Primary care teams’ reported actions to improve medication safety: a qualitative study with insights in high reliability organising

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ABSTRACT

Background Our aim was to understand actions by primary care teams to improve medication safety.

Methods This was a qualitative study using one-on-one, semistructured interviews with the questions guided by concepts from collaborative care and systems engineering models, and with references to the care of older adults. We interviewed 21 primary care physicians and their team members at four primary care sites serving patients with mostly low socioeconomic status in Southwest US during 2019–2020. We used thematic analysis with a combination of inductive and deductive coding. First, codes capturing safety actions were incrementally developed and revised iteratively by a team of multidisciplinary analysts using the inductive approach. Themes that emerged from the coded safety actions taken by primary care professionals to improve medication safety were then mapped to key principles from the high reliability organisation framework using a deductive approach.

Results Primary care teams described their actions in medication safety mainly in making standard-of-care medical decisions, patient-shared decision-making, educating patients and their caregivers, providing asynchronous care separate from office visits and providing clinical infrastructure. Most of the actions required customisation at the individual level, such as limiting the supply of certain medications prescribed and simplifying medication regimens in certain patients. Primary care teams enacted high reliability organisation principles by anticipating and mitigating risks and taking actions to build resilience in patient work systems. The primary care teams’ actions reflected their safety organising efforts as responses to many other agents in multiple settings that they could not control nor easily coordinate.

Conclusions Primary care teams take many actions to shape medication safety outcomes in community settings, and these actions demonstrated that primary care teams are a reservoir of resilience for medication safety in the overall healthcare system. To improve medication safety, primary care work systems require different strategies than those often used in more self-contained systems such as hospital inpatient or surgical services.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Research and measures on medication safety in ambulatory settings have reported possible performance deficiencies by primary care physicians and their teams, which are potentially inappropriate prescriptions (PIPs), though the correlation between PIPs and patient harms is weak.

WHAT THIS STUDY ADDS

Qualitative analysis of interviews with primary care team members identified a wide range of actions performed by primary care teams to anticipate and respond to risks for medication harms that were not previously identified in the patient safety literature in community settings, and are consistent with the principles of high reliability organising.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

Primary care teams demonstrated that they are a reservoir of resilience for medication safety in the overall healthcare system. Future medication safety improvement efforts should support and enhance existing actions by primary care teams, who require different strategies than those often used in more self-contained systems such as hospital inpatient or surgical services.

BACKGROUND

Medication-related harms cause significant numbers of unnecessary emergency department (ED) visits and hospitalisations.1 A commonly quoted estimate is that 16.5%–27% of all ambulatory patients experience an adverse medication event.2 3 But there has been little success in improving medication safety in primary care. A review of studies of professional, structural and organisational interventions in primary care found that they made little or no difference to the number of people admitted to hospital or the number of hospitalisations, ED visits or mortality.4 Other researchers ‘went back to the drawing board’ to ask frontline primary care clinicians about...
their priorities in medication safety,5 and identify other possible tools and interventions.6 We could find little information on actions primary care teams were already taking to improve ambulatory medication safety.

Existing harm reduction strategies focusing on potential prescribing errors by clinicians likely do not address many of the causes of adverse drug events (ADEs). For instance, an analysis of insulin-related ED visits identified the leading cause of those visits to be patients incorrectly managing their food intake and insulin products at home.8 Similar studies identified the leading contributors to benzodiazepine adverse events as non-medical use (56%) and self-harm (30%),9 reflecting causes from multiple factors of medication safety in ambulatory care.10

At the same time, a recent systematic review identified gaps in our knowledge of steps the primary care teams already undertake beyond reducing prescribing errors to improve medication safety, such as simplifying medication regimens and engaging patients in shared decision-making.11 A broader look at actions of primary care physicians (PCPs) and their teams is warranted to understand how to amplify and support their efforts in medication safety, and mitigate multiple threats to safety in the complex primary care environment.12 As articulated in the safety improvement paradigm known as ‘Safety-II’,13 learning from how clinicians take proactive actions in everyday patient encounters to strive for safety in highly varied situations is just as important for safety improvement as learning from performance deficiencies.14

