

Accepted Manuscript

British Journal of General Practice

Implementing emergency admission risk prediction in general practice: a qualitative study

Evans, Bridie; Dale, Jeremy; Davies, Jan; Hutchings, Hayley; Kingston, Mark; Porter, Alison; Russell, Ian; Williams, Victoria; Snooks, Helen

DOI: <https://doi.org/10.3399/BJGP.2021.0146>

To access the most recent version of this article, please click the DOI URL in the line above.

Received 01 March 2021

Revised 27 July 2021

Accepted 23 August 2021

© 2021 The Author(s). This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>). Published by British Journal of General Practice. For editorial process and policies, see: <https://bjgp.org/authors/bjgp-editorial-process-and-policies>

When citing this article please include the DOI provided above.

Author Accepted Manuscript

This is an 'author accepted manuscript': a manuscript that has been accepted for publication in British Journal of General Practice, but which has not yet undergone subediting, typesetting, or correction. Errors discovered and corrected during this process may materially alter the content of this manuscript, and the latest published version (the Version of Record) should be used in preference to any preceding versions

Implementing emergency admission risk prediction in general practice: a qualitative study

Bridie Angela Evans PhD, Health Services Researcher*

Jeremy Dale PhD, FRCGP, Professor of Primary Care

Jan Davies, Service User

Hayley Hutchings PhD, Professor of Health Services Research

Mark Kingston PhD student and Health Services Researcher

Alison Porter PhD, Associate Professor of Health Services Research

Ian Russell PhD, Professor Emeritus

Victoria Williams PhD, Health Services Researcher

Helen Snooks PhD, Professor of Health Services Research

*Corresponding author

Bridie Angela Evans

Swansea University Medical School

ILS 2, Singleton Campus

Swansea SA2 8PP

b.a.evans@swansea.ac.uk

Tel: 01792 295888

Implementing emergency admission risk prediction in general practice: a qualitative study

Abstract

Background: Using computer software in general practice to predict patient risk of emergency hospital admission has been widely advocated despite limited evidence about effects. In a trial evaluating introduction of a predictive risk stratification model (PRISM), we reported statistically significant increases in emergency hospital admissions and use of other NHS services without evidence of benefits to patients or the NHS.

Aim: to explore experiences of incorporating PRISM into routine practice.

Design and setting: semi-structured interviews with 22 general practitioners and practice managers in 18 practices in South Wales.

Methods: Interviews at two timepoints: 3-6 months after gaining PRISM access; study end, approximately 18 months later. We analysed data thematically using Normalisation Process Theory.

Results: Respondents reported the decision to use PRISM was based mainly on fulfilling reporting requirements for Quality and Outcome Framework (QOF) incentives. Most applied it to a very small number of patients for a short period. Using PRISM entailed technical tasks, information sharing within practice meetings and small-scale changes to patient care. Use was inhibited by PRISM not being integrated with practice systems. Most doubted any large scale impact, but cited examples of impact on individual patient care. They reported increased awareness of patients in high-risk groups.

Conclusions: Qualitative results suggest mixed views of predictive risk stratification in general practice and raised awareness of highest-risk patient groups, potentially affecting unplanned hospital attendance and admissions. To inform future policy, decision-makers need more information about implementation and effects of emergency admissions risk stratification tools in primary and community settings.

Trial registration: Controlled Clinical Trials no. ISRCTN55538212.

Keywords: General practice, emergency hospital services, chronic disease, health risk appraisal, health service evaluation, qualitative research

How this fits in

UK policy has incentivised use of risk prediction stratification in primary care to reduce emergency hospital admissions, despite lack of evidence about process or effect. In a trial evaluating a risk prediction tool (PRISM) in general practice, our team reported increased emergency and hospital admissions. To understand implementation, we interviewed GPs and Practice Managers who reported using PRISM on a small group of high-risk patients. Although they doubted any impact on care, they said PRISM raised their awareness of highest-risk patient groups, which potentially may affect unplanned hospital attendance and admissions.

Background

Using computer software in primary care to predict risk of emergency hospital admission is widely advocated to support proactive care of vulnerable patients and manage demand on healthcare services [1-4]. In 2012–2013, there were 5.3 million emergency admissions to hospitals in England costing £12.5 billion [5]. Around half came from 5% of the population yet an estimated one in five is avoidable [6, 7, 8].

Using predictive risk stratification in general practice allows clinicians to identify patients at high risk of emergency admission [8, 9, 10, 11, 12, 13, 14], targeting care and services according to level of risk [14, 15, 16]. Individual risk scores are estimated based on past use of healthcare, diagnoses and medications, and tools are generally more accurate and consistent than clinical opinion [17]. The rationale is that targeted management of patients can reduce emergency admissions, improve patient outcomes and experience and provide better value for money [14, 16], but there is little evidence to support this. A 2015 systematic review and meta-analysis of 36 studies showed no significant differences in total cost, mortality, utilisation of primary or secondary care when case management was used to support vulnerable patients [18]. A 2013 review of six stratification tools was criticised for misleading presentation of findings [19]. Even so, predictive risk stratification is widely promoted in policy internationally and across the UK [11, 12, 13, 20, 21, 22] with recent incentive schemes focusing on patients the highest level of risk [23, 24].

