

1 **Title: Innovating medication reviews through a technology-enabled process**

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43 **Abstract**

44

45 Medication reviews are effective in improving the quality of medication use among older  
46 people. However, they are conducted to various standards resulting in a wide range of outcomes  
47 which limit generalisability of findings arising from research studies. There also appear to be  
48 funding and time constraints, lack of data storage for quality improvement purposes, and non-  
49 standardised reporting of outcomes, especially clinically relevant outcomes. Furthermore, the  
50 coronavirus disease-19 (COVID-19) pandemic has restricted many face-to-face activities,  
51 including medication reviews. This article introduces a technology-enabled approach to  
52 medication reviews that may overcome some limitations with current medication review  
53 processes, and also make it possible to conduct medication reviews during the COVID-19  
54 pandemic by providing an alternate platform. The possible advantages of this technology-  
55 enabled approach, legislative considerations and possible implementation in practice are  
56 discussed.

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58 **Key words:** Computerized decision support system, innovation, medication reviews,  
59 technology

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68 **Introduction**

69 Medication reviews are effective in improving the quality of medication use among older  
70 people, especially older individuals in aged care facilities (1,2) and those residing in the  
71 community who do not have regular follow-ups with their general practitioners (GPs).  
72 Medication reviews are aimed at identifying, resolving and preventing any medication-related  
73 problems, and optimising medication use in collaboration with GPs, medical practitioners,  
74 other healthcare professionals and patients (3); the process is patient-centred. Medication  
75 reviews form the foundation of national policies and guidelines associated with medication  
76 optimisation strategies and intervention studies (4). These remunerated services include  
77 Medication Therapy Management and Medication Regimen Review in the United States of  
78 America (USA) (5), Residential Medication Management Review (RMMR) (6) and Home  
79 Medicines Review (HMR) (7) in Australia, Medicines Use Review in the United Kingdom (8),  
80 and MedsCheck in Canada (9). Although regular medication reviews remain an important  
81 consideration in geriatric medicine, achieving this goal may pose many challenges (10).

82

83 Increasingly, technology has played a key role in improving productivity in healthcare (11).  
84 Technology is increasingly used in health settings (12) and a systematic review has shown how  
85 it can reduce costs due to time savings and improve individual health outcomes and safety (13).  
86 Importantly, the challenges faced during the coronavirus disease-19 (COVID-19) pandemic  
87 has ceased many face-to-face activities and has plummeted many parts of the world into a  
88 protracted economic, social and medical crisis (14). An approach to medication reviews that  
89 utilises technology effectively could optimise medication use and encourage continued reviews  
90 during the pandemic. To contribute to the growing field of technology, we discuss the potential  
91 for incorporating a unique technology-enabled approach to facilitate medication reviews,

92 drawing from international research to highlight shortcomings and consequences of current  
93 medication review processes.

#### 94 **Limitations with current medication review processes**

95 Medication review processes differ across countries and the variation may introduce a wide  
96 range of outcomes. While national practice guidelines often recommend that pharmacists adopt  
97 a systematic approach when conducting medication reviews, guidelines usually only offer a  
98 ‘checklist’ approach and recommend a variety of prescribing indicator tools that would aid in  
99 the review process (6,7,15,16). However, the individualised nature of medication reviews  
100 requires distinctive approaches (17) and may be time-consuming. Barriers, limitations and  
101 shortcomings of current medication review processes are summarised in Table 1, with  
102 supporting citations and evidence.

103 Lack of time and funding constraints are barriers to conducting regular medication reviews  
104 (10,18–20). Lack of an efficient process may preclude a medication review from being  
105 conducted regularly or when required; this is apparent in aged care settings (10,19–21). In  
106 Australia, an evaluation of the RMMR process reported that the majority (64%) of Accredited  
107 Pharmacists (registered pharmacists accredited by the Australian Association of Consultant  
108 Pharmacy or the Society of Hospital Pharmacists of Australia (6)) indicated inefficient record-  
109 keeping in aged care facilities, and significant time required to access dispensing histories,  
110 contributed to costs associated with RMMRs (10). The system currently used to identify  
111 individuals who are eligible for a medication review has also proven to be costly in terms of  
112 time management, because there are costs associated with administrative overheads and the  
113 time required to liaise with GPs to clarify issues (18). Lack of timely reviews have also resulted  
114 in rejection of ineligible claims which had been submitted to the government for remuneration  
115 (17). Furthermore, the lack of financial reimbursements in some countries have restricted the  
116 frequency of medication reviews, and thus follow-up reviews (19).

117 Lack of process integration at an aged care facility may retard an efficient medication review  
118 process (10). Transfers of individuals between aged care facilities and hospitals may result in  
119 changes in the prescriber and there is no standardised system in place to ensure that the new  
120 aged care facility and GP have access to an individual's previous RMMRs. Similarly, when  
121 there is a change in the Accredited Pharmacist who provides the review, it can sometimes be  
122 difficult to identify when an individual's medication was last reviewed because the medication  
123 review report generated by the previous reviewer may not be located at the facility (10). In  
124 addition, storage of hard copy data is limited and it may be challenging to initiate quality  
125 improvement measures to the current medication review process without prior data (21).