We aimed to learn more about medication safety from the perspective of primary care teams, especially in the context of older adults who live in the community. Specifically, we sought to discern PCPs and their team members’ beliefs about their roles in medication safety, and the actions they routinely take in daily practices to improve medication safety for their patients. As inspired by the ‘Safety-II’ paradigm, we wanted to explicate primary care professionals’ routine efforts to promote safety; efforts that may be unrecognized and thus may be unsupported or even hampered. The success of these routine efforts may be reflected by the contrast of the relatively low ADE rates leading to harm versus reported high rates of potentially inappropriate medication and high-risk medication prescribing in ambulatory settings.11

Moreover, any success of routine existing efforts to promote safety may be reflected by the idea that safe and reliable performance can be described as a ‘dynamic non-event’.15 Safety is ‘non-event’ as it does not call attention as there is nothing to pay attention to, and safety is dynamic in the sense that it is an ongoing condition in which problems are momentarily under control due to compensating changes in components.16 Efforts to improve safety are often invisible as people often do not know how many mistakes they could have made but did not because of such efforts, and when nothing is happening, people often assume nothing will continue to happen.

Consequently, in conceptuallyising and delineating the large number of actions reported by primary care professionals contributing to prevention of medication-related harms in ambulatory settings and ultimately to improvements in medication safety, we turned to insights from the high reliability organising (HRO) paradigm.17 Similar to a study on patients’ contributions to medication safety,18 insights from HRO may provide potentially new avenues for enhancing the value of primary care in medication safety.19-21

METHODS
Study design
This was a qualitative study of PCPs and their teams conducted from June through September of 2020. We used the Systems Engineering Initiative for Patient Safety (SEIPS) model in the development of the facilitator’s interview guide (see below for the main questions) to capture broadly the complex sociotechnical aspects in primary care.22 This model incorporates the concepts of the chronic care model23 and ‘coproduction’,24 and reflects the essential roles of patient interactions with health professionals in primary care. Since no previous study systematically identified ‘resilience strategies’ or actions used by PCPs and their teams to enhance medication safety, we conducted thematic analysis using an inductive coding approach to incrementally categorise responses to develop themes of ‘resilience strategies’ or actions reported by the study participants.25 Themes emerged from the coded safety actions taken by primary care professionals to improve medication safety were then mapped to key principles from the high reliability organisation framework using a deductive approach. Once the code structure was finalised, each interview was coded by two researchers independently using qualitative NVivo software (QSR, V.12 Pro); any discrepancies were reconciled in coding through consensus.26

Source of participants
Study sites were purposefully chosen: three small private primary care clinics (rural, suburban and urban), and a large family medicine residency teaching clinic. All clinics were located in Texas. Using a purposive sampling approach, participants were recruited at the study sites from each relevant job category: family physicians, family medicine resident physicians, advance practice professionals (nurse practitioners and physician assistants), nurses and medical assistants. Human subject study approval was obtained from the Institutional Review Board of the University of Texas at Arlington. Within each job category, convenience sampling was used by approaching participants nominated by the administrators at the study sites. An informed consent document was electronically sent in advance. Prior to interviews and audio recording, participants provided verbal consent per human subject study approval.