We evaluated the implementation of one emergency admissions risk stratification tool (PRISM) in Wales (NIHR Health Services Delivery and Research programme: project 09/1801/1054) [25]. PRISMATIC was a randomised stepped wedge trial with a qualitative component [10, 26], which found that, contrary to expectations, the predictive risk stratification increased emergency admissions to hospital; full results are reported elsewhere [27]. Here we report our qualitative work exploring implementation of PRISM in general practice.

Aim

To explore views and experiences of general practitioners and practice managers who used the PRISM risk stratification tool.

Methods

Theoretical framework

Implementing new health care technologies can be slow and difficult [28, 29]. Normalisation Process Theory (NPT) [30] is increasingly used as a conceptual framework to examine and explain this [31]. NPT considers implementation as a process entailing sustained work by those responsible and suggests four constructs that help us understand how innovation happens in routine practice: how people understand the innovation and its purpose (coherence); what decisions are taken to use it, based on perceived advantages (cognitive participation); what people do to bring the innovation into everyday use (collective action); how an innovation is reviewed, modified or abandoned (reflexive monitoring) [32].

We have previously reported on coherence, the first of these constructs, explored in focus groups with GPs and other practice staff before PRISM was introduced [33]. They welcomed the opportunity to use the tool, some dubbing it a 'golden goose' for its potential both to benefit patients and manage demand on health services. In this paper we use the other three constructs of NPT (cognitive participation, collective action, reflexive monitoring) to shape our analysis of the experiences and reflections of GPs and Practice Managers after they received access to PRISM.

Setting

The PRISMATIC trial took place in 32 practices in South Wales. The stepped wedge design (also known as randomised multiple interrupted time-series or progressive cluster randomised trial) [34] enabled all participating practices to implement PRISM during the 18 month study. All practices began as control practices without PRISM. Each month over a year, two or three practices received training and access to PRISM. As the trial progressed the numbers of intervention practices increased and control practices fell. This design protects against some sources of bias, including inherent differences and contamination between practices, as well as the 'resentful demoralisation' of controls deprived of the intervention.

Each practice nominated a GP lead responsible for coordinating use of PRISM and participation in PRISMATIC, including engagement with other clinical and practice staff. During interviews, we asked respondents to describe how they used the tool. PRISM provides individual risk scores for patients and stratifies general practice population into four levels based on the individual patient risk of an emergency admission to hospital in the following 12 months [35] (S1).

During the study period, the Welsh Government introduced a financial incentive, through the Quality and Outcomes Framework (QOF), to encourage GPs to use emergency admission risk stratification tools to support hospital avoidance [24](Table 1 and Table S1). The Health Board encouraged practices to use PRISM for this work. Payment was made when the completed QOF tasks were submitted to the Health Board. The phased rollout meant practices had access to PRISM for different lengths of time during this period.

Data collection

We purposively sampled half the participating practices to cover a range of practice sizes, geographic and socio-economic spread. We interviewed the lead GP in each at two timepoints: 1) between three and six months after PRISM was activated in their practice; 2) at the end of the intervention phase, about 18 months after it was available in the first practices (see Table 2). This enabled us to understand how the tool was introduced and used and to describe changes over time. In a few practices, the Practice Manager contributed to these interviews. We remunerated all participating practices (up to £1250) for supporting the study including participating in interviews.

Two experienced researchers from the study team (BAE and MRK) conducted all interviews, held at general practices and lasting between 30 and 90 minutes. We used probes to explore respondents' comments. With participants' consent, we recorded interviews. These were independently

transcribed and all personal and geographic identifiers removed. We made field notes after each interview. See Appendix S2 and S3 for interview schedules.

Analysis

We analysed interview transcripts thematically, informed by NPT as our underlying theoretical framework. Thematic analysis is a systematic and transparent method that generates themes from the explicit and implicit ideas in the original accounts of participants [36]. Team members (researchers BAE, MRK, AP, VW and service user SW) read the transcripts and developed a coding framework informed by the NPT framework. BAE led the analysis with the others independently supporting key stages of coding considering consistency or deviation of views across our sample, generating themes and interpretation, thus encouraging a critical stance to test and confirm findings [37, 38, 39].

Reporting

We selected quotations to be illustrative and typical of respondents' comments unless otherwise stated. Where a respondent emphasised a word or phrase, that emphasis is indicated by bold type. Quotations are identified by respondent role (GP for general practitioner, PM for Practice Manager), practice unique identifier, time point (interview 1 or interview 2).

