



## Improving smart medication management

Medications are a cornerstone in patient management in primary, secondary and tertiary care. However, with about 9% of errors in prescriptions<sup>1</sup> and patients often taking their prescribed medications incorrectly or not at all, there are several areas with room for improvement in medication management. In recent years apps and other digital tools have been implemented in health care systems to assist in drug management. Yet, these new smart technologies can cause new challenges to prescribers and patients. Healthcare systems and staff need to ensure correct prescriptions and that patients take their medications as prescribed and report if side effects occur. To achieve improved outcomes for patients, technology's role is as important as human factors.

### Participants

**Rita K. Jew**, Vice President of Operations, Institute for Safe Medication Practices (ISMP), USA

**Robyn Tamblyn**, Professor at the Department of Medicine and the Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Canada

**Fraz Arif Mir**, Consultant Physician and Clinical Pharmacologist, Addenbrooke's Hospital, Cambridge and Senior Medical Advisor, British National Formulary, UK

**David W. Bates**, Medical Director of Clinical and Quality Analysis, Information Systems, Partners HealthCare System, Inc. and Professor and Chief, Division of General Internal Medicine Brigham and Women's Hospital, USA

**Shawn Hsiang-Yin Chen**, Professor and Associate Dean, College of Pharmacy, Taipei Medical University, Taiwan

**NT Cheung**, Head of IT and HI, Hospital Authority, Hong Kong

### Chair

**Yu-Chuan (Jack) Li**, Editor-in-chief, BMJ Health and Care Informatics; Distinguished Professor, Graduate Institute of Biomedical Informatics, Taipei Medical University, Taiwan; and President, International Medical Informatics Association (IMIA)

On 23rd July 2021 a roundtable discussion, sponsored by BD, was held as a spin-off meeting of the International Forum on Quality and Safety in Health Care Europe 2021. Participants discussed how smart medication management can be improved to optimize healthcare quality and efficiency. The meeting was chaired by Yu-Chuan (Jack) Li, a researcher of artificial intelligence (AI) in medicine and medical informatics, and editor-in-chief of BMJ Health and Care Informatics who began by asking participants to introduce their key observations regarding problems and possible solutions in medication management.



## Medication lists and medication changes

**“Medication lists are often incomplete and inaccurate”**

Rita Jew, a paediatric pharmacist with 30 years of acute care pharmacy practice, started the discussion.

“Doctors should make sure to have a complete drug list of patients to avoid inappropriate combinations”, agreed Robyn Tamblyn, a researcher in safety and quality of health care improvement. “Especially when patients can go to as many doctors as they want, the prescribing is often not coordinated and the combination can be inappropriate. In Canada it is possible to get complete medication lists from provincial population-based drug repositories. They contain drugs dispensed by community pharmacies for all medications for everybody in the province. However, access is limited by privacy-related restrictions.”

Also, Fraz Mir who aside from his clinical work is Chairman, Joint National Formulary Committee and Senior Medical Advisor, British National Formulary, acknowledged the problem. “Duplication of drugs, for example, after a hospital stay due to lack of communication and different names for the same drug are common”, he said. “In the UK, there’s a big disconnect between what general practitioners (GPs) do in the community and what hospitals do. At the time of discharge from hospital, patients might go home with a completely different set of medications, many in addition to what they have been previously prescribed by their GP. This is something that

could easily be remedied with integrated prescribing systems, which are generally much safer”, he added.

Shawn Hsiang-Yin Chen, who is Associate Dean at the college of pharmacy, Taipei Medical University, agreed and mentioned that in Taiwan, all the medication information prescribed in primary, secondary or tertiary care can always be retrieved in the National Health Insurance (NHI) PharmaCloud system at the next encounter.

The same is true for Hong Kong. “In our organisation, we have brought together all the clinical records including the entire drug history of the entire population in a standard interoperable format no matter where a patient had their care”, said NT Cheung, an informatician who runs the health informatics function at the Hong Kong hospital authority. “However, transition of care is a problem, because it’s at the transition of care where something goes wrong, something gets lost, a medication is dropped when it shouldn’t be, or often it’s repeated when it shouldn’t be repeated. At NT Cheung’s hospital system explicit discontinuation was introduced: “If a doctor stops a drug he has to tell if he’s really stopping it as opposed to switching to another

drug. If another doctor re-prescribes that drug or repeats an old prescription, the system will stop him from doing that", he explained. "It's little things like that, that we put in. A lot of the errors get introduced at a transition."