126

127 Most medication reviews are conducted in the presence of the individual (patient); however,  
128 this may prove to be a major barrier in current circumstances of the COVID-19 pandemic. Not  
129 all healthcare settings may have integrated information about medications, and as such  
130 medication reviews may not be conducted regularly without patient interaction, especially  
131 when an individual is newly transferred to an aged care facility, or when an initial review needs  
132 to be conducted for community-dwelling individuals. Regular and follow-up medication  
133 reviews may also be affected during this pandemic, resulting in poor optimisation of  
134 medications.

135

136 Outcome measures in studies that aimed to test the effectiveness of medication reviews as well  
137 as new medication interventions are heterogeneous and non-standardised (21–23).  
138 Furthermore, most outcomes reported are not clinically relevant (21,23), such as number of  
139 recommendations made by pharmacists and those that were accepted by the GPs; these  
140 outcomes may not be translated to practice. Health outcomes such as quality of life, adverse

141 drug events, falls among older people and hospital admissions remain crucial health outcomes  
142 that should be reported to aid in quality improvement initiatives for medication reviews.

143

144 The barriers to conducting medication reviews highlighted are likely to have influenced the  
145 outcomes in medication review studies, resulting in non-significant findings. However, non-  
146 significance does not preclude the importance of medication reviews (23). Despite the  
147 limitations with current medication reviews, the majority of stakeholders, i.e. pharmacists  
148 (90%), GPs (60%) and aged care home staff (75%), reported positive health outcomes among  
149 older people as a result of medication changes identified during medication reviews (10).

150

### 151 **Adopting technology in medication reviews**

152

153 The use of technology is being implemented in healthcare in various ways. Ventola (2014)  
154 reviewed the use of mobile devices and apps for healthcare professionals that have provided  
155 many benefits, including increased access to point-of-care tools which are proven to support  
156 improved clinical decision-making and patient outcomes (24). Interestingly, the use of  
157 technology in clinical pharmacy services were implemented as early as 2012 (25).  
158 “Telepharmacy” is defined as using communication technology and electronic information for  
159 the provision and support of comprehensive pharmacy services particularly when distance  
160 separates participants (26). In the context of “telepharmacy”, Cole et al. (2012) concluded that  
161 “telepharmacy” represented a potential alternative to on-site pharmacist medication reviews in  
162 rural hospitals, and reaffirmed the importance of continued medication reviews (25). It also  
163 contributes to “telehealth”, a term that is used extensively in health care and which is defined  
164 as the delivery of various healthcare services at a distance via the use of technology (27).

165

166 A potential solution to the limitations of current medication review processes would be to  
167 encourage use of “telepharmacy” and further innovate the medication review process through  
168 our unique technology-enabled approach. This comprises three fundamental components:  
169 *content knowledge, a guided framework* and *technology* in an approach we propose as a  
170 technology-enabled medication review process.

171

172 Firstly, content knowledge is essential and can be achieved through various accreditation and  
173 training programs available for conducting medication reviews. For example, in Australia, only  
174 Accredited Pharmacists are remunerated for conducting medication reviews (6). Secondly,  
175 while current medication review guidelines (6,7) provide lists of common medication-related  
176 issues, this approach could be augmented using a guided framework. For example, an algorithm  
177 or minimisation framework could expedite the process when pharmacists conduct medication  
178 reviews, with the answer to one question leading to the next option that has to be considered  
179 (28,29); this may aid the decision-making process during medication reviews.

180

181 Finally, coupled with knowledge gained from being trained to conduct medication reviews  
182 (6,15,16) and utilising a guided framework, technology has the potential to improve the  
183 efficiency and effectiveness of medication reviews and could, for example, be adapted to focus  
184 specifically on older people (2,28,29). Technology in the form of a computerised decision  
185 support system (CDSS) can ensure that a comprehensive review is conducted in a timely and  
186 cost-efficient manner. Cresswell and colleagues (2012) define CDSS as a software application  
187 utilising patient data, a database of clinical knowledge, and ‘conditional’ logic, for instance ‘if-  
188 then’ and ‘do while’, to produce patient-specific recommendations related to healthcare (30).  
189 Their review paper provides evidence on improved practitioner performance and patient

190 outcomes with the use of CDSS (30). In this article the term CDSS refers to the technological  
191 aspects of our proposed innovation.

192

193 CDSS is based on three aspects: level of integration, data entry, and user engagement (30).

194 Medication reviews could be ‘integrated’ with other clinical information systems such as

195 electronic health records, rather than being ‘stand-alone manual processes’. Essential

196 individual data can be inputted into the system via transfer from clinical information systems,

197 or by electronic transmission from medical devices. The medication review system should have

198 ‘active’ user engagement; the CDSS provides the user with real-time information to assist in

199 decision-making at the point-of-care (31); this may include a list of references and resources

200 to aid in decision-making and could be further supplemented with existing mobile apps that

201 aid in clinical decision-making. CDSS has proven effective in supporting prescribing-related

202 and guideline-based decisions; for example, CDSS alerts the user to inappropriate medication

203 doses and contraindications which are two major components of a medication review (28,30).

204 When medication reviews are conducted in person (face-to-face), pharmacists are able to use

205 the CDSS to conduct the reviews after interviewing patients for their input about medication-

206 related issues and management, while considering other aspects of patient characteristics such

207 as their preferences, attitudes, beliefs, goals, and life expectancy, end-of-life care and frailty.

208 To encourage a patient-centred approach when face-to-face interactions are limited, phone calls

209 or video calls can be organised to interview patients; this feature could be built into the CDSS.