Service user involvement

We report service user involvement according to GRIPP guidance [40]. We recruited two service users (SW, JanD) who, throughout the study, were collaborators in our research partnership [41, 42, 43]. As members of the Research Management Group, they were responsible for strategic and operational decisions and contributed as equal team members to ensure we considered patients' perspectives at all stages of the study. SW was also involved in data analysis.

We recruited SW and JanD through SUCCESS (Service Users with Chronic Conditions Encouraging Sensible Solutions), a group of patients and carers engaged in research linked to the chronic conditions management policy in Wales. They reported regularly to SUCCESS and sought feedback to inform their contributions to PRISMATIC [44].

We recruited two more service users to the Trial Steering Committee through Involving People (<http://www.wales.nhs.uk/sites3/page.cfm?orgid=1023&pid=59261>) to ensure their independence. We followed best practice by ensuring all users received honoraria, expenses, training and support, a named contact, information and networking opportunities [45].

Ethics

We obtained ethical approval for the main protocol and all subsequent amendments from the Multi-Centre Research Ethics Committee for Wales (reference 10/MRE09/25).

Results

We conducted 22 interviews at timepoint 1 and 19 interviews at timepoint 2 (Table 2). Most respondents were GPs. One GP left between the first and second interviews while two Practice Managers were not available at the second interview.

We present results for the three constructs of NPT – cognitive participation, collective action and reflexive monitoring – having covered coherence elsewhere [32].

Cognitive participation: deciding to use PRISM

Respondents described how they made decisions about using PRISM, based on its perceived advantages. There was a consistent message that they used it mostly to identify patients at high risk to fulfil QOF requirements.

'it was fantastic because we were able to pick out the patients that the local health board had highlighted for the QOF thing' (GP11 interview2)

'...we only really wanted to know what we needed to know, to do the piece of work that we were gonna get judged on.' (GP32 interview 1)

A few practices reviewed and refreshed their PRISM list throughout the trial period. Respondents said the majority of patients were known and considered high-risk, but some names were unexpected or unfamiliar. During the second interview at the end of the study, only two practices reported that they were still using PRISM after completing and submitting their QOF reports to the local Health Board.

A few GPs, who had access to PRISM earlier in the study reported using PRISM to support patient care in ways outside the QOF requirements. They interrogated the PRISM data to understand the reason for a high score or to review specific patient groups such as patients with COPD.

'looking at patients that've been deemed high risk, but not necessarily the highest risk, people that we might be able to do something about. Just exploring the data and seeing if there is anything that we could do to be more proactive.' (GP13 interview2)

Collective action: what people did to bring PRISM into use

Bringing PRISM into use involved three processes: using the technology itself; sharing the information it generated with relevant clinical teams; and, in the light of this information, taking action with patients.

'within the first couple of weeks of having it, and we all sat down and we went through the ones who were on the top...what we thought about it and what interventions we thought might work – without any plan, we just discussed it.' (GP06 interview 1)

Typically, the lead GP or Practice Manager generated a list of patients within the top stratum of risk and saved this in an electronic spreadsheet or printed it. A few practices also created a screen popup on the record of high-risk patients, which alerted all staff to tailor care or make early appointments when these patients phoned reception.

'that flags up – that's like a warning sign that maybe we should take them a bit more seriously'
(GP06 interview2)

PRISM was not without technical challenges: slow broadband speeds; system crashes; passwords locking. Some respondents also complained that PRISM was not integrated with practice-based clinical information, inhibiting routine management of patient data:

'what I wanted was to download my 53 patients...the information that would allow me to work out why they're on that list...and it really disappointed me that a lot of that I had to do manually' (GP15 interview1)

Respondents described sharing the list of individual patients' risk scores at routine practice meetings for discussion when time allowed, or dividing it among partners who worked individually, if close to the QOF deadline.

More than half the respondents said the work of bringing PRISM into use was inhibited by the many demands on GPs' time, shortage of GPs due to illness, retirement or maternity leave.

GPs reported a range of actions after using PRISM. These were generally small amendments to supplement existing care for individual patients, or extra reviews (some through house calls) to fine-tune current treatment.

'There will have been people who were reviewed or assessed, who otherwise wouldn't have been'
(GP14 interview2)

Some reviews explicitly focused on how best to manage crises which might lead to emergency admission, with one GP reporting the conversation with a patient during a face to face consultation:

' "Look – you've been admitted on a number of occasions. Obviously the chances of you being admitted are quite high, why don't we do something a bit different? We will try and alter your medication to maybe control your condition a bit better. We are here during the day, so use us rather than dial 999, and we can get somebody to see you."' (GP11 interview2)

Other effects on patient care were reported. One GP described a nurse talking to high-risk patients about identifying infections, weight management and spotting early warning signs.

