independently by RH and FJ then coding was compared to identify a wider breadth of issues. Preliminary codes were agreed. This was followed by (second order) inductive, coding of how the codes were being discussed, and deductive/ interpretive (third order) relating to acceptable digital intervention design. Codes were organized hierarchically according to meaning, similarities/ differences and descriptive categories (reducing codes to their simplest and most representative form). Category importance was assessed by frequency and intensity of expression; the most prominent categories were those that met both criteria.

Reporting: NVivo was used to produce summary reports of codes and quotes. The main categories and themes (definition, related codes, indicative quotes and analysis, discussion of deviant cases, and further points for consideration and comparison) were summarized in memos and shared with the team for comment. Extracts representative of the data corpus from a first-person perspective were identified. The extracts were interpreted to draw out implicit themes in relation to CP's role, medication reviews and perceptions of the data presented. Findings and revealed qualities are discussed in context of existing theory and research [22], and contribution to future intervention design.

RESULTS

Analytics Feedback

CP feedback on BetterRx analytics interventions presented were organized by the overarching themes of: Data uses, Data use reservations, Making tools acceptable, and Online Community of Practice evaluation (OCoP).

Data Uses

CPs discussed several ways that BetterRx data or tools could be used in their work (see **Table 2** primary and secondary themes with quotes). Participants were very positive toward analytics data that could indicate realistic clinical risk of drug-drug interactions ("you might get better sort of interaction and sort of engagement with existing pop-ups with this"). Incorporating these data in a reference tool that would help CPs to look at potential risky medication combinations to prioritize medication reviews. It would be useful to organize the data (perhaps through filter functions) to allow CPs to manage and monitor outcomes for patient groups, such as those on neuroleptics, or specific conditions such as those at increased risk of serotonin syndrome. CPs noted that emerging dashboards included patient outcomes beyond hospitalization (such as falls) that are useful. Better alerts or flags that GPs or Advanced Nurse Practitioners (ANPs) could use to identify problematic medication combinations earlier were also suggested.

Table 2: Analytics Feedback: Summary of primary and secondary themes and indicative quotes

1˚ Themes	Data uses	Data use reservations	Acceptable tools	Online Community of Practice
2˚ Themes	**Clinical significance of drug interactions** "this' … helps to answer that question as to whether an interaction in real life causes a problem or not for an individual patient."	**Data confidence** "X number of people hospitalised who we took off a statin ended up in hospital, actually what does that mean? Because of the confounding [yeah]."	**Targeted** "Not too much data; being about being able to see the wood from the trees"	**Existing peer communication** "you know, like I say, did I think things are quite informal with the sort of a networks at the minute so yeah sounds like a good idea."
	Prioritisation of reviews "I think that really that would be quite useful if you had that. I'd like that information"	**Data explainability** "actually, this information wouldn't tell me enough to be able to have a conversation with the patient about anything so what's the point what's the point of presenting the data"	**User-friendly** "So, it really depends how user friendly you make it and how intuitive it is because let's face it, we all probably get those flash up interactions our screens and we can see, in most cases, we just don't even look at them, you know"	**OCoP uses** "I don't always know where to look for guidance guidelines that-I do know where to look but it's clunky I have to go on to different guidelines so be nice to have it all in one place that specifically for clinical pharmacist, I think it'd be helpful."

Pinpointing issues

"I could target a certain area and say okay I've got a huge issue with let's say all corticosteroid you know prescribing in this particular area or those broad-spectrum antibiotics"

"Potentially whittled it down to even one prescriber that just needs a bit of educating or you know we can have a group education session in the area right."

Individual patient reviews

"For more like preventative medicine, you know that's where I think this may be useful, but whether it would help me with regards to how I review my patients, no."

Clear explanation of data

"I think you may struggle, a little bit with buy-in, if like you mentioned.... if you can give a little bit of information, maybe around why certain patients have been indicated as being high-risk"

Potential issues

"It's a good idea but do sort of with the community aspect and that you know sharing of things all great in principle-it's you know sort of validating things and who is going to moderate these discussions?"

Structured reminders

"because, otherwise, if you start stopping things and then you don't review the patient and that's when you can end up with problems."

Hindrance (to work practices)

"I agree with you there as well, I think, actually, if anything, it might hinder your reviews because you'll be presenting all this data…"

User autonomy

"we have to remember that machines are machines and it's all about clinicians and clinician experience and that trumps everything"

"So maybe having something there that we could run if we wanted to, when we wanted to... would be... the data obviously would be useful."

