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RESEARCH PAPER

Consensus validation of a screening tool for cardiovascular pharmacotherapy in geriatric patients: the RASP_CARDIO list (Rationalization of Home Medication by an Adjusted STOPP list in Older Patients)

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Key summary points

Aim To update and validate the content of the cardiovascular segment of the RASP list, a previously validated explicit screening tool to improve geriatric polypharmacy.

Findings A three-step process was followed, starting with the tool update based on new literature and clinical experience. Next, internal discussions with four cardiologists and one cardiologist-internal medicine physician were held to finalize the construct and a Delphi consensus method was applied with the input of 17 geriatricians, cardiologists, an internal medicine physician and pharmacists to end up with a final construct with high agreement.

Message To support health care professionals in reviewing cardiovascular therapy in geriatric patients, we have worked out a valid screening tool, the RASP_CARDIO list, which identifies 95 clinically relevant instances of potentially inappropriate over-, under- or misuse of cardiovascular medications.

Abstract

Purpose Cardiovascular agents commonly used in geriatric patients, are linked to potentially avoidable harm and might hence be a suitable substrate for medication review practices. Therefore, we sought to update and validate the content of the cardiovascular segment of the previously published Rationalization of Home Medication by an Adjusted STOPP list in Older Patients (RASP) List.

Methods A three-step study was conducted by the pharmacy department in collaboration with the geriatric medicine and cardiology department at the University Hospitals Leuven, Belgium. First, the cardiovascular segment of the RASP list version 2014 was updated taking into account published research, other screening tools and the input of end-users. Secondly, this draft was reviewed during three panel discussions with five expert cardiologists and three clinical pharmacists, all of whom had relevant expertise in geriatric pharmacotherapy. Thirdly, the content was validated using a modified Delphi Technique by a panel of European hospital pharmacists, cardiologists, geriatricians and an internal medicine physician.

Results After the first and second step, the RASP_CARDIO list comprised 94 statements. Consensus ($\geq 80\%$ agreement) of all statements and one new statement about gliflozins in heart failure was achieved by a panel of seventeen experts across four

Hannah De Schutter and Julie Hias Shared first co-authorship.

The list can be used by any healthcare provider, but the prescriber stays entirely responsible for the final decision of their prescription. The list has to be updated and reviewed regarding to actual published evidence.

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European countries after two validation rounds. The final construct comprised a list of 95 statements related to potentially inappropriate prescribing of cardiovascular agents.
Conclusion The RASP_CARDIO list is an updated and validated explicit screening tool to optimize cardiovascular pharmacotherapy in geriatric patients.

Keywords Delphi technique · Geriatrics · Cardiovascular agents · Medication review · Inappropriate prescribing

Introduction

Potentially inappropriate medication use is highly prevalent in older adults. Causes are multiple, but can in part be explained by the presence of multimorbidity and associated polypharmacy [1–5]. Both might exacerbate medication-related harm, resulting in a reduced quality of life and an increased risk of unplanned hospital readmissions [6–9]. Older adults and in particular geriatric patients are disproportionally affected by this medication-related harm [6, 10–13]. Patients with a geriatric profile are commonly characterized by an age of 75 years or older, frailty, polypharmacy, cognitive dysfunction and functional dependency [6, 10]. In sum, it is crucial to evaluate and optimize pharmacotherapy to reduce avoidable harm in these geriatric patients [14–16].

In older adults, health care professionals should retain only those therapies with a clear net clinical benefit. The potential for medication-related harm should be accounted for as well [9]. For example, geriatric inpatients suffer from a relatively high prevalence of cardiovascular conditions. Most cardiovascular conditions are managed only using drug therapies, potentially adding to the risk of unwanted overtreatment and hence avoidable harm (e.g., continued use of dual antiplatelet therapy beyond standard duration). Conversely, the inappropriate underuse of cardiovascular medications might equally add to avoidable patient harm (e.g., underuse of anticoagulants in atrial fibrillation) [17]. Accordingly, inappropriate cardiovascular pharmacotherapy, including both under- and overuse, in geriatric patients, might be a suitable substrate for targeted medication review [14, 18–20].

Medication-related harm is considered to be preventable, particularly when resulting from the use of potentially inappropriate therapies [21]. Several strategies on reducing potentially inappropriate medication use have already been shown to improve clinical outcome in older adults. However, the evidence in support of such strategies for geriatric patients specifically still remains to be established [22–27]. Central to most approaches is performing a medication review. However, as shown in the meta-analysis by Dautzenberg L. et al., a medication review is only likely to confer any clinical benefit when provided in combination with other care components (e.g., patient education, medication reconciliation) [26]. A comprehensive medication review might also be further supported by explicit screening tools [5, 28]. The use of such explicit tools lead to an improved quality of prescribing and a reduced risk of adverse drug reactions [5, 8, 29]. In previous studies, frequently identified medications were psychotropics, medications without convincing evidence (e.g., vitamins) and proton pump inhibitors [30]. Subsequently targeting the aforementioned agents is unlikely, however, to substantially impact clinical outcome (e.g., readmission risk), which probably explains the largely neutral trial results [31, 32]. Accordingly, it might be more effective to target a specific pharmacological substrate, such as cardiovascular pharmacotherapy, which is more clearly linked to a measurable outcome [30].

Previously, our group developed and validated an explicit screening tool, the Rationalization of Home Medication by an Adjusted STOPP in Older Patients (RASP) List [33]. In three controlled studies, use of the RASP list in geriatric inpatients decreased the number of potentially inappropriate medications during hospital stay [30, 34, 35]. We also observed a small but significant improvement of the quality of life and fewer emergency department visits without hospital admission [30]. Afterward, we noted that cardiovascular medications accounted for a substantial portion (29%) of all clinical pharmacist recommendations [20]. Hence, we hypothesized that providing more explicit support for cardiovascular therapies might lead to a larger impact on both the medication review process, as well, downstream, on patient outcome. Therefore, we aimed to update the cardiovascular segment of the RASP list, intended for use in geriatric patients.

Methods

Design and setting

The RASP_CARDIO list was created through a literature search, panel discussions and finally a content validation. The study was performed by a research team (HDS, LH, JH and LVDL), consisting of clinical pharmacists specialized in geriatric pharmacotherapy of the University Hospitals Leuven (UZ Leuven), Belgium. A collaboration was established with the geriatric, cardiovascular and pharmacy departments of the University Hospitals Leuven. The study was conducted from August 2021 to April 2022. Approval

was given by the Ethical Committee on the 12th of July 2021 (MP017238).

Development and face validity of the RASP_CARDIO list

The cardiovascular segment of the previously published RASP list was used as basis for this update [14, 31, 33]. The update focused on potentially inappropriate cardiovascular medication