Source of data
Each interview was semistructured and was informed by a facilitator’s guide. Interviews were approximately
analysts met multiple times with other members of the
into an updated code book. In the third phase, the
revised by individual analysts, and consolidate changes
themes or revising existing themes. In team coding,
using themes already in the code book, adding new
each cycle, one analyst coded one new interview by
analysis software (NVivo V.12) and team coding. In
the code book was incrementally revised in four cycles
ised as in the facilitator’s guide. In the second phase,
failure modes, safety hazards and strategies as organ-
nary code book of themes grouped by perceived roles,
noted by each analyst. The first phase led to a prelimi-
facilitated session to compare and contrast themes
themes. The analysts then participated in a 3-
and audio-
conducted in private rooms or remotely by telephone
and audio-recorded. Notes were taken for oversight
and planning purposes in case technology failed. The
facilitator’s guide consisted of eight main questions,
with multiple probes associated with each question
that broadly covered participants’ beliefs about their
roles in medication safety, failure modes (what could
go wrong) and safety hazards (conditions with the
potential for harm) in professional and patient work
systems, and strategies they have developed or have
used to mitigate the effects of these hazards: (1) In
general, what do you see as your role in medication
safety? (2) In general, among your patients who are
65 years or older, what do you see as top medication-
related problems at home? (3) In general, what are
your techniques and practices to help elderly patients
to manage their medications at home? (4) How does
the current system help you keep patients safe? (5)
What would you change about the current system? (6)
What do you see as community pharmacists’ roles in
medication safety? (7) What do you wish health system
leaders understood better about primary care medi-
cation safety? (8) What are the factors that limit your
ability to partner with patients on medication manage-
ment that have not been mentioned so far? Preceding
the eight ‘general’ questions, interviewees were first
asked to discuss ‘specific’ cases of patients who either
experienced or were at increased risk for ADEs. Recorded
interviews were transcribed verbatim, and transcripts
were screened for any potential protected
information before analysis.

Data analytic approach
Three phases were used to conduct thematic anal-
ysis of the data using a combination of inductive and
deductive approach. In the first phase, using an
inductive approach, a team of five analysts (APG, KGF,
KMD, RAY and YX) with clinical, system engineering
and health service research backgrounds annotated
a common set of two interviews independently for
themes. The analysts then participated in a 3-hour
facilitated session to compare and contrast themes
noted by each analyst. The first phase led to a prelimi-
nary code book of themes grouped by perceived roles,
failure modes, safety hazards and strategies as organ-
ised as in the facilitator’s guide. In the second phase,
the code book was incrementally revised in four cycles
of coding by individual analysts using a qualitative
analysis software (NVivo V.12) and team coding. In
each cycle, one analyst coded one new interview by
using themes already in the code book, adding new
themes or revising existing themes. In team coding,
the analysts met to review the themes added and
revised by individual analysts, and consolidate changes
into an updated code book. In the third phase, the
analysts met multiple times with other members of the
investigative team to reflect on the themes and cate-
gorise themes into major ‘buckets’ based on the estab-
lished concepts of medication safety, safety science
and organisational theories and professional–patient
collaboration (deductive approach): perceived roles
in medication safety, safety actions by the primary
care clinics working with patients and safety actions in
responding to multiple work systems outside primary
care clinics.

A large number of safety actions emerged in the
final code book and required further conceptual-
isation. The concepts related to HRO were found
to synthesise these actions well in terms of medica-
tion safety in primary care. The HRO paradigm is an
important construct for designing safer healthcare
delivery. HRO is enacted through practices and
processes consistent with a set of principles: sensitivity
to operations, reluctance to simplify, preoccupation
with failure, deference to expertise and commitment
to resilience. An earlier understanding of reli-
ability in HRO is that it describes ‘what one can count
on not to fail in doing what is expected’. A recent
and more nuanced understanding of HRO is that reli-
ability is an ideal that is never fully achieved, a journey
rather than a single destination. HRO is comprised
of two major logics: a logic of anticipation/preven-
tion; and a logic of resilience/containment.

Patient and public involvement
Patients and the public were not involved in this study.

RESULTS
Participants
Participants (table 1) included six family physicians (20
years average experience), four family medicine resident
physicians (1–3 years in training), four advanced practice
professionals (11 years average experience), four nurses
(14.3 years average experience) and three medical assis-
tants (15.7 years average experience).

Themes
We grouped themes of actions by the study participants
in three broad areas: perceived roles in medication safety,
safety actions by the primary care clinics working with
patients and safety actions in responding to multiple work
systems outside primary care clinics. Overall we identified
actions along 30 themes. Even with repeated prompts,
only a small number of cases were described where
patients were found to have experienced actual ADEs.