Robyn Tamblyn emphasised that the stopping and changing of drugs needs to be adequately communicated to dispensing pharmacies.

"There is no regulatory framework for stopping medication in Canada. In British Columbia, there is currently a project, putting that information in the central pharmacy system to alert if a drug has been previously prescribed but was stopped for a certain problem", she said.

## Computerised prescribing

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David Bates, who has published several hundred papers on the topic of medication safety, said that patients are harmed by prescribing and that results today are not what they should be.

**"Computerised prescribing with better decision support and linked with barcoding could improve the situation."**

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"A UK General Medical Council (GMC) study from 2009 showed that about 9% (Foundation Year 1 doctors 8.4%; Foundation year 2 doctors 10.3%) of prescriptions written by junior doctors (who do most of the prescribing in UK hospitals) have errors in them<sup>1</sup>", Fraz Mir said. "Electronic prescribing has improved a lot of things, but it still is not fail-safe."

Robyn Tamblyn agreed. "There is a lot of evidence that computerised prescribing is better. It is important not having to do mental math and get that wrong. This is a small incremental step that will improve things, both in efficiency and then in safety."

"However, there are different challenges with computerised prescribing with errors when choosing from drop-down menus and alert fatigue", she acknowledged. "More intelligent patient centred systems are needed."

"Health care professionals are commonly overriding alerts when prescribing", David Bates said. "At my institution, people are overwriting about 98% of medication related alerts. We did a study recently<sup>2</sup> in which there were 5,095 suggestions and doctors overrode all 5,095 of them."

"Once you have structured data on health, allergies and drugs, the question is how can

we use it to better support safe prescribing, dispensing and use. For example, currently systems don't take into consideration how long people take a drug. We could do much smarter things to be more patient-centered in the generation of drug alerts", Robyn Tamblyn said.

David Bates also agreed that the patient context is very important and added "For example, if somebody's potassium is low, it's a different situation than if it's high. We have been working with a company that utilizes a variety of approaches to condition the suggestions on a variety of patient parameters. In a retrospective study<sup>3</sup>, we found that if the new application is used as opposed to the current one, they could have 93% fewer warnings and at the same time have much higher sensitivity."

"This is where AI comes in, where characteristics such as comorbidities, age, and others are fed into the system. It would then hopefully give a prompt of various interventions that could be made," Fraz Mir said.

"There are more novel ways to approach medication quality and safety. One recent idea is 'concurrent safety checking' whilst in the prescription process", NT Cheung added.

# IT systems

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David Bates addressed the system perspective and said:

**“The usability of the big systems is not better in part because companies didn’t spend enough time with usability testing at the beginning and had mainly engineers, not clinicians designing the systems. Now, where everyone is using electronic records, it’s time to make some mid-course corrections and adjust.”**

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“From a developer’s perspective”, NT Cheung said, “it is very difficult because of the complexity of clinical care. New drugs coming through and things that were never anticipated when the system was built happen. Classes of drugs you never thought would exist come into your system. Therefore it is really hard to build systems for medicine. A lot of has to do with design decisions.”

“Unfortunately, there is no real incentive for health IT companies to improve their systems as they don’t get paid for quality”, Jack Li said. “Most doctors are also facing several systems from different hospitals, so they never

get to familiarize themselves with one system properly.”

Rita Jew said that the best way would be to step back and think about how to build the right system to make it work with the help of clinicians and usability experts rather than fixing a system or the infrastructure.

“We have improved our system over the last two decades and focused on making sure it is actually usable”, NT Cheung said. “It’s very much focused on clinical workflow, something which is intuitive to all users. It is important that it supports what users are doing instead of becoming an administrative burden.”