'We got these patients and tried to (take) more time in educating them ... you teach them what to do.' (GP19 interview 2)

In another practice, emergency drug packs were made up for identified patients to use at weekends and bank holidays if their health deteriorated. Some high-risk patients were referred to outpatient clinics, nursing teams or other care agencies for non-medical needs. All respondents reported difficulty changing from a reactive to a proactive approach to care when the daily routine in general practice was so busy. Some respondents said they were concerned that practice staff did not have the capacity or skills to take on more patients

Reflexive monitoring: reviewing PRISM

GPs generally judged it unlikely that PRISM had any effect on emergency admissions and ED attendances, with widespread feeling that admissions initiated by GPs were already low with little scope for further reductions.

'There are odd occasions where you were able to proactively help somebody or put a plan in place to stop them being admitted to hospital. I think it's a fallacy to think that you could reduce emergency admissions from primary care because the primary care admissions are so small...one case a week, if that.' (GP02 interview2)

A minority of respondents could identify instances where an emergency admission may have been avoided. One GP suggested how PRISM may have been associated with increased hospital admissions.

'We did bring in a certain number of people and do care plans with them and then we ended up admitting them because we'd seen them and they looked unwell.' (GP31 interview2)

By contrast, two GPs who targeted patients with frequent ED attendance reported that those patients' use of 999 services had fallen.

The majority of respondents described how PRISM changed their awareness of high-risk patients, especially when unexpected patients appeared in the top stratum.

'We've probably had more talks together, as a group, as to how we have contacted the ambulance service and A & E... And we've talked about these patients more I think.' (GP18 interview2)

GPs said the combination of PRISM and the QOF incentive increased their contact with some patients in this high-risk group to reassure themselves that these patients' care was optimum.

'It [a high risk score] does have an effect of making you sit up and think 'heck, what's he doing up?' (GP05 interview2)

Most believed that the increased GP-patient interaction was probably beneficial, regardless of any treatment delivered, because patients appeared to appreciate the extra attention and advice. GPs did not generally tell patients about their risk score, careful not to alarm them and precipitate self-referrals.

Some respondents felt the QOF focus on highest-risk patients was misplaced as these were already well known to the practice. They believed that medium-risk patients would have the most to gain from close attention and proactive care, if resources were available.

'Those in the middle bracket were the kind of patients that you were possibly able to help more than those...in the higher echelons that were already having all the input that was available...because you can actually put in things that will stop them from going up the pyramid.' (GP02 interview2)

Respondents reflected that the QOF payments encouraged short term use of PRISM, in the absence of extra resources to support changing practice in the long term.

'I think QOF work highlighted our lack of support in managing these individuals. So, although they did have medical case review, that didn't really generate much extra activity, particularly almost no response from district nursing.' (GP08 interview 2)

Although a small number of respondents reported referrals to non-medical services, the majority suggested that provision of community health and social services was inadequate to support proactive care for the high-risk patients they reviewed.

'We discussed those patients at various meetings, we made plans about how to minimise admissions, access Out of Hours, Casualty, but it's not in this year's QOF...it was more a question of a useful tool to achieve points, more than anything else.' (GP10 interview2)

Discussion

Summary of findings

Our study identified a range of often contrasting views about the use and usefulness of PRISM within general practices. GPs and Practice Managers reported that the decision to use PRISM was based mainly on fulfilling QOF requirements, and it was generally applied, for a short period, to a very small number of patients with high risk of emergency admissions. Only a minority used PRISM in other ways, such as identifying patients at medium risk. Though most considered they knew their high-risk patients well, GPs said their awareness of these individuals was heightened by knowing the PRISM scores.

The work of bringing PRISM into practice was inhibited by not being integrated with practice systems. Information sharing was generally done in practice meetings. It seemed the QOF incentive to use the tool temporarily overcame systemic barriers such as other demands on GPs time, shortage of GPs, software and technical problems. Changes to care of high-risk patients as a result of using PRISM were diverse and generally small scale, such as extra visits, care plan reviews, medication amendments, tailored self-care advice and referrals to other services. Respondents' evaluation of PRISM was mixed: there were doubts about it having any large scale effect, but many cited effects on individual patients. Some concerns were expressed about how QOF influenced use of PRISM, particularly the focus on highest risk patients who may have been least suitable for proactive management, and the short term nature of the implementation.

Strengths and limitations

We interviewed GPs and Practice Managers with a wide range of experiences across 18 diverse practices. Collecting data at two time points allowed us to recognise changes in attitudes and expectations. However, we mainly talked to one individual per practice and relied on their reports of views and activities of other practice staff.

These practices volunteered to take part in PRISMATIC, committing themselves to using the PRISM tool for a fixed time and receiving a small payment. Their views may not be typical of practices which did not take part in the study.

We examined participation, action and reflections among GPs who used PRISM. We do not know the views of local commissioners and managers.