Multiplicity of roles in medication safety
PCPs and their teams believed that medication safety
is an important fiduciary responsibility of all team
members, and is expressed through making standard-of-
care medical decisions, patient-shared decision-making,
educating patients and their caregivers, providing asyn-
chronous care separate from an office visit and providing
clinical infrastructure (table 2).
Participants confirmed a fiduciary duty to the safe use of medications in spite of many complex patient and system challenges. They gave examples of medication decisions as flexible, not simplistic and algorithmic and driven by consideration of many patient-specific factors.

Sometimes the patients don’t take it, or sometimes they take too much because they don’t remember if they’ve already taken it. There are patients that don’t tell us what they’re taking, so we don’t know that there could be interactions. -PCP001 (physician)

PCP teams also provided team management and infrastructure tools (as much as resources allowed) for clinic visits, such as making medication safety roles a key part of nurses’ and medical assistants’ daily tasks, and using electronic aids such as e-prescribing through electronic health record (EHR) systems. This infrastructure aided

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Interview participants by clinic types and roles in primary care teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical assistant</td>
<td>Large public clinic (urban)</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Nurse</td>
<td>2</td>
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<tr>
<td>Nurse practitioner</td>
<td>1</td>
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<tr>
<td>Physician</td>
<td>2</td>
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<tr>
<td>Physician assistant</td>
<td></td>
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<tr>
<td>Resident physician</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 2 | Primary care teams’ perceived roles in medication safety

<table>
<thead>
<tr>
<th>Actions</th>
<th>Selected supporting quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>➤ Take on fiduciary responsibility to their patients and medication safety, such as completing tasks that are often out of routine clinic hours and unpaid.</td>
<td>Patients are human beings and that, unless everything is structured in their perception, sometimes it can be derailed, you know. Just the cost of care, the cost of medication, and so forth, and their memory, those are things we focus on and try to be sure that they’re participating in their health. PCP016 (physician)</td>
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<tr>
<td>➤ Make ‘standard-of-care’ medical decisions, but maintain flexible medical decision-making based on a large number of inputs.</td>
<td>I drive the bus. So medicine reconciliation when they get out of the hospital or the emergency room or urgent care or when one of the specialists is being creative or when the patient and his brother-in-law are being creative. Have them bring their medicines to every visit, so I can look at their compliance by looking at the bottles and their refills and when they were filled. PCP013 (physician)</td>
</tr>
<tr>
<td>➤ Use patient-shared decision-making strategies to jointly define safety goals.</td>
<td>And then as a primary care provider, really trying to take ownership of the patient despite, you know, all the other specialists or other people that they may have seen to say, it’s my responsibility to try to track down exactly what’s going on, exactly what they’re taking in order to kind of limit these sort of duplications or inappropriate prescribing or cascades of medications that can happen. PCP015 (physician)</td>
</tr>
<tr>
<td>➤ Educate patients about medications.</td>
<td>A lot of the nurses in our clinic, we are very good about going over how to do their insulin, how to check their blood sugars, all of that. We try to give very good teaching with all of that before they leave, so they understand what they’re doing. PCP002 (nurse)</td>
</tr>
<tr>
<td>➤ Recruit and include family members to assist patient.</td>
<td>So I think when they hand off, when you and the nurse gets involved in the medications, I think it actually helps with the safety. The other thing is that the pharmacists also are a big part of it, so it sort of becomes a team where all three can work together and prevent medication errors. PCP003 (physician)</td>
</tr>
<tr>
<td>➤ Perform asynchronous patient care activities separate from the office visit, such as monitoring for drug abuse, communicating with a multitude of agents impacting on medication safety (community pharmacists, other physicians inside and outside clinic walls, hospitals, insurance companies and other entities such as home health agencies).</td>
<td></td>
</tr>
<tr>
<td>➤ Provide clinic team management and infrastructure, including (a) medical assistants and nurses who conduct medicine reconciliation, patient education and documentation, (b) in some clinics pharmacists in clinic, social workers or case managers, translation services, (c) safe environment to hear concerns of other team members and (d) electronic health records.</td>
<td></td>
</tr>
</tbody>
</table>
Table 3  Themes of selected highlights of primary care teams’ actions to improve medication safety, structured within a high-reliability organising framework