210

211 An example of how a technology-enabled medication review could be used is illustrated in

212 Figure 1 (3). The first step involves an assessment conducted by a GP with the patient or their

213 carer, to determine the need for a medication review, followed by a referral from the GP to an

214 Accredited Pharmacist. The pharmacist would first interview the patient or their carer. Being



215 an Accredited Pharmacist, they have sufficient content knowledge. The guided framework to  
216 aid in decision-making about optimal medication use is embedded within the CDSS including  
217 a medical/medication history and other relevant information. The pharmacist would provide  
218 their recommendations to the GP for consideration and would conduct follow-ups to ensure  
219 implementation of changes if these are required (3).

220

### 221 **Potential advantages of a technology-enabled medication review process**

222

223 Table 2 summarises potential advantages that may overcome limitations of current medication  
224 review processes. Firstly, use of this process may allow for a systematic and structured  
225 medication review as the incorporation of a stepwise guided framework will facilitate a  
226 systematic medication review process (20,28,29); automatic prompts for medication  
227 monitoring parameters will also ensure that all aspects of a medication review are completed.  
228 Our technology-enabled medication review process may also be time-saving as consolidation  
229 of individuals' information and medication history could negate unnecessary documentation  
230 thus speeding the process and allowing for more reviews to be conducted in a shorter period.  
231 Pharmacists will then have an opportunity to perform quality improvement initiatives with the  
232 'additional' time, such as counselling patients on appropriate use of medications and  
233 conducting audits of reviews. Furthermore, incorporation of essential information in the system  
234 about eligibility for medication reviews could translate into cost savings as GPs and  
235 pharmacists can easily submit claims for reimbursement of the service.

236

237 A once-off investment in the design and implementation of the proposed system would offset  
238 long-term costs associated with unnecessary documentation and the related expenses  
239 (administrative overheads). A more efficient process for medication reviews may reduce direct

240 costs associated with the use of unnecessary pharmacotherapy and potentially inappropriate  
241 medications (PIMs), and the indirect costs of treating adverse effects (32).

242

243 The use of the proposed technology-enabled medication review approach may facilitate  
244 process integration at aged care facilities and other healthcare settings, including the potential  
245 for storage of medication review reports and associated data which would allow for continuity  
246 of care and medication management. Individuals' data would have to be integrated as per  
247 privacy and ethical policies, and allow GPs and staff to have easy access to medication records,  
248 including to identify previous reviews and to facilitate regular reviews. Data access by policy-  
249 makers could lead to improvement in systems and processes, for audit purposes,  
250 and education and research, encouraging inter-professional discussion and collaboration. Our  
251 technology-enabled medication review process which consolidates individuals' information  
252 will be particularly useful during the current COVID-19 pandemic that restricts physical  
253 interaction. Our CDSS have an in-built feature for phone and video calls to interview patients  
254 about their medications.

255

256 To encourage homogeneity in outcome measures of medication review intervention studies,  
257 our proposed system will allow researchers to select from a list of outcomes that can standardise  
258 the reporting of outcome measures for interventional studies (33); this will also facilitate the  
259 reporting of clinically relevant outcomes and could assist in improvements which may lead to  
260 changes in policy and guidelines.

261

262 **Potential drawbacks of a technology-enabled medication review process**

263

264 While technology has the potential to improve and enhance the medication review process,  
265 there are some disadvantages including the initial set-up costs of CDSS (34). Funding for a  
266 new technological system could be limited; for example, depending on whether the  
267 organization is non-profit, which tend to have higher investments in technology, or for-profit,  
268 which look to reduce costs (35). The software and hardware of technological systems have to  
269 be upgraded and/or replaced in a timely manner. Disruption in workflow may cause loss of  
270 productivity due to end-users including aged care facility staff, GPs and pharmacists, learning  
271 and adopting a new system (34).

272

273 Concerns of privacy and security need to be addressed. The confidentiality of individuals’  
274 information during technology-enabled medication reviews must be maintained regardless of  
275 the process of how the CDSS is integrated with health records; the safety and security of data  
276 should not be compromised. Additionally, the technology-enabled medication review process  
277 may potentially mitigate the risk of using potentially inappropriate medications, thereby  
278 reducing the incidence of adverse drug events and subsequent hospitalisations. However, the  
279 reverse may also occur as poor design of the interface, for example, and could lead to errors  
280 and unintended consequences (36).

281

282 Overall, it is important to consider the pros and cons of implementing a new system and a  
283 systematic approach of implementing the new system could mitigate or minimise potential  
284 issues. Furthermore, one has to consider a technological approach in the context of policy and  
285 practice.

286

287 **Policy and practice**

288

289 The concept of a technology-enabled medication review process is consistent with government  
290 initiatives in some countries. In the USA, for example, recent support for adopting technology  
291 was the result of the Health Information Technology for Economic and Clinical Health Act;  
292 this was enacted as part of the Recovery and Reinvestment Act of 2009 which had approved a  
293 US\$19 billion-program to encourage the adoption of technology, particularly electronic health  
294 records in hospitals and clinics (37).

295

296 Prior to the implementation of the technology-enabled medication review process it is  
297 important to develop and refine a guided framework such as the consolidated medication  
298 review algorithm to improve medication use in older people proposed by Thiruchelvam et al.  
299 (2018). This stepwise decision making-process framework aims to reduce the use of  
300 inappropriate medications among older people. It was used among older community-dwelling  
301 Malaysians (28), and could be used as a basis for developing a guided framework within the  
302 CDSS for medication reviews.