Comparison with existing literature

Software in general practices that predicts risk of emergency hospital admission for every registered patient has been widely promoted as a means of targeting preventive services to people at high risk to avoid crises that result in emergency admissions [10, 23]. However main PRISMATIC findings showed that introduction of PRISM resulted in a statistically significant increase in emergency hospital admissions and use of other NHS services without evidence of benefits to patients or the NHS [27]. One interpretation is that the increases arose from changed awareness and behaviour, among GPs and other practice staff, particularly when unexpected individuals showed up in the top stratum, making practitioners more cautious in their clinical practice leading to over-diagnosis which may in turn lead to emergency admissions. It is also possible that patients (and their carers) who received extra contact became more aware of their poor health and sought emergency care when they previously would not have done [46, 47, 48, 49]. Additionally, it may be that GPs had less time for other patients leading to them needing emergency hospital care [50]. GPs and practice managers in these interviews were restrained in their assessment of PRISM and uncertain of any clear consequences for patients or health services. They had few options for enhancing care to high-risk patients because of very limited access to community services, known to be important when targeting such individuals and reducing emergency admissions [51, 52]. Our PRISMATIC trial was highly powered, meaning that the inclusion of >200,000 people registered to the participating general practices, and >1000 at the highest level of risk, meant the trial had enough participants to be able to detect small differences in outcomes. Consequently, moderate behaviour changes at individual surgeries contributed to significant increases in NHS activity across the 32 participating practices. Our qualitative findings suggest small behaviour changes, which practice staff may barely have noticed. We should also acknowledge that the QOF requirements may have affected GP behaviour and opportunities for innovative working. The QOF incentive scheme, where specific issues are targeted using short-term payments, has been associated with adding an administrative and time-consuming load to practice work and limiting multi-disciplinary activity to coordinate care for patients with multiple needs [53]. Our respondents acknowledged that QOF was the context within which they initially used and subsequently didn't re-use PRISM. It is possible that the potential benefits of incorporating risk prediction software into general practice were unrealised because of the way the incentive scheme was structured.

Implications for policy

The primary hypothesis of the predictive risk stratification (PRISM) intervention is that identifying people at high risk of emergency admission to hospital can facilitate further targeted care and thus reduce emergency admissions to hospital. This assumption appears to underlie wide implementation of predictive risk stratification tools in primary across the UK, without evidence that expected reductions in emergency admissions would actually be achieved [18, 26, 27, 54]. Logic suggests such software should align with other policy-promoted interventions to improve patient health and wellbeing, such as integrated care, case management and a focus on the socio-economic and lifestyle factors which impact quality of life [55, 56, 57]. However, findings from our PRISMATIC trial illustrate the unpredictable consequences of introducing service innovations into NHS practice.

Implications for practice

Our qualitative data do not entirely explain our quantitative findings of a rise in NHS activity when the risk prediction tool arrived in general practices [27]. However they do offer insight into the changed perceptions and behaviours of general practice staff and help to understand the unexpected trial results. In this case it could be that the intervention identified new unmet need; or that in the context of a focus on risk, that clinicians lowered their threshold for admission. Our results also highlight how complex are the processes of adopting and using innovation in the real world and how apparently helpful incentive schemes may distort outcomes.

Implications for research

It is not uncommon for implementation to proceed before supporting research evidence is available [58]. Assumptions are made about mechanisms which do not necessarily reflect reality. Embedding this qualitative work within the PRISMATIC trial responded to calls for thorough understanding of how new services are adopted and used, since organisational culture affects implementation [59, 60]. Our findings highlight the need for further research into behaviours and attitudes within general practice to inform use of emergency admissions risk stratification tools as they are available [54]. We plan to carry out further research to explore these potential mechanisms of change.

Conclusions

Emergency admission risk stratification tools are widely advocated to reduce emergency hospital admissions and are available in primary and community care across much of the UK. However, there is a lack of evidence to support the view that they enable proactive care and improve patient outcomes. We found varied views and experiences among GPs and Practice Managers about use of the PRISM tool, which was short term and driven by external factors rather than embedded in new ways of working. Raised awareness of patient risk and focusing attention on the small numbers of patients who are at greatest risk may explain quantitative trial findings of increased emergency hospital admissions and use of other NHS services. Decision-makers need more information about the implementation and effects of such emergency admissions risk stratification tools in primary and community settings to inform future policy on their use and negative effects on patients and the NHS.

Ethics approval and consent to participate

We gained ethical approval from the Multi-Centre Research Ethics Committee for Wales (reference 10/MRE09/25). All respondents gave informed consent in writing to participate in this study.

Consent for publication

No applicable

Availability of data and materials

All data generated or analysed during this study are included in this published article.

Competing interests

HS is a member of the National Institute of Health Research (NIHR) Health Technology Assessment (HTA) editorial board and a scientific advisor to the NIHR Health Services and Delivery Research (HS&DR) Programme. The other authors declare that they have no competing interests.

Funding

This study was funded by the National Institute for Health Research (NIHR) Health Services and Delivery Research Programme (Grant Number: 09/1801/1054).