<table>
<thead>
<tr>
<th>Themes</th>
<th>Selected supporting quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity to operations (fitting to patient work systems)</td>
<td>► Simplify medication regimen as much as possible for patients with specific limitations or challenges</td>
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<tr>
<td></td>
<td>► Encourage patient and family to keep a list of current medications and directions at home</td>
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<tr>
<td>Reluctance to simplify (applying complexity of primary care)</td>
<td>► Use shared decision-making with patient and family for high-risk situations, conflicting comorbidities or affordability challenges</td>
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<td></td>
<td>► Must often write out instructions on top of EHR company-generated discharge instructions</td>
</tr>
<tr>
<td>Preoccupation with failure (reducing risks of future failures)</td>
<td>► Use medication safety guidance, such as Beer’s list, as a guide, not as an absolute</td>
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<tr>
<td></td>
<td>► Decline to prescribe some specific medications</td>
</tr>
<tr>
<td>Deference to expertise (and external capacities)</td>
<td>► Ask home health agencies to assist with home medication management</td>
</tr>
<tr>
<td>Commitment to resilience</td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>► Ask patients to bring all medications to office visits</td>
</tr>
<tr>
<td>Responding</td>
<td>► Social workers/case managers check for medication vouchers</td>
</tr>
<tr>
<td></td>
<td>► Supply language translation services</td>
</tr>
<tr>
<td>Anticipating</td>
<td>► Educate patients and families how refills work at pharmacies</td>
</tr>
<tr>
<td></td>
<td>► Advise patients to avoid common recommendations—take medicine with food, for example—if an alternative might increase adherence</td>
</tr>
<tr>
<td></td>
<td>► Read hospital discharge summaries from hospitals even as they are often hard to reach for questions and often not sent to the PCP</td>
</tr>
<tr>
<td>Learning</td>
<td>► Interact with insurance companies (private or governmental), including ‘fighting’ to get medications authorised and seeking formulary information</td>
</tr>
<tr>
<td></td>
<td>► Use electronic tools but often need to adapt by writing out instructions on top of EHR company-generated discharge instructions</td>
</tr>
</tbody>
</table>

PCP, primary care physician.

asynchronous care outside of clinic visits and interacted with many other healthcare work systems, sometimes well, other times not.

Safety actions by primary care teams

Primary care teams took a myriad of actions both during clinic visits and asynchronously outside such visits (table 3 contains thematic highlights. The full table of primary care team actions is in the online supplemental file). These actions aligned well with commonly accepted principles of HRO: sensitivity to operations by fitting safety interventions to patient work systems (two themes), reluctance to simplify by meeting complexity of primary care (seven themes), preoccupation with failure by reducing risks of future failures (five themes), deference to expertise (one theme), and commitment to resilience (15 themes). The PCPs and their teams gave numerous examples of patient-customised actions that demonstrated their safety organising efforts to meet specific patient needs.

A lot of times, I will get the family member involved, a daughter or, you know, a spouse, and give them a call after a visit to make sure that the information I got was correct or have them a little bit more involved in
Examples of specific actions included the physician’s medical decision-making customised to individual patients (eg, an atypical diabetes treatment plan for a patient who works night shifts), customised interactions with patients and families with regards to medication management (eg, teaching a family member how to administer insulin for a patient with poor eyesight); communicating with pharmacies, other doctors, other healthcare system agents and insurance companies; and deciding which EHR tools to use or ignore.

Other actions included limiting the supply of certain medications prescribed, identifying high-risk or high-need patients, simplifying medication regimens in certain patients, deprescribing and individualising chronic disease and medication monitoring. These actions reflected frontline professionals’ sensitivity to a number of high-risk factors including age, cognitive status, prior failings, social support, severity of disease, English-language capacity and comorbidities. They also cited customised approaches to patient education and support with regards to medication management at home such as hand writing the most important information, writing directions in non-English languages and drawing symbols for low literacy patients.