Aid deprescribing decisions

"Yeah, I think it could be reassuring… if the data, then shows that actually it doesn't harm the patient then that could be reassuring for people trying to keep the scribe"

Practical use

"It's what you do with that data isn't it? I don't think... I don't think it would have any practical use" [Re. data on patient hospitalisation outcomes following deprescribing]

Shared decision-making

"And you miss the bigger picture that we've got to remember there is a patient in front of us, there still has got to be that that discussion with the patient, ideally, you know that holistic approach."

Long-term effects of drug interactions

"If we stop a PPI with people with GORD, [I would like to know] the number of times that a person will then present with GP with like, with recurrent symptoms"

Cumulative medication risk calculator

"if that had just come up for me click on this button and it'll give you the automatic ACB score that might be useful."

A proposed advantage of prescribing or deprescribing outcomes for similar patients included reassurance and increased confidence. Tracking long-term effects of deprescribing and the odds of recurrence of symptoms after deprescribing would be useful for conditions where a medication is no-longer indicated but there is little information about the future costs or benefits to the patient. Examples included deprescribing antipsychotics where the likelihood of potential relapse could be particularly detrimental (possibility of harm to self or others, hospital admission, loss of independence), and symptom monitoring for patients with gastro-oesophageal reflux disease where a proton pump inhibitor (PPI) had been deprescribed.

"If we stop a PPI with people with GORD, the number of times that a person will then present with GP with like with recurrent symptoms is x...there's no trial data to do that, but that would be a lot more powerful."

Polypharmacy medication risk can be less obvious when small risks from several medications add-up incrementally. Being able to produce and display cumulative risk scores like anticholinergic burden (ACB see NHS Hull University Teaching Hospital [23]) or cumulative serotonin risk during a medication review could be a useful way to highlight problems that could easily be overlooked.

"When I looked at the risk of the mortality associated with that it was quite it was quite scary… if that had just come up for me-'click on this button and it'll give you the automatic ACB score' that might be useful."

Data use reservations: The majority of participants saw interesting potential uses of analytics in at least one of the four

topics and genuine interest/consideration of possibilities; however, many also indicated a degree of reservation in uses of the data. Key issues are examined below **Table 2**.

Some CPs were not confident about the reliability of the data due to EHR code quality and potential confounds. A preference for Randomized Control Trial (RCT) data was expressed as it was felt this could be relied upon; however the ethical and logistical issues around RCTs for deprescribing research were pointed out. CPs seemed unsure what conclusions they could reliably draw from the data and needed to know more about the relative merits and limitations. Some CPs expressed interest in case studies which are a familiar way to share peer learning. This might make other clinicians feel more confident by essentially demonstrating the utility of the risk data through triangulation with a more familiar method.

Some CPs were more comfortable with the idea of using the data to prioritize cases and make resource-targeting decisions than decision on changes to the medication of individual patients within an SMR or instigate a patient discussion. This appeared to be due to a combination of data confidence and explainability. One data confidence issue appeared to be uncertainty in how to explain the data to a patient (an important consideration during SMRs). Decisions needed to be co-created with patients (and potentially justified to other clinicians) so CPs needed information that they could explain confidently. It also seemed difficult for CPs to see how the data or tool might fit the way they conducted their SMRs, and they appeared to have been anticipating that the workshop might contain ideas to patient explanations and shared decision-making.

CPs wanted to avoid any data or tool that could hinder them. The main concern in this regard was the potential for too much irrelevant information or additional notifications/pop-ups that could be a potentially dangerous distraction they didn't have control over. The main concern here was to avoid further complication of a high-stakes task which could compromise patient safety.

"Depends on whether it becomes.... if you want something that facilitates our work and rather than a hindrance, where it becomes almost keep on flashing…"

The question of how the data would be used practicality by CPs was deliberated. The main outcome of the data presented was risk of subsequent hospital admission and participants queried how useful this was, especially following deprescribing ("Would it change our practice? I don't think it'd change our practice"). The idea of linking deprescribing with negative outcomes was emotive, and one explanation could be that CPs suspected the data could be used to blame clinicians for negative outcomes without considering wider issues.