303

304 When the guided framework has been computerised, one must determine the effectiveness and  
305 ease of use of the technology. The Technology Acceptance Model (TAM) is a theoretical model  
306 that was developed as an extension of the Theory of Reasoned Action and the Theory of  
307 Planned Behaviour. The TAM comprises two components, i.e. perceived usefulness and  
308 perceived ease of use (38); IT is 'more adopted' if it is more useful, and it is 'more accepted'  
309 if it is easy to use.

310

311 If a feasibility study demonstrates high user acceptance, this may expedite the introduction of  
312 the new technology-enabled medication review service within healthcare settings. Uptake and  
313 acceptability can be guided by Rogers' Diffusion of Innovations Theory that suggests new

314 services are unlikely to be immediately or uniformly used across a target population (39).  
315 Providing incentives may assist; for example, the Economic and Clinical Health Act in the  
316 USA provided financial incentives to physicians and hospitals to adopt and implement the  
317 adoption of technology (37).

318

319 In the context of clinical implications, the previous decade has seen a dramatic increase in  
320 prescribing, posing a burden to healthcare systems (40). Deprescribing can be achieved via  
321 medication reviews which promote appropriate polypharmacy, decrease the use of  
322 inappropriate medications, and aid in identification of potential and real drug-related adverse  
323 events; deprescribing also offers opportunities to promote medication adherence. The  
324 technology-enabled medication review process may increase the use and effectiveness of the  
325 service to achieve optimal use of medications for older people, particularly the frail, and for all  
326 older people especially during the current COVID-19 pandemic.

327

## 328 **Conclusion**

329

330 It is time to facilitate change and embrace what technology has to offer to improve appropriate  
331 use of medications. There is ‘positive potential’ associated with medication reviews, and the  
332 technology-enabled medication review approach could improve processes in developed and  
333 developing countries, and may be particularly useful during and post the COVID-19 pandemic.

334

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336 The authors declare that there is no conflict of interest.

337

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## 342 **References**

343 1. Thiruchelvam K, Hasan SS, Wong PS, Kairuz T. Residential aged care medication review  
344 to improve the quality of medication use: a systematic review. *J Am Med Dir Assoc.*  
345 2017;18:87.e1-87.e14. <https://doi.org/10.1016/j.jamda.2016.10.004>.

346 2. Thiruchelvam K, Byles J, Hasan SS, Egan N, Kairuz T. Residential medication  
347 management reviews and continuous polypharmacy among older Australian women. *Int J*  
348 *Clin Pharm.* 2021. <https://doi.org/10.1007/s11096-021-01294-3>.

349 3. Pharmaceutical Society of Australia. *Guidelines for comprehensive medication*  
350 *management reviews*; 2020. accessed on [https://www.ppaonline.com.au/wp-](https://www.ppaonline.com.au/wp-content/uploads/2020/04/PSA-Guidelines-for-Comprehensive-Medication-Management-Reviews.pdf)  
351 [content/uploads/2020/04/PSA-Guidelines-for-Comprehensive-Medication-Management-](https://www.ppaonline.com.au/wp-content/uploads/2020/04/PSA-Guidelines-for-Comprehensive-Medication-Management-Reviews.pdf)  
352 [Reviews.pdf](https://www.ppaonline.com.au/wp-content/uploads/2020/04/PSA-Guidelines-for-Comprehensive-Medication-Management-Reviews.pdf). Accessed June 10, 2021.

353 4. Thiruchelvam K, Hasan S, Wong P, Kairuz T. Optimizing medication use among older  
354 people residing in aged care facilities. *Innov Aging.* 2017;1:432.

355 5. Pellegrino AN, Martin MT, Tilton JJ, Touchette DR. Medication therapy management  
356 services: definitions and outcomes. *Drugs.* 2009;69:393–406.  
357 <https://doi.org/10.2165/00003495-200969040-00001>.

358 6. Pharmaceutical Society of Australia. *Guidelines for pharmacists providing Residential*  
359 *Medication Management Review (RMMR) and Quality Use of Medicines (QUM) services*;  
360 2017. accessed on