Sometimes we are calling pharmacy to make sure that they’re picking their medications up. Then we try to encourage them to do the pillbox and to organize them, and then call them. …I tell their families to fill it once a week…so they know what they’re taking each day. PCP001 (physician)

The primary care teams (and their employers in some cases) provided infrastructure to improve medication safety. This included nurses and medical assistants performing medicine reconciliation and informing prescribers when concerns were noted. Social workers or case managers were mentioned as resources by the primary care teams for helping with financial or other social determinant challenges. Participants from one clinic mentioned in-office clinical pharmacists who reviewed medication lists and provided direct patient care, and in-clinic translators or translation services to address language barriers. A common strategy was handing out supplies such as pill organisers or medication bags to serve as reminders to bring in medications at each or selected visits.

Participants reported both positive and negative aspects of EHR in medication safety. Pop-up reminders were cited as useful by some participants, while others described them as mostly meaningless. Participants reported the value of EHR in allowing PCPs to see medications prescribed by other physicians, but they also pointed out that access to vital information was more limited than universal. Participants mentioned that the EHR automatically generated medication summaries and instructions, but these were often not patient friendly, so team members wrote out important guidance by hand at the end of the clinic visit.

I would definitely make sure [the EHR-generated after visit] summary was easier for people to understand. You know, not so much technical words, so many big words that medical people use. And just highlight the most important things. I mean, I know it’s a lot of legal things where they want to tell you all the different side effects. But, I mean, maybe not every single side effect ever known to man for this medicine. PCP005 (nurse)

Responding to multiple work systems in primary care
Participants cited interactions with many other agents in the complex healthcare system, which included pharmacies (both local and mail order), other doctors, hospitals, other agents (eg, home health agencies) and insurance companies. Participants often mentioned how these agents took actions that the primary care team could not control. One example was an insurance company changing its formulary causing a medication taken for years by a patient to become unaffordable. Another example was a non-PCP doctor prescribing a drug that duplicates a medication prescribed by the PCP. Participants described how primary care teams responded in the moment to these challenges when they arose, but did not report much top-down assistance from outside agents to the breadth of challenges the primary care teams faced.

For instance, insulin, that’s probably our number one thing. Levemir versus Lantus versus Humulin, all those three, it’s just a pick and choose from what they (insurance companies) are going to pay. So Blue Cross Blue Shield will pay for this one. Medicare will pay for that one. Every year I go through the same thing with them. But [the pharmacies] don’t actually help us do anything, because they too don’t know what is being covered until we send a new prescription. They process it. Then guess what. Nope, that one wasn’t covered either, so let’s try this one. Nope, that one wasn’t covered either. And then, again, insurances are forcing us to change medication without patients’ knowledge because of cost. -PCP007 (nurse)

**DISCUSSION**
Our study reveals that PCPs and their teams believe they have an important and fiduciary role in improving medication safety for their patients, and they provide key infrastructure elements within their work systems, and take numerous actions towards this goal.
The 30 themes of primary care work actions identified here were similar to a survey of general practitioners in Britain, which revealed 48 distinct problems in medication safety and 45 solutions. The top three problems identified were incomplete reconciliation of medication during patient ‘hand-overs’, inadequate patient education about their medication use and poor discharge summaries. These naturally reflect strategies of successful mindful HRO: sensitive to and constantly adjusting to small cues or mishaps; constantly adapting, tweaking, and solving small problems; timely human adjustment; and anticipating vulnerabilities, contingencies and discrepancies.

Implications for defining patient safety in primary care

Many of the safety actions reported by the primary care teams were aimed at processes: reducing hazards and risks (deprescribing, considering polypharmacy), improving patient and support system/family capacity (education and support), improving patient and family support system trust and identifying shared goals (reasonable adherence targets). These actions were largely targeted to reduce risks and support patient work systems.