## Overreliance on technology

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**“There is a new set of problems, especially now that people are relying on technology sometimes too much”,**

Rita Jew said and talked about a couple of examples that were reported to ISMP:

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- “One is a chemotherapy drug that comes in a liquid formulation but needs to be diluted by a special diluent prior to administration. The incorrect undiluted concentration was programmed in the pharmacy application and used to calculate the volume needed for administration. The incorrect drug volume was used in several patients and was not picked up by more than 14-16 pharmacists and pharmacy technicians.”
- “Another example was a drug, that was not intended for human use, but was programmed into the drug formulary in an electronic health record. It was perpetuated for 13 years and used in 10 patients before someone uncovered the programming error.”

**“In my opinion over-reliance on technology which can accelerate errors is the biggest safety issue that needs to be solved.”**

Rita Jew added.

# Better education for medics

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“As a teacher I also see the need for better education regarding safe prescribing and polypharmacy for medical students and clinicians generally, especially junior doctors - as they are in charge of most of prescribing (in the UK)”, Fraz Mir went on. “For my medical students and trainee doctors I developed the following “tool”. (Figure 1)

Figure 1.

## The MIR Commandments for Administering Therapies (MIR-CAT® Index).

- M** **ANDATORY** review of all prescriptions regularly (daily on ward rounds and in clinics)
- I** **NCLUDE** drugs that improve mortality\* and morbidity
- R** **EMOVE** drugs that do not provide symptomatic or longevity\* benefit / or are likely to lead to more harm

\* if appropriate

# Patient engagement and appropriate information

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**“Also patient education and patient empowerment are pivotal”,**

Fraz Mir said.

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“Patients often don’t know what drugs they are taking and why, and what side effects can occur. If patients can be empowered to look after their own medications themselves, not only would it allow them to be better informed and educated about them, it will almost certainly improve compliance”, he said. “It’s amazing that clinicians spend a lot of time trying to explain diagnoses and communicate blood test results or investigation results with people. But we seldom spend any time talking about how their pills work.”

“Twenty percent of medications are never filled often due to side effects and doubts of

effectiveness”, Robyn Tamblyn went on. “This can cause exacerbation of the underlying illness. Smarter information at the outset would help.”

“In Hong Kong, patients have their entire drug history at hand, which is the first step to get patients involved in their own medication. The private sector in Hong Kong is now also submitting their prescriptions into the same shared platform. So, patients have access to their entire public and private prescriptions here”, NT Cheung said. “I agree, it is often said that patients have a lack of information. Actually everybody can look up any drug on

the internet. In my experience, people don't do it", NT Cheung continued. "I'm interested to see how many patients will actually read about their drug, when given information. So just getting the information is not the entire solution. I think there needs to be some new thinking involved on how to strengthen patient engagement for example gamification to make it more interesting."

"In my experience, the level of health information is not always related to the patient's educational background", Shawn Hsiang-Yin Chen added and suggested that health education could be included into high school education. "For example, in chemistry, content on medication could be added. In biology, more information on human health could be covered. So, when people become patients or carers they would have a better understanding of the disease and medication."

Rita Jew agreed that even if patients are provided with information it is usually not at a level patients can fully comprehend. "There are two problems. One is that even people who are highly educated may not have enough background in the medical field enough to

read the information, might not have the full context to understand it or they might misinterpret the information. Secondly, people don't know what information applies to them or not e.g. which side effects will be of concern to them", she pointed out. "There needs to be context behind information. For people to understand all the information, they first have to understand the disease and then their medications and the side effects associated with it. Creating some simple information for patients is good but human interaction is important. Teaching patients and helping them understand what the medications are for needs to be done with the human touch to better put things in context and answer their questions", she added.

"Apparently human curated information can help", Jack Li summarised. "There also is research on using AI and natural language processing to soften the medical language into lay language<sup>4</sup>."

"In Taiwan, the academy of scientists has an initiative to make prescriptions readable to laypeople as even to highly educated people they can sound like alien text", he added.

## Patient follow up and real world surveillance

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**"Another important area is patient engagement in patients' homes"**, David Bates continued.

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"Another important area is patient engagement in patients' homes", David Bates continued. "We found when patients were called, they mentioned eight times as many adverse drug events (ADE) than were noted in the chart.<sup>5</sup> So often patients have an ADE, but they don't tell their doctors about it. In an ideal world, patients should be interacting with doctors and letting them know through their personal health record, if they've had a problem with a drug so that they are not given that or a similar one again."