- 361 [https://my.psa.org.au/servlet/fileField?entityId=ka17F000000cmjcQAA&field=PDF\\_File](https://my.psa.org.au/servlet/fileField?entityId=ka17F000000cmjcQAA&field=PDF_File)  
362 [\\_Member\\_Content\\_\\_Body\\_\\_s](#). Accessed December 18, 2020.
- 363 7. Pharmaceutical Society of Australia. *Guidelines for pharmacists providing Home*  
364 *Medicines Review (HMR) services*; 2011. accessed on [https://www.ppaonline.com.au/wp-](https://www.ppaonline.com.au/wp-content/uploads/2019/01/PSA-Guidelines-for-Providing-Home-Medicines-Review-HMR-Services.pdf)  
365 [content/uploads/2019/01/PSA-Guidelines-for-Providing-Home-Medicines-Review-](https://www.ppaonline.com.au/wp-content/uploads/2019/01/PSA-Guidelines-for-Providing-Home-Medicines-Review-HMR-Services.pdf)  
366 [HMR-Services.pdf](https://www.ppaonline.com.au/wp-content/uploads/2019/01/PSA-Guidelines-for-Providing-Home-Medicines-Review-HMR-Services.pdf). Accessed December 18, 2020.
- 367 8. Stewart D, Whittlesea C, Dhital R, Newbould L, McCambridge J. Community pharmacist  
368 led medication reviews in the UK: A scoping review of the medicines use review and the  
369 new medicine service literatures. *Res Soc Adm Pharm.* 2020;16:111–122. [https://doi.org/](https://doi.org/10.1016/j.sapharm.2019.04.010)  
370 [10.1016/j.sapharm.2019.04.010](https://doi.org/10.1016/j.sapharm.2019.04.010).
- 371 9. Hanna J. Real-world application of MedsCheck opportunities. *Can Pharm J (Ott).*  
372 2013;146:325–328. <https://doi.org/10.1177/1715163513506831>.
- 373 10. Campbell Research and Consulting. *Evaluation of the residential medication management*  
374 *review program: main findings report*. Department of Health and Ageing; 2010. accessed  
375 on  
376 [https://www.health.gov.au/internet/main/publishing.nsf/Content/F520A0D5EDEA0172C](https://www.health.gov.au/internet/main/publishing.nsf/Content/F520A0D5EDEA0172CA257BF0001D7B4D/$File/RMMR%20Report.pdf)  
377 [A257BF0001D7B4D/\\$File/RMMR%20Report.pdf](https://www.health.gov.au/internet/main/publishing.nsf/Content/F520A0D5EDEA0172CA257BF0001D7B4D/$File/RMMR%20Report.pdf). Accessed January 2, 2021.
- 378 11. Baines D, Bates I, Bader L, Hale C, Schneider P. Conceptualising production, productivity  
379 and technology in pharmacy practice: a novel framework for policy, education and  
380 research. *Hum Resour Health.* 2018;16:51. <https://doi.org/10.1186/s12960-018-0317-5>.
- 381 12. Bezboruah KC, Paulson D, Smith J. Management attitudes and technology adoption in  
382 long-term care facilities. *J Health Organ Manag.* 2014;28:344–365.  
383 <https://doi.org/10.1108/JHOM-11-2011-0118>.

- 384 13. Kruse CS, Mileski M, Alaytsev V, Carol E, Williams A. Adoption factors associated with  
385 electronic health record among long-term care facilities: a systematic review. *BMJ Open*.  
386 2015;5:e006615. <https://doi.org/10.1136/bmjopen-2014-006615>.
- 387 14. Abi-Habib M. *Millions had risen out of poverty. Coronavirus is pulling them back*. The  
388 New York Times; 2020. accessed on  
389 [https://www.nytimes.com/2020/04/30/world/asia/coronavirus-poverty-](https://www.nytimes.com/2020/04/30/world/asia/coronavirus-poverty-unemployment.html)  
390 [unemployment.html](https://www.nytimes.com/2020/04/30/world/asia/coronavirus-poverty-unemployment.html). Accessed January 1, 2021.
- 391 15. LeadingAge Center for Aging Services Technologies. *Medication management*  
392 *technologies for long-term and post-acute care: a primer and provider selection guide*;  
393 2015. accessed on [https://leadingage.org/white-papers/medication-management-](https://leadingage.org/white-papers/medication-management-technologies-long-term-and-post-acute-care-primer-and-provider)  
394 [technologies-long-term-and-post-acute-care-primer-and-provider](https://leadingage.org/white-papers/medication-management-technologies-long-term-and-post-acute-care-primer-and-provider). Accessed January 9,  
395 2021.
- 396 16. National Health Service. *Medication review – best practice guidelines*. Dudley Clinical  
397 Commissioning Group; 2018. accessed on  
398 [file:///C:/Users/c3316376/Downloads/medication-review-guidelines-version-1-aug-2018-](file:///C:/Users/c3316376/Downloads/medication-review-guidelines-version-1-aug-2018-formatted-sb-1535538539.pdf)  
399 [formatted-sb-1535538539.pdf](file:///C:/Users/c3316376/Downloads/medication-review-guidelines-version-1-aug-2018-formatted-sb-1535538539.pdf). Accessed January 9, 2021.
- 400 17. Coane S, Payne R. Carrying out a structured medication review. *Prescriber*. 2016;22–26.  
401 <https://doi.org/10.1002/psb.1426>.
- 402 18. Meditrax Medication Management Specialists. *The review of professional pharmacy*  
403 *programs and services*; 2016. Australia. Report No.: 136. accessed on  
404 [http://www.health.gov.au/internet/main/publishing.nsf/Content/review-pharmacy-](http://www.health.gov.au/internet/main/publishing.nsf/Content/review-pharmacy-remuneration-regulation-submissions-cnt-3/$file/136-2016-09-23-meditrax-submission.pdf)  
405 [remuneration-regulation-submissions-cnt-3/\\$file/136-2016-09-23-meditrax-](http://www.health.gov.au/internet/main/publishing.nsf/Content/review-pharmacy-remuneration-regulation-submissions-cnt-3/$file/136-2016-09-23-meditrax-submission.pdf)  
406 [submission.pdf](http://www.health.gov.au/internet/main/publishing.nsf/Content/review-pharmacy-remuneration-regulation-submissions-cnt-3/$file/136-2016-09-23-meditrax-submission.pdf). Accessed January 5, 2021.