The safety actions by the primary care teams provided new insights into HRO and work systems. Primary care teams may be ‘preoccupied with failure’, but still have to accept that many of the failures of medication safety occur from factors completely outside of their control. They can try to influence anticipated medication safety events (give out pill organisers, ask for family members’ help, call pharmacies and so on), but they cannot control them. The hallmark of HRO is not that it is error free, but that errors do not disable it. Primary care teams accept that error-free medication usage will never happen over thousands of patients.

Implications for medication safety improvement in primary care

Organising for safety and reliability in primary care settings takes creativity beyond adherence, likely more so than inpatient care. In hospital environments where most hazards and processes are under the control of hospital professionals, HRO principles may be applied to decrease patient harms such as using surgical checklists. For example, in an operating room, the surgeon and anaesthesiologist know that a small percentage of their patients will ‘crash’ during the procedure. They can control their response to these known events by having agreements in place of the role of each of the team members, and by ensuring that equipment such as ‘crash carts’ are maintained and quickly available. For primary care teams, there are too many ways for medication events to deviate from ideal, too many locations for safety failures to occur, and too many other work systems involved that they cannot control.

Our study sheds light on the challenges of medicine reconciliation for ambulatory patient populations. We identified multiple actions the physicians or teams take to ensure accurate medication lists. Other studies have found that as many as 90% of patients were found to have inaccurate medication information in their chart compared with what they were actually taking at home, and medication discrepancies were experienced by nearly half of the patients during care transitions. Our study did not measure these outcomes, but similar anecdotes were numerous.

Many of our respondents reported efforts to increase patient access and build trusting relationships. Kuzel et al concluded that errors reported by patients suggest that breakdowns in access to and relationships with clinicians may be viewed as more prominent medical errors than technical errors in diagnosis and treatment.

The complexity of the interacting entities within and connecting to the primary care environment has been previously recognised. Baumgartner et al used cognitive work analysis to develop a model to better understand medication management systems in primary care. Their abstraction hierarchy model included five levels of hierarchy containing 32 separate nodes with multiple interactions per node. While we did not attempt to develop a similar visualisation, the many reports of interactions in our data reveal a similar conceptualisation of the complexity of primary care prescribing and monitoring.

More broadly, safety in healthcare could be measured by patient-oriented outcomes (e.g., potentially unnecessary hospitalisations), prescriber actions or behaviours, capacity to act safely, hazards in the system and gaps or issues in care perceived by patients. Our respondents gave numerous examples of their own internal safety measures that they collected on their own initiatives through their day-to-day care, but none reported that they regularly measured these outcomes. Rather, their responses more generally highlighted how they ‘enact’ their roles in medication safety and seek to build a stronger culture of safety in ambulatory care. These roles and actions emerged in their patient care without any explicit regulatory, programmatic, or financial incentives. Still, the findings have implications for how safety cultures in ambulatory care, particularly around medication safety, can be enabled and elaborated going forward.

Examples of cases of ADEs were rare, which is consistent with a ‘Safety-II’13 approach in requiring a focus on clinicians’ proactive actions in routine patient care to improve medication safety in primary care. Our results are similar to previous work that found that safety was conceptualised more in terms of work functions involving grouping of tasks or responsibilities, rather than domains such as medications, diagnoses, care transitions, referrals and testing. Therefore, a more traditional view of quality improvement that measures almost exclusively performance deficiencies may have limited added value in primary care medication safety. For instance, professionals’ actions in establishing patient–physician trust and requirements for decision-making flexibility have not been routinely measured, even those are key for enacting safety in daily practices.
Our findings share some conclusions with other reviews on the disappointing role of EHRs in medication safety in primary care.\textsuperscript{43–46} Positive features of EHRs identified by the participants included more certainty that the prescription would actually reach the pharmacy, messages about drug–drug interactions and the ability to see what specialists prescribe, but only if they are on the same EHR system. Downsides of EHRs were also noted by the participants that reflect other literature. Participants noted that computerised decision support ‘pop-ups’ were often not helpful and were ignored,\textsuperscript{47, 48} records from other hospitals, pharmacies and physicians’ offices were not available if they used different systems,\textsuperscript{46, 49} after-visit summaries were often long and too full of technical jargon that required more work by primary care teams to explain printed information,\textsuperscript{50} and summaries were often not available in non-English/Spanish languages.\textsuperscript{51} Our findings suggest that new directions and design concepts are needed to support clinicians’ routine safety actions beyond EHR alerts for prescribing high-risk medication combinations, such as benzodiazepines and opioids, that do not change prescribing practices.\textsuperscript{52}