Making acceptable tools: There was a general feeling that analytics had good merit (especially clinical risk of BNF drug interactions and prioritization of SMR cases) however getting the 'buy-in' of CPs to use the data in a tool would be a challenge unless it was carefully designed and had a clearly targeted purpose. The tool should not be 'clutter' on the screen and should not distract CP attention from important tasks. CPs were strongly opposed to having more pop-ups especially about drug interactions (which they regarded as mainly theoretical and a constant annoyance). CPs would prefer that the tool did not integrate with the EHR if that was going to create more pop-ups, however, if the analytic data was able to be used to reduce the number of pop-ups (i.e., restrict these to interactions that had clinical evidence or suppress them) this would be very welcome.

"If we can tweak it so that we are able to quantify how much of an issue that interaction is so that we are getting less pop ups, so to speak, you know, and that will be more useful."

If a digital analytics tool was being used within an SMR, clinicians were clear that (at a minimum) it should not detract from shared decision-making and ideally would support it. This would entail ensuring that the uses and limitations of any content was easily understood by clinicians and could be easily explained to a patient in a way that was clear applicable to them and/or their condition/s.

Online community of practice: Fewer attendees took part in the discussion about the OCoP (partly due to the session running over) but those that remained (n=3) showed interest in a secure online space that would allow them opportunity to share good practice (e.g., getting the most out of BetterRx tools), ask questions of colleagues (including those outside the immediate local area). For existing communication systems CP's used informal online groups such as WhatsApp to communicate with others locally. These were good for quick answers to urgent issues, especially when supported by senior colleagues. There was not a national group that targeted CPs, and participants felt it would be good to have a formal CP support network such as the OCoP.

"It might be nice to have something for things that err you might not want to ask locally or you just a more general or aren't things you need to sort out immediately so for the medication reviews I think it'd be really, really helpful yeah."

Participants suggested the OCoP (**Table 2**), would be a good source of support for SMRs if it had functionality such as easy guideline access ('all in one place'), information about under-researched area (such as hormone replacement therapy) and case studies (e.g., to illustrate data findings).

Bite-size articles on current topics of interest (with the option to looking into things further) would be useful, but the main advantage of the OCoP would be the ability to get ideas and support from colleagues.

Potential OCoP issues included establishing a clear reason for the group, focusing content (avoiding too much 'chatter'), having appropriate validation of content, and moderation to avoid misunderstandings or interpersonal issues. Having local champions on-board to raise the profile of the OCoP and BetterRx tools was also suggested.

"yeah, great idea if it's focused and we can actually share practice guidance and whatnot, so to speak, yeah."

DISCUSSION

The current study examined CP perspectives on the use of analytics data in polypharmacy medication reviews. Main themes of data use, data reservations and digital tool acceptance factors were identified. Several ways that analytics could support

safer prescribing for frail and elderly patients were identified, along with recommendations to support user-focused development digital tools for clinical pharmacy. Advanced analytics derived from patient record data offer a new way to evidence clinical outcomes for polypharmacy patients, including those at increased risk of PIP.

Uses of Analytics to Address Polypharmacy

The lack of formal guidance on polypharmacy medication reviews and deprescribing procedures [24] is compounded by the dearth of clinical evidence for high-risk populations due to their exclusion from clinical trials [5,10]. The current research identified ways that analytics data could support clinical pharmacy, including helping to prioritize patient SMRs and highlight anomalous prescribing patterns (targeting quality improvement). CPs would also value analytic evidence of the real-life/clinical effects of contraindicated drugs listed in the British National Formulary (BNF) as this would add important academic knowledge (Medicines Information) and clinical understanding to existing theory.

Knowledge of clinical outcomes following deprescribing (including hospitalizations and long-term impact such as re-consultations over time) could be useful when CPs consider whether to stop or maintain a medication. An example is deprescribing of psychopharmacology medication which can affect mobility and cognition (increased falls, memory problems, delirium) and jeopardizing independent living [11]. Clinicians maybe reluctant to deprescribe due to little evidence of the likelihood and impact of relapse verses continuing effects. Recent literature concurs that there are significant gaps in evidence-based knowledge of deprescribing, particularly in relation to individual differences such as age and gender [25] which could gain insight from 'big data' [14].