Authors' contributions

BAE drafted the manuscript with editorial input from all authors – JanD, JD, HH, MK, AP, IR, VW, HS. BAE led qualitative analysis with JanD, MK, AP and VW. The research idea was conceived and developed by HH, IR, HS. All authors read and approved the final manuscript.

Acknowledgements

We thank all the general practices who took part in PRISMATIC and the GPs and Practice Managers who gave their time to be interviewed by team members. We also acknowledge Shirley Whitman, one of two service users involved in undertaking PRISMATIC, who was unable to contribute to this paper.

References

1. Freund T, Wensing M, Mahler C, Gensichen J, Erler A, Beyer M, et al. Development of a primary care-based complex care management intervention for chronically ill patients at high risk for hospitalization: a study protocol. *Implement Sci* 2010;5:70. <http://dx.doi.org/10.1186/1748-5908-5-70>
2. Department of Health. *Integrated care and support: our shared commitment*. London; 2013. www.gov.uk/government/publications/integrated-care
3. World Health Organization. *Noncommunicable diseases country profiles 2011*, 2011.
4. Abegunde DO, Mathers CD, Adam T, et al. The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet* 2007;370:1929–38.doi:10.1016/S0140-6736(07)61696-1
5. National Audit Office. *Emergency admissions to hospital: managing the demand*, 2013. www.nao.org.uk/report/emergency-admissions-hospitals-managing-demand
6. Department of Health. *Improving quality of life for people with long term conditions*. Department of Health, 2013.
7. Lewis G, Kirkham H, Duncan I et al. How health systems could avert 'triple fail' events that are harmful, are costly, and result in poor patient satisfaction. *Health Aff* 2013;32:669–76.doi:10.1377/hlthaff.2012.1350
8. The Health Foundation and Nuffield Trust. *Focus on preventable admissions: trends in emergency admissions for ambulatory care sensitive conditions 2001 to 2013*, 2013.
9. Kings Fund. *Older people and emergency bed use: exploring variation*, 2012. www.kingsfund.org.uk/publications/older-people-and-emergency-bed-use?%5B0%5D=im_field_health_topic%3A21&%5B1%5D=im_field_health_topic%3A20&page=1
10. Purdy S, 2010. Avoiding hospital admissions. What does the research evidence say? London: The King's Fund. Available from: http://www.kingsfund.org.uk/sites/files/kf/Avoiding-Hospital-Admissions-Sarah-Purdy-December2010_0.pdf [Accessed 02 Jul 2018].
11. Department of Health. *The national service framework for long-term conditions*, 2005. www.gov.uk/government/publications/quality-standards-for-supporting-people-with-long-term-conditions
12. European Commission. *European Innovation Partnership On Active And Healthy Ageing. A compilation of good practices: replicating and tutoring integrated care for chronic diseases, including remote monitoring at regional level*. Brussels: EC, 2013.
13. Welsh Assembly Government. *Designed to improve the health and management of chronic conditions in Wales. An integrated model and framework*, 2007.
14. Nuffield Trust. *Choosing a predictive risk model: a guide for commissioners in England*, 2011.
15. Georghiou T, Blunt I, Steventon A, Lewis G, Billings J, Bardsley M. Predictive risk and healthcare: an overview. London: The Nuffield Trust; 2011.
16. Lewis G. Next steps for Risk Stratification in the NHS; 2015.
17. Curry N, Billings J, Darin B, Dixon J, Williams M, Wennberg D. Predictive Risk Project Literature Review. London: The King's Fund; 2005
18. Stokes J, Panagioti M, Alam R, Checkland K, Cheraghi-Sohi S, Bower P. Effectiveness of Case Management for 'At Risk' Patients in Primary Care: A Systematic Review and Meta-Analysis. *PLoS One* 2015;10:e0132340. <http://dx.doi.org/10.1371/journal.pone.0132340>