Implications for understanding primary care work systems
High reliable entities are able to anticipate, contain and recover from mishaps, knowing that in spite of the best preparation, they will still happen.\textsuperscript{20} Primary care teams interact with many other work systems that are beyond their control, or even act against the actions of primary care teams. These systems include pharmacies, insurance companies, other physicians, hospitals, nursing homes, home health agencies and so on. The primary care team should be considered as the hub of a larger healthcare system full of many independent but interconnected agents.\textsuperscript{39} Primary care teams experience daily the dispersed and often poorly coordinated actions of healthcare system silos.\textsuperscript{53, 54}

The long list of primary care work system strategies and actions our participants reported reflects the complexity of their environment, and the necessity of flexibility in applying the logics of anticipation and resilience.\textsuperscript{17} In contrast to more self-contained systems, successful improvement efforts in primary care often result by not following rigidly imposed protocols, but rather from bottom-up innovations, flexibility and a deep understanding of patient work systems and other connected systems.\textsuperscript{55} While primary care teams anticipate potential failure modes and proactively address risk factors, they have to respond to influences from other work systems, with which the primary care teams have few effective and reliable coordinating mechanisms. The primary care teams have to deal with conflicts and confusions among distributed systems with little ability to control the nature, frequency or magnitude of inputs from other systems.

Although a logic of anticipation is important, our findings suggest that if primary care teams are to maximise reliability in the midst of complex systems, resilience should be privileged.\textsuperscript{20} A long list of protocols and rules, especially without enough attention to human-centred design principles,\textsuperscript{56} is not the answer to this reality. Even if it were possible to write procedures for every situation, too many rules can reduce the flexibility to react to unexpected surprises that will never vanish in an open socio-technical work system such as primary care.\textsuperscript{17}

This reaction to myriad external forces reflects mindfulness in the primary care teams and is consistent with research in other high hazard/high risk settings, but it also reflects a strong culture of adaptability.\textsuperscript{20} Primary care teams represent a reservoir of resilience for overall healthcare system safety, likely for more than just medications.

Study limitations
Our study was limited to only four clinics of primary care teams in one state. It is possible that responses from other primary care teams in other locations or healthcare systems may produce different themes. We made no attempt to rank identified themes in order of importance or frequency.

Our study was also limited in that we did not obtain input from other healthcare system agents that interact with primary care teams such as pharmacies, non-primary care doctors, other agents in the healthcare system (eg, home health agencies) or insurance companies. It is possible that respondents gave us mostly positive self-reports and missed insights into ways they could improve medication safety processes.

CONCLUSIONS
PCPs and their teams reported a large number of actions to improve medication safety that can best be framed as processes of continually shaping medication safety outcomes in complex primary care environments. They recognised their fiduciary responsibility for the medication safety of their patients, and took a multitude of actions to achieve this goal. These actions were consistent with the features of the HRO paradigm, especially a commitment to resilience. These actions were both internal to their own decision-making and clinic infrastructure, and were triggered in response to many external forces coming from other work systems that are outside of the primary care team’s control. Primary care teams demonstrated that they are a reservoir of resilience for medication safety in the overall healthcare system. Any efforts to improve primary care medication safety must recognise the inherent complexities of primary care teams, and design improvement efforts to support these frontline professionals’ existing day-to-day efforts for medication safety, or risk becoming another burden to PCPs, their teams and their patients, with little likelihood of success.

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