Data Use Reservations

CPs expressed reservations about statistics derived from historical EHR data including reliability and whether the data had a clear, practical use. CPs were skeptical of situations where they might be asked to 'just trust the data,' being conscious of the need to co-create decisions (with patients and possibly other clinicians). They were unclear about the advantages and limitations of modelled data, and circumstances that made RCT evidence unfeasible to collect. CPs expressed fewer reservations when they could see a clear applicability of the data to patients, such as those with a given disorder or condition. CPs did not strongly identify with use of hospital admission as an outcome variable for medication review decisions and were more familiar with considering less severe outcomes, such as symptomatic exacerbations, or reported concerns from clinicians or the patient. Use of wider outcome measures to judge efficacy and safety of medication changes were suggested, such as patient falls (presumably recorded in the EHR if the patient attended the GP for treatment). Rankin et al., [26] identified further outcomes for elderly patients which could be considered in future analytics research, including serious adverse drug reactions, medication appropriateness, falls, medication regimen complexity, quality of life, mortality, and medication side-effects. Medication outcomes include adherence, appropriateness, clinically significant drug interactions, number of regular ongoing medications (indicating a possible difference between acute and chronic outcomes), and therapeutic duplication. The electronic frailty index offers an additional means to stratify cumulative frailty deficits [27].

CPs were interested in outcomes that reflected patient quality of life but appeared to rely on patient/carer self-report to judge this rather than validated scales. It was acknowledged that psychological health and wellbeing indicators existed (such as pain scales) but were unlikely to be systematically recorded for a patient. This is in contrast to physiological health measures (blood pressure, peak expiratory flow etc.), where more frequent recording allows changes in the patient to be tracked. The lack of systematic collection of data could be an important barrier to monitoring healthcare needs and addressing disparities in physical and mental health per government legislation and care objectives [28,29].

Addressing Clinician Reservations

The perception that 'only RCT evidence can be trusted' neglects the limitations of the methodology (such as reduced ecological validity; [30]), and the benefits of other scientific methods [31,32], including pragmatic randomized controlled trials [33]. Real world clinical data such as historical patient record data with appropriate controls and triangulation hold considerable promise to address medical research needs. Such data are already being utilized by healthcare industries to assess realistic risk and intervention efficacy [34]. In view of reticence for clinicians to rely on such data, intervention developers and medical educators should consider updating criteria to help clinicians validate the applicability of evidence from real world study designs [35] and concise ways to communicate these heuristics to users.

Designing Digital Tools that 'Help not Hinder'

Digital tools such as health analytics dashboards have become an important way to monitor quality improvement in health care, but optimal design is essential [36]. Participants were very clear that any new information or tools needed to be developed carefully to ensure they 'helped rather than hindered' their work (reflecting negative experiences with distracting features of current tools). The five themes of acceptable analytics tools identified by clinical pharmacists suggest tools should

- Be targeted (clearly related to tasks the clinician completes),
- User-friendly (uncluttered trouble free usage, not assuming high levels of IT or data interpretation skill),
- Clear data explanations (e.g., what factors lead a patient to be deemed at a given level of risk),
- Support user autonomy (allowing clinician choice in how and when they use the system),
- Support shared decision-making (show explicit relevance to patient care and suggest how the information could be relayed to the patient). Attention to these 5 themes can be used to help ensure analytics tools are focused to help clinicians understand and utilize them for patient care.

Strengths and Limitations

The current study forms part of person-centered approach to health analytics intervention development adopted by the BetterRx medication optimization project and had several strengths. The approach follows recommendations [16,32,37] to adopt a person-centered approach from the inception of an intervention and make use of well validated extant theory to guide development. Feedback on the use of analytics data and role context benefited from the views of primary care CPs with a spectrum of experience in the field (reflecting the current workforce). The qualitative analysis method followed a systematic person-centered approach to minimize epistemological restrictions and encourage diverse input in-keeping with the exploratory nature of the workshop [21]. To broaden insights and help reduce the effects of preconceptions/experiential bias in the analysis, coding was reviewed by team members from different disciplines (psychology and applied health analytics). A multi-level coding approach was adopted to consider the findings from both the participants perspective (what issues were emphasized or repeated) and then in relation to behavioral theory.

A more exhaustive breadth of CP views could have been obtained by holding further workshops (until saturation). The current sample provided good preliminary overview of issues and a basis for consideration of areas for further research and development at this early planning stage. The study has highlighted several challenges in the role, but further quantitative research would be required to gauge how widespread issues are, such as dissatisfaction with EHR alerts and preferences for the OCoP. Findings of the study are however in-line with previous research on digital healthcare professional interventions. We did not carry out participant checking processes but it is recognized that this could be a useful validity check in subsequent stakeholder consultations on the project [38]. Although out of the scope of this paper, further consultation with patient groups to seek their opinion on the use of patient data to inform health risk analytics (and the use of these data in their care) are planned.