19. Barry D., Hass L.R., Takahashi P.Y et al. Simple Errors in Interpretation and Publication Can Be Costly. *Am J Manag Care*, 2014; 20(7): 538-40
20. Haas LR, Takahashi PY, Shah ND, Stroebel RJ, Bernard ME, Finnie DM, et al. Risk-stratification methods for identifying patients for care coordination. *Am J Manag Care* 2013; 19(9):725-32.
21. Stokes J, Checkland K, Kristensen SR. Integrated care: theory to practice. *J Health Serv Res Policy* 2016; 21:282–5.doi:10.1177/1355819616660581
22. NHS England, 2013. House of Care: NHS England. Available from: www.england.nhs.uk/ourwork/ltc-op-eolc/ltc-eolc/house-of-care/ [Accessed 02 Jul 2018]
23. NHS England. Enhanced Service Specification: Avoiding unplanned admissions: proactive case finding and patient review for vulnerable people. 2015. URL: www.england.nhs.uk/wp-content/uploads/2014/08/avoid-unplanned-admissions.pdf (Accessed September 2015).
24. Welsh Assembly Government. Quality And Outcomes Framework Guidance for the GMS Contract Wales 2013/14 Cardiff: BMA Cymru Wales; 2013.
25. Hutchings HA, Evans BA, Fitzsimmons D, Harrison J, Heaven M, Huxley P, et al. Predictive risk stratification model: a progressive cluster-randomised trial in chronic conditions management (PRISMATIC) research protocol. *Trials* 2013;14:301. <http://dx.doi.org/10.1186/1745-6215-14-301>
26. Wallace E, Stuart E, Vaughan N, Bennett K, Fahey T, Smith SM. Risk prediction models to predict emergency hospital admission in community-dwelling adults: a systematic review. *Med Care*. 2014;52(8):751–765. doi:10.1097/MLR.0000000000000171
27. Snooks H, Bailey-Jones K, Burge-Jones D, et al. Effects and costs of implementing predictive risk stratification in primary care: a randomised stepped wedge trial *BMJ Quality & Safety* 2019;28:697-705.
28. Berwick DM. Disseminating Innovations in Health Care. *JAMA*. 2003;289(15):1969–1975. doi:10.1001/jama.289.15.1969
29. Ferlie E, Fitzgerald L, Wood M, Hawkins C. The Nonspread of Innovations: the Mediating Role of Professionals *Academy of Management Journal* 2005; 48(1). <https://doi.org/10.5465/amj.2005.15993150>
30. May C, Finch T. Implementation, embedding, and integration: an outline of Normalization Process Theory. *Sociology*. 2009; 43:535–54. doi: 10.1177/0038038509103208.
31. McEvoy R, Ballini L, Maltoni S, O'Donnell C, Mair F, MacFarlane A. A qualitative systematic review of studies using the normalization process theory to research implementation processes. *Implement Sci*. 2014;9:2. doi: 10.1186/1748-5908-9-2.
32. Murray E, Treweek S, Pope C, MacFarlane A, Ballini L, Dowrick C, et al. Normalisation process theory: a framework for developing, evaluating and implementing complex interventions. *BMC Med*. 2010; 8:63. doi: 10.1186/1741-7015-8-63.
33. Porter A, Kingston MR, Evans BA, Hutchings H, Whitman S, Snooks H. Erratum to: It could be a 'Golden Goose': a qualitative study of views in primary care on an emergency admission risk prediction tool prior to implementation. *BMC Fam Pract*. 2016; 17:14. Published 2016 Feb 3. doi:10.1186/s12875-016-0416-0
34. Brown C, Lilford R. The stepped wedge trial design: a systematic review. *BMC Med Res Methodol* 2006; 6:54
35. Kingston MR. Initial uses of the PRISM risk stratification tool in CCM Demonstrator sites: a qualitative study: National Leadership and Innovation Agency for Healthcare; 2010
36. Corbin J, Strauss A. Basics of qualitative research. 3. San Jose: Sage; 2008
37. Marshall C, Rossman, GB. Designing qualitative research. Fifth edn. Los Angeles: Sage; 2011.