- 407 19. Dovjak P. Tools in polypharmacy. Current evidence from observational and controlled  
408 studies. *Z Gerontol Geriatr.* 2012;45:468–472. <https://doi.org/10.1007/s00391-012-0362->  
409 y.
- 410 20. Scott IA, Hilmer SN, Reeve E, et al. Reducing inappropriate polypharmacy: the process of  
411 deprescribing. *JAMA Intern Med.* 2015;175:827–834.  
412 <https://doi.org/10.1001/jamainternmed.2015.0324>.
- 413 21. Cowie T. *Medicine use in aged care: a pill for every ill?*. Australian Pharmacist; 2018.  
414 accessed on [https://www.australianpharmacist.com.au/medicine-use-in-aged-care-a-pill-](https://www.australianpharmacist.com.au/medicine-use-in-aged-care-a-pill-for-every-ill/)  
415 [for-every-ill/](https://www.australianpharmacist.com.au/medicine-use-in-aged-care-a-pill-for-every-ill/). Accessed January 5, 2021.
- 416 22. Silva R de OS, Macêdo LA, dos Santos GA, Aguiar PM, de Lyra DP. Pharmacist-  
417 participated medication review in different practice settings: Service or intervention? An  
418 overview of systematic reviews. *PLoS One.* 2019;14:e0210312.  
419 <https://doi.org/10.1371/journal.pone.0210312>.
- 420 23. Alldred DP, Raynor DK, Hughes C, Chen TF, Miller P. Interventions to optimise  
421 prescribing for older people in care homes. *Cochrane Database Syst Rev.*  
422 2016;2:CD009095. <https://doi.org/10.1002/14651858.CD009095.pub3>.
- 423 24. Ventola CL. Mobile devices and apps for health care professionals: uses and benefits.  
424 *Pharm Ther.* 2014;39:356–364.
- 425 25. Cole SL, Grubbs JH, Din C, Nesbitt TS. Rural inpatient telepharmacy consultation  
426 demonstration for after-hours medication review. *Telemed J E Health.* 2012;18:530–537.  
427 <https://doi.org/10.1089/tmj.2011.0222>.

- 428 26. Health Resources and Services Administration. *Glossary of pharmacy-related terms*; 2021.  
429 accessed on <https://340bopais.hrsa.gov/help/SearchViewExport/Searching.htm>. Accessed  
430 June 24, 2021.
- 431 27. Harvard Health Publishing. *Telehealth: the advantages and disadvantages*. Harvard  
432 Medical School; 2020. accessed on [https://www.health.harvard.edu/staying-](https://www.health.harvard.edu/staying-healthy/telehealth-the-advantages-and-disadvantages)  
433 [healthy/telehealth-the-advantages-and-disadvantages](https://www.health.harvard.edu/staying-healthy/telehealth-the-advantages-and-disadvantages). Accessed June 24, 2021.
- 434 28. Thiruchelvam K, Wong PS, Kairuz T, Babar ZU, Hasan SS. Consolidated medication  
435 review algorithm to improve medications use in older adults: components, scoring scheme,  
436 and implementation. *J Am Med Dir Assoc*. 2018;19:717-718.  
437 <https://doi.org/10.1016/j.jamda.2018.03.007>.
- 438 29. Poudel A, Balloková A, Hubbard RE, et al. Algorithm of medication review in frail older  
439 people: Focus on minimizing the use of high-risk medications. *Geriatr Gerontol Int*.  
440 2015;16:1002-1013. <https://doi.org/10.1111/ggi.12589>.
- 441 30. Cresswell K, Majeed A, Bates DW, Sheikh A. Computerised decision support systems for  
442 healthcare professionals: an interpretative review. *Inform Prim Care*. 2012;20:115–128.  
443 <https://doi.org/10.14236/jhi.v20i2.32>.
- 444 31. Eslami S, Abu-Hanna A, de Jonge E, de Keizer NF. Tight glycemc control and  
445 computerized decision-support systems: a systematic review. *Intensive Care Med*.  
446 2009;35:1505–1517. <https://doi.org/10.1007/s00134-009-1542-0>.
- 447 32. Harrison SL, Kouladjian O'Donnell L, et al. Costs of potentially inappropriate medication  
448 use in residential aged care facilities. *BMC Geriatr*. 2018;18:9.  
449 <https://doi.org/10.1186/s12877-018-0704-8>.

- 450 33. Millar AN, Daffu-O'Reilly A, Hughes CM, et al. Development of a core outcome set for  
451 effectiveness trials aimed at optimising prescribing in older adults in care homes. *Trials*.  
452 2017;18:175. <https://doi.org/10.1186/s13063-017-1915-6>.
- 453 34. Menachemi N, Collum TH. Benefits and drawbacks of electronic health record systems.  
454 *Risk Manag Healthc Policy*. 2011;4:47–55. <https://doi.org/10.2147/RMHP.S12985>.
- 455 35. Hamann DJ, Bezboruah KC. Utilization of technology by long-term care providers:  
456 comparisons between for-profit and nonprofit institutions. *J Aging Health*. 2013;25:535–  
457 554. <https://doi.org/10.1177/0898264313480238>.
- 458 36. Campbell EM, Sittig DF, Ash JS, Guappone KP, Dykstra RH. Types of unintended  
459 consequences related to computerized provider order entry. *J Am Med Inform Assoc*.  
460 2006;13:547–556.
- 461 37. Office for Civil Rights. *HITECH Act Enforcement Interim Final Rule*. United States  
462 Department of Health & Human Services; 2017. accessed on  
463 [https://www.hhs.gov/hipaa/for-professionals/special-topics/HITECH-act-enforcement-](https://www.hhs.gov/hipaa/for-professionals/special-topics/HITECH-act-enforcement-interim-final-rule/index.html)  
464 [interim-final-rule/index.html](https://www.hhs.gov/hipaa/for-professionals/special-topics/HITECH-act-enforcement-interim-final-rule/index.html). Accessed January 6, 2021.
- 465 38. Weng F, Yang R-J, Ho H-J, Su H-M. A TAM-based study of the attitude towards use  
466 intention of multimedia among school teachers. *Appl Syst Innov*. 2018;1:36.  
467 <https://doi.org/10.3390/asi1030036>.
- 468 39. Rogers EM. *Diffusion of innovations*. New York, United States of America: The Free  
469 Press.1995.