"To follow up with patients to see if they are taking the drug, if it helps and if they have ADEs is important", Jack Li said. "At the moment, we are often lacking in the whole lifecycle of medications."

"In terms of bringing the patient into the equation, there are a variety of ways of doing it", David Bates said. "It could be by an app on the smartphone. It could be through something on somebody's computer. I don't

think that's going to solve all the problems, but we want to interact with people and say, how are you doing with your drug? And, and is it working for you?"

Robyn Tamblyn talked about the pilot of an app with the intent of empowering people and their caregivers to manage their medication. "When asked, the two things that people most wanted for the app was an interaction checker and a symptom checker to see if any of their medications actually produced a symptom", she explained. "We provide a download of all the drugs and we let them text a pharmacist with their questions."

"We could potentially implement some of the pharmacy knowledge into a chatbot." Jack Li suggested. "So, when the patient has a problem, they could talk to the chatbot first, before they interact with a human who is more expensive and usually not available at night".

"There are now electronic tools to look for ADEs, both inside the hospital and outside them", David Bates said. "They could make it practical to count how many problems we're having. I would like to use those more and have them validated better, and if we can get

a robust estimate, ideally in the outpatient setting from connecting with patients that would let us know, if we're doing better."

"Often there is not enough information how well a drug performs in the real world. We need to systematically collect information on how well a drug is working after it has been prescribed with a focus on newly prescribed", Robyn Tamblyn agreed.

"We have tried using interactive voice recording systems to actually call the person up. I think at this point it's quite sophisticated and there is excellent stuff out there. I see no reason why that could not be almost legislated as we are systematically going to collect this information. Then the most important part is you're continuously analyzing that information in a post-market surveillance mode. You can then provide that feedback loop back to prescriber and patients to say that this percentage of the people who took that drug had this side effect. It would engage them in the whole process", she went on. "There is also the additional part of the feedback loop that aids in selection of drugs for individual patients."

## Measuring outcomes

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**"A lot of information should be collected. From my experience at ISMP, reporting medication errors and collecting them helps us understand the problems and improve the system",**

Rita Jew said.

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"Tracking provider satisfaction regarding the system is also important", Rita Jew continued. "With providers I mean not just physicians, but nurses, pharmacists and everybody who's touching the system."

"You could take it one step back and look at more generic outcomes", Fraz Mir added. "So, for instance, prescribing errors in general should fall with better medicines management. If your management of medications is better, hospital admissions related to ADEs should be

reduced too. Costs could go down in terms of dispensing less unnecessary medications."

David Bates said that hospitals often don't have a good sense which warnings are turned on and which ones are turned off or how their system is performing. "A test that lets hospitals know how they are doing at picking up important medication related warnings is now used annually by about 2,000 hospitals in the US<sup>6</sup>", he told the panel.

# Outlook into the future

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**“We need to dive much deeper into all the data that the system has about each patient and do contextualized and personalized decision support which will give a much better hit rate and less false alerts”, NT Cheung said.**

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“We need to dive much deeper into all the data that the system has about each patient and do contextualized and personalized decision support which will give a much better hit rate and less false alerts”, NT Cheung said. “We’re running massive data collection machines but we are not using that data to its fullest in terms of improving the outcomes of care and the systems”, he added.

“Clinical data needs to be better connected with genomic data. Genomic data should be included in healthcare records”, Shawn Hsiang-Yin Chen said. “Evidence shows that combining genomic and clinical risk factors results in the best prediction of important ADEs<sup>7</sup>.”

To better tailor medications, Robyn Tamblyn sees a lot of opportunity in pharmacogenetics. “Medication could be tailored to people to have the right medicine at the right time that will not produce ADEs.”

“Automation for the right purpose can save time of healthcare providers and then this time should be used to provide more interactive communication with patients”, Shawn Hsiang-Yin Chen added.

“Leveraging new tools as AI for a variety of causes and giving patients more information could result in dramatic improvement, even in the near term”, David Bates said. “The biggest opportunity in this area I see is computerised decision support with patient specific suggestions.”

“The potential is having ambient AI in the background, not just for medication”, NT Cheung added.

Jack Li concluded that there are many challenges and areas of improvement. “We have to prioritize the areas that are easiest to solve with the greatest benefit.

## References

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