38. Ziebland S, McPherson A. Making sense of qualitative data analysis: an introduction with illustrations from DIPEX (personal experiences of health and illness). *Med Educ* 2006; 40:405-14.
39. Miles MB, Huberman AM. *Qualitative data analysis: An expanded sourcebook*. London: Sage; 1994.
40. Staniszewska S, Brett J, Simera I, Seers K, Mockford C, Goodland S et al. GRIPP2 reporting checklists: tools to improve reporting of patient and public involvement in research *BMJ* 2017; 358: j3453
41. Evans BA, Bedson E, Bell P, Hutchings H, Lowes L, Rea D, et al. Involving service users in trials: developing a standard operating procedure. *Trials* 2013; 14:219.
<http://dx.doi.org/10.1186/1745-6215-14-219>
42. Evans BA, Gallanders J, Griffiths L, Harris-Mayes R, James M, Jones S, Joseph-Williams N, Nettle M, Rolph M, Snooks H, Wallace C, Edwards A and on behalf of the SUPER group and PRIME Centre Wales Public involvement and engagement in primary and emergency care research: the story from PRIME Centre Wales IJPS <https://doi.org/10.23889/ijpds.v5i3.1359>
43. INVOLVE (2012) Briefing notes for researchers: involving the public in NHS, public health and social care research. INVOLVE, Eastleigh
44. Evans BA, Porter A, Snooks H, Burholt V. A co-produced method to involve service users in research: the SUCCESS model. *BMC Med Res Methodol*. 2019;19(1):34. Published 2019 Feb 15. doi:10.1186/s12874-019-0671-6
45. Crowe, S., Adebajo, A., Esmael, H. *et al.* 'All hands-on deck', working together to develop UK standards for public involvement in research. *Res Involv Engagem* 6, 53 (2020).
<https://doi.org/10.1186/s40900-020-00229-y>
46. Skinner HG, Coffey R, Jones J, Heslin KC, Moy E. The effects of multiple chronic conditions on hospitalization costs and utilization for ambulatory care sensitive conditions in the United States: a nationally representative cross-sectional study. *BMC Health Serv Res*. 2016; 16:77. doi: 10.1186/s12913-016-1304-y.
47. Lisk, R., Uddin, M., Parbhoo, A. *et al.* Predictive model of length of stay in hospital among older patients. *Aging Clin Exp Res* 31, 993–999 (2019). <https://doi.org/10.1007/s40520-018-1033-7>
48. Agarwal S, Banerjee J, Baker R, *et al.* Potentially avoidable emergency department attendance: interview study of patients' reasons for attendance. *Emergency Medicine Journal* 2012;29: e3.
49. Saini P., McIntyre J., Concoran R. *et al.* Predictors of emergency department and GP use among patients with mental health conditions: a public health survey. *Br J Gen Pract* 2020; 70 (690): e1-e8. DOI: <https://doi.org/10.3399/bjgp19X707093>
50. Cowling TE, Harris M, Watt H, *et al* Access to primary care and the route of emergency admission to hospital: retrospective analysis of national hospital administrative data *BMJ Qual Saf* 2016;25:432-440.
51. Hudon C, Chouinard M, Lambert M, *et al.* Key factors of case management interventions for frequent users of healthcare services: a thematic analysis review *BMJ Open* 2017;7:e017762. doi: 10.1136/bmjopen-2017-017762
52. Korczak, V., Shanthosh, J., Jan, S. *et al.* Costs and effects of interventions targeting frequent presenters to the emergency department: a systematic and narrative review. *BMC Emerg Med* 19, 83 (2019). <https://doi.org/10.1186/s12873-019-0296-4>
53. Close J, Fosh B, Byng R, Blackwell R, Witts L, Hall L and Lloyd H. Evaluation of a countywide alternative to QOF, aimed at improving person-centred coordinated care. *British Journal of*

General Practice 2019; 69 (suppl 1): bjgp19X702905. DOI:

<https://doi.org/10.3399/bjgp19X702905>

54. Kingston M, Griffiths R, Hutchings H, Porter A, Russell I, Snooks H. Emergency admission risk stratification tools in UK primary care: a cross-sectional survey of availability and use. *Br J Gen Pract.* 2020 Oct 1;70(699):e740-e748. doi: 10.3399/bjgp20X712793.
55. NHS England (no date). Population Health and the Population Health Management Programme. Available at: www.england.nhs.uk/integratedcare/what-is-integrated-care/phm/ [Accessed: 01 06 2021]
56. NHS England (no date). Supporting link workers in primary care networks. Available at: www.england.nhs.uk/personalisedcare/social-prescribing/support-and-resources/ [Accessed: 01 06 2021]
57. NHS England (no date). Ageing well and supporting people living with frailty. Available at: www.england.nhs.uk/ourwork/clinical-policy/older-people/frailty/ [Accessed: 01 06 2021]
58. McDonnell A. Evaluating and implementing new services. *BMJ* 2006; 332:109
59. Li, S., Jeffs, L., Barwick, M. et al. Organizational contextual features that influence the implementation of evidence-based practices across healthcare settings: a systematic integrative review. *Syst Rev* 7, 72 (2018). <https://doi.org/10.1186/s13643-018-0734-5>
60. Moore Graham F, Audrey Suzanne, Barker Mary, Bond Lyndal, Bonell Chris, Hardeman Wendy et al. Process evaluation of complex interventions: Medical Research Council guidance *BMJ* 2015; 350: h1258.

List of abbreviations

NHS	National Health Service
QOF	Quality and Outcomes Framework
UK	United Kingdom
NIHR	National Institute for Health Research
PRISMATIC	Predictive Risk Stratification Model: A Trial In primary Care
PRISM	Predictive Risk Stratification Model
GP	General Practitioner
NPT	Normalisation Process Theory
SUCCESS	Service Users with Chronic Conditions Encouraging Sensible Solutions
ED	Emergency Department

Table 1: summary of QOF tasks to support hospital avoidance

<ul style="list-style-type: none"> • Produce a list of 5% of patients in the practice who are predicted to be at significant risk of unscheduled admission • Review 10% of patients on this list (maximum 0.5% of practice list) and prepare an active management plan • Hold at least four meetings a year to review care for identified patients

Table 2: Numbers and roles of respondents at data collection timepoints

TIMEPOINT	Interview respondents
Timepoint 1 - Mid-trial: 3-6 months after PRISM activation (June 2013-July 2014)	18 GPs
	4 Practice Managers
Timepoint 2 - End trial: 18 months after PRISM activation (June – December 2014)	17 GPs
	2 Practice Managers