470 40. Franchi C, Tettamanti M, Pasina L, et al. Changes in drug prescribing to Italian  
471 community-dwelling elderly people: the EPIFARM-Elderly Project 2000-2010. *Eur J Clin*  
472 *Pharmacol.* 2014;70:437–443. <https://doi.org/10.1007/s00228-013-1621-6>.

473

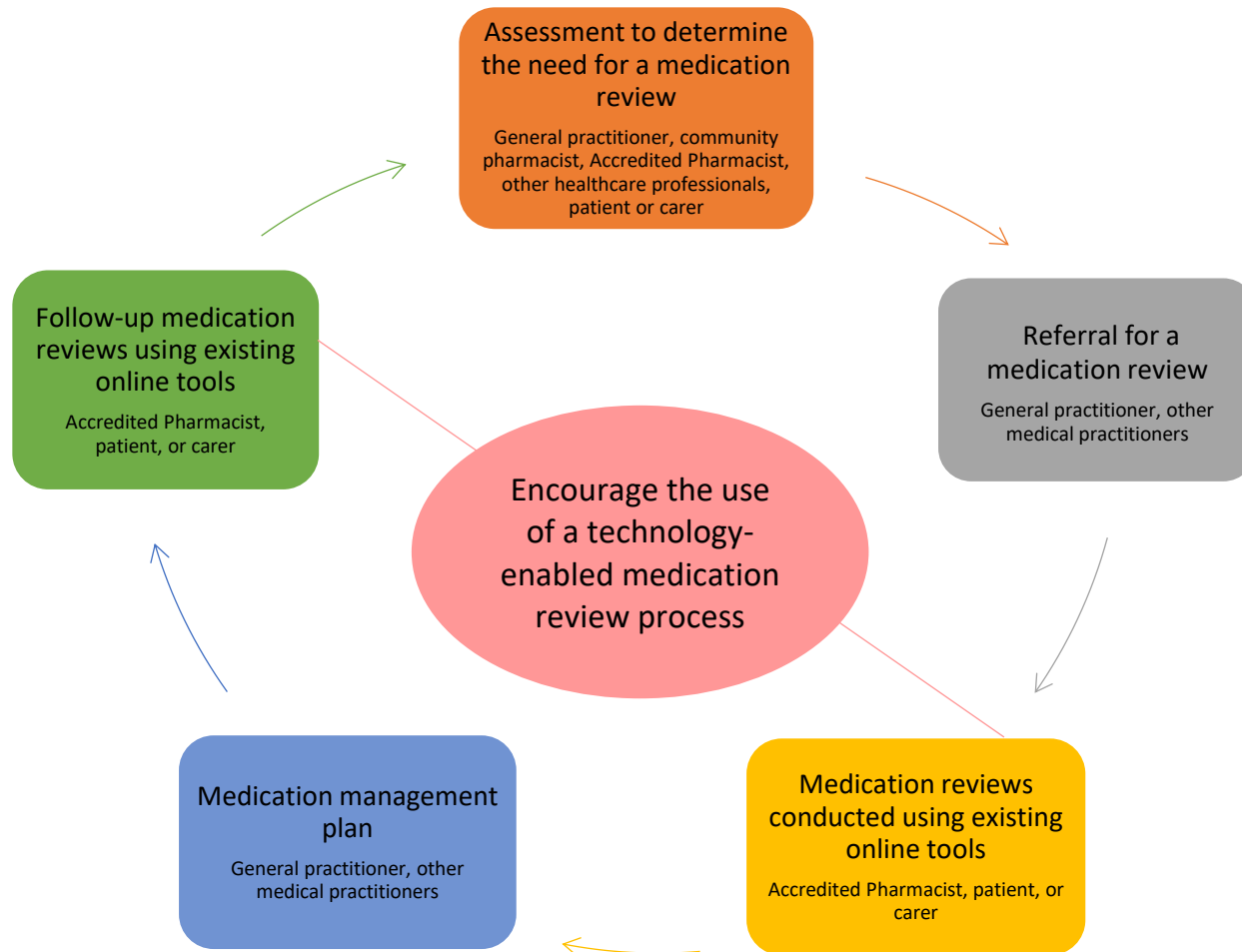


Figure 1: A general overview of the medication review process in Australia (adapted from the Guidelines for comprehensive medication management reviews 2020) (3)