Suggestions for Future Research

Future research should establish whether CPs find patient data analytics more acceptable if they are presented with short clear explanations of methodological strengths and limitations and suggested use cases. A wider range of potential polypharmacy outcome data for elderly patients should be investigated, such as the core outcome set [26]. Ways to facilitate systematic measurement and recording of such outcomes should also be investigated. For example, short validated electronic surveys with findings that are automatically updated to the EHR could aid consistent assessment of mental and physical health outcomes. This would also increase opportunities for future systematic investigation within a learning health system.

CONCLUSION

Currently, clinical evidence for the effects of taking multiple medications remains largely theoretical. Data analytics offer an innovative way to highlight drug combinations that pose genuine risk to patient health, wellbeing, and independent living. However, to be useful within a structured medication review CP's require more than identification of PIP. Hearing from stakeholders at this early stage of intervention planning helped to increase user empathy, including awareness of the critical importance minimizing cognitive distractions when designing digital tools for SMRs. Additionally, this highlighted the need to support evaluation and assessment of modelled analytics before clinicians can confidently explain and apply them to patient care decisions.

DECLARATIONS

Ethical Approval and Consent to Participate

The study was approved by the Northeast-Newcastle and North Tyneside 2 Research Ethics Committee Ref. 21/NE/0103 and all methods were performed in accordance with the relevant guidelines and regulations including obtaining informed consent from all participants prior to participation.

AUTHORS CONTRIBUTION

RH, TPvS and FJ developed the study methodology. RH, FJ and TPvS carried out the data collection with support from the BetterRx team. RH (background in psychology, health, education and human computer interaction) completed the data cleaning and data analysis with support from FJ (background in managing medical intervention research). RH wrote the manuscript with input from TPvS, CJA and VP. All authors read and approved the final manuscript.

ACKNOWLEDGEMENT

The authors would like to thank all participants who attended the workshop. In addition, we would like to thank the BetterRx team at the University of Manchester for their assistance in organizing and delivering the workshop. Armitage is supported by NIHR Manchester Biomedical Research Centre and the NIHR Greater Manchester Patient Safety Translational Research Centre.

FUNDING

This work was supported by Health Data Research UK (Better prescribing in frail elderly people with polypharmacy: Learning from practice and nudging prescribers into better practice BetterRx) and by the National Institute for Health Research (NIHR130581-Cluster randomized trial to improve antibiotic prescribing in primary care: Individualized knowledge support during consultation for general practitioners and patients-BRIT2). Funders were not directly involved in study design data collection, report writing or manuscript publication.

DECLARATION OF INTEREST

None.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

SUMMARY TABLE

What was Already Known on the Topic

- Overprescribing and polypharmacy pose a challenge to healthcare systems in terms of safe prescribing and effective use of resources.
- There is a lack of evidence for the clinical effects of polypharmacy for frail and elderly people (a higher risk group for potentially inappropriate prescribing).
- Clinical pharmacists are a new and developing workforce of primary care medication specialists who are working to identify and address overprescribing (particularly in vulnerable groups).

What this Study Added to our Knowledge

- There are several ways that clinical pharmacists may benefit from real-world insights into polypharmacy-related potential adverse events from historical patient record data.
- Clinical pharmacists do not currently feel well supported by their computer systems, largely due to being overwhelmed and with alerts for theoretical medical interactions that do not fit their workflow.
- Key themes related to data use and reservations about digital analytics tools were identified, including the need to support for clinicians' understanding and confidence in the strengths, limitations and validity of modelled data to support patient care decision-making.