**Table 1** Limitations of current medication review processes

<b>Limitations of current medication reviews</b>	<b>Description</b>
Checklists which lead to variations in processes (6,7,15-17)	Commonly used guides and national practice guidelines often include a 'checklist' approach about aspects to consider during a medication review, and recommend prescribing indicator tools that may provide information
	Lack of a systematic and structured process may prevent identification of medication-related issues
	The individualised nature of medication reviews may be time-consuming depending on the approaches adopted by each pharmacist
Time constraints (10,19-21)	Multiple documentation and records in aged care facilities that need to be accessed before a review is conducted affects the overall time taken for pharmacists to conduct the reviews, thus increasing associated costs
	The system to identify individuals who are eligible for a review is costly in terms of time management, and often result in rejection of ineligible claims which had been submitted to the government for remuneration
Funding constraints (10,17-21)	There are costs associated with administrative overheads and the time required to liaise with general practitioners to clarify issues
	Lack of financial reimbursement restricts the frequency of medication reviews and the failure to provide follow-ups
Process integration at an aged care facility (10)	There is a lack of support to ensure that an individual enrolled at an aged care facility for the first time and their general practitioners have access to an individual's previous medication review report during transfers of individuals that results in changes in treatment provider
	If there are changes in the reviewing pharmacist there may be difficulties identifying when an individual was last reviewed as the medication review report generated by the previous reviewer may not be located at the aged care facility
Data storage for quality improvement (21)	Storage of hard copy data is limited and may prevent the initiation of quality improvement measures to the current medication review processes
Inability to conduct face-to-face medication reviews during the COVID-19* pandemic	The COVID-19 pandemic has made it challenging to conduct face-to-face medication reviews; furthermore, not all healthcare settings may have integrated individual information about medications. This may preclude reviews from being conducted, especially when an individual is newly transferred to an aged care facility, or when an initial review needs to be conducted for community-dwelling individuals
Outcomes reported in studies that assess medication reviews (21-23)	Reporting of non- standardised health outcomes, i.e. heterogeneity of outcome measurements
	There is a lack of reporting of clinically relevant outcomes

\*COVID-19: Coronavirus disease-19

**Table 2** Potential advantages of a technology-enabled medication review process

<b>Potential advantages of technology-enabled medication reviews</b>	<b>Description</b>
Systematic and structured medication review process	Incorporating a guided framework that is stepwise in approach will facilitate a systematic and structured process
	Identification of important medication-related problems will ensure that optimal decisions are made about continuing, discontinuing or substituting a medication, and potentially prevent the prescribing cascade which is associated with an increase in number and cost of medications
	A computerised stepwise process which includes automatic prompts for medication monitoring parameters ensures that all aspects of a medication review are completed, thus increasing efficiency of the medication review process
Time-saving	Consolidation of all the individual's information in a CDSS may negate unnecessary documentation and could speed the process thereby saving cost; this would allow more reviews to be conducted.
	<p>Quality improvement measures that pharmacists can perform during the 'additional' time they may have available:</p> <ul style="list-style-type: none"> <li>• Counsel individuals on appropriate use of their medications</li> <li>• Conduct regular medicine/drug utilisation reviews and/or audits</li> <li>• Analyse outcomes from medication reviews regularly to identify any gaps in guidelines and frameworks</li> </ul>
	Incorporation of essential information about individuals' eligibility for medication reviews saves time; this translates into cost savings as claims can be easily submitted to the government for reimbursement
Cost-saving	Decision-making tools integrated with individuals' information in long-term care will ensure that reviews are conducted with maximum efficiency
	An investment in a robust, technology-enabled process that integrates information such as medical histories, medical charts, dispensing data, and medication review reports, will negate the need for unnecessary documentation (administrative overheads). Discussions with GPs may not need to be face-to-face when the necessary information is available online. This may offset long-term costs that are associated with the current system
Integration of the process at aged care facilities and other healthcare settings	Costs associated with unnecessary and potentially inappropriate medications, and treatment of their adverse effects, can be saved through a once-off investment in a systematic and structured system that will allow regular reviews to be conducted when required
	A system that is well-integrated with individuals' data as per privacy and ethical policies will ensure that all general practitioners and aged care facilities have easy access for continuity of care; this will ensure that medication reviews are initiated and follow-ups are done when necessary. This will also ensure treatment is not changed or stopped inappropriately

Data storage for quality improvement	<p>The use of CDSS will record outcomes and generate reports from reviews; data can be useful for:</p> <ul style="list-style-type: none"> <li>• Confirming when previous reviews had been conducted to ensure reviews are regularly conducted when indicated, and to prevent over-provision of medication reviews</li> <li>• Use by policy-makers for audit purposes based on the stored data which will allow for continuous improvement in the review process</li> <li>• Education and research purposes</li> <li>• Ensuring a technology platform is available to strengthen inter-professional collaboration during medication review feedback discussions and meetings</li> </ul>
Medication optimisation during the COVID-19* pandemic	<p>Integration of individuals' information could ensure that regular medication reviews are conducted even during the COVID-19* pandemic when face-to-face interactions during medication reviews may be restricted. This would allow for regular medication reviews and initiation of new reviews for individuals requiring reviews for the first time, thus optimising medications and avoiding the incidence of medication-related problems</p>
Outcomes reported in intervention studies using medication review processes	<p>Allowing researchers to select from a list of outcomes will allow for standardisation of outcome measurements to conduct meta analyses that can provide conclusive statements about the medication review interventions used in research, leading to effective changes in the medication review process</p>
	<p>A system that integrates technology with a guided framework and content knowledge may facilitate the reporting of clinically relevant outcomes, as the list of outcome measures can be pre-determined. This may allow more effective reporting</p>

\*COVID-19: Coronavirus disease-19