REFERENCE

1. Masnoon N (2017) What is polypharmacy? A systematic review of definitions. BMC Geriatr 17(1): 230.
2. Alderwick H, Dixon J (2019) The NHS long term plan. BMJ 364: l84.
3. Soley-Bori M (2021) Impact of multimorbidity on healthcare costs and utilisation: A systematic review of the UK literature. British J Gen Prac 71(702): e39-e46.
4. Sinnott C, Bradley CP (2015) Multimorbidity or polypharmacy: Two sides of the same coin? J comorbidity 5: 29-31.
5. DHSC (2021) Good for you, good for us, good for everybody. Dept Healt Soc Care.
6. Midao L (2018) Polypharmacy prevalence among older adults based on the survey of health, ageing and retirement in Europe. Arch Gerontol Geriatr 78: 213-220.
7. O'Shea J (2022) Pharmacogenetic interventions to improve outcomes in patients with multimorbidity or prescribed polypharmacy: A systematic review. Pharmacogenomics J 22(2): 89-99.
8. NHS (2020) Structured medication reviews and medicines optimisation: Guidance, in Network Contract Directed Enhanced Service.
9. NICE (2022) British National Formulary.
10. Scott IA, Guyatt GH (2010) Cautionary tales in the interpretation of clinical studies involving older persons. Arch Intern Med 170(7): 587-95.
11. Gray SL, Lai KV, Larson EB (1999) Drug-induced cognition disorders in the elderly: Incidence, prevention and management. Drug Saf 21(2): 101-22.
12. Spinewine A (2007) Appropriate prescribing in elderly people: How well can it be measured and optimised? The Lancet 370(9582): 173-184.
13. Palin V (2020) Developing the infrastructure to support the optimisation of antibiotic prescribing using the learning healthcare system to improve healthcare services in the provision of primary care in England. BMJ Healt Care Inform 27(1).
14. Batko K, Slezak A (2022) The use of big data analytics in healthcare. J Big Data 9(1): 3.
15. Rankin A (2018) Interventions to improve the appropriate use of polypharmacy for older people. Cochrane Database Syst Rev 9: CD008165.
16. Craig P (2008) Developing and evaluating complex interventions: The new Medical Research Council Guidance. BMJ 337: a1655.
17. Reddy A (2019) Applying participatory design to a pharmacy system intervention. Res Social Adm Pharm 15(11): 1358-1367.
18. Avery AJ (2012) A pharmacist-led information technology intervention for medication errors (PINCER): A multicentre, cluster randomised, controlled trial and cost-effectiveness analysis. Lancet 379(9823): 1310-9.
19. Wenger E (2000) Communities of practice and social learning systems. Organization 7(2): 225-246.
20. Tonkin-Crine S (2011) GPs' views in five European countries of interventions to promote prudent antibiotic use. Br J Gen Pract 61(586): e252-61.
21. Gale NK (2013) Using the framework method for the analysis of qualitative data in multi-disciplinary health research. BMC Med Res Methodol 13: 117.
22. Watts S (2013) User skills for qualitative analysis: Perspective, interpretation and the delivery of impact. Qual Res Psych 11(1): 1-14.
23. NHS Hull University Teaching Hospital (2020) Anticholinergic Burden (ACB).
24. Ibrahim K (2021) A systematic review of the evidence for deprescribing interventions among older people living with frailty. BMC Geriatr 21(1): 258.
25. Rochon PA (2021) Polypharmacy, inappropriate prescribing, and deprescribing in older people: Through a sex and gender lens. The Lancet Healthy Longevity 2(5): e290-e300.
26. Rankin A (2018) Core outcome set for trials aimed at improving the appropriateness of polypharmacy in older people in primary care. J Am Geriatr Soc 66(6): 1206-1212.
27. Clegg A (2016) Development and validation of an electronic frailty index using routine primary care electronic health record data. Age Ageing 45(3): 353-60.

28. Health and social care act. UK Pub Gen Acts 473.

29. DHSC (2019) The Government's revised mandate to NHS England for 2018-19. Dept Healt Soc Care.

30. Rothwell PM (2005) External validity of randomised controlled trials: "To whom do the results of this trial apply?". The Lancet 365(9453): 82-93.

31. Concato J, Shah N, Horwitz RI (2000) Randomized, controlled trials, observational studies, and the hierarchy of research designs. N Engl J Med 342(25): 1887-92.

32. Berwick DM (2008) The science of improvement. JAMA 299(10): 1182-4.

33. Dal-Re R, Janiaud P, Ioannidis JPA (2018) Real-world evidence: How pragmatic are randomized controlled trials labeled as pragmatic? BMC Med 16(1): 49.

34. Blonde L (2018) Interpretation and impact of real-world clinical data for the practicing clinician. Advances in Therapy 35(11): 1763-1774.

35. Franklin JM, Schneeweiss S (2017) When and how can real world data analyses substitute for randomized controlled trials? Clin Pharm Thera 102(6): 924-933.

36. Weggelaar-Jansen A, Broekharst DSE, de Bruijne M (2018) Developing a hospital-wide quality and safety dashboard: A qualitative research study. BMJ Qual Saf 27(12): 1000-1007.

37. Yardley L (2015) The person-based approach to intervention development: Application to digital health-related behavior change interventions. J Med Internet Res 17(1): e30.

38. Birt L (2016) Member Checking: A tool to enhance trustworthiness or merely a nod to validation? Qual Health Res 26(13): 1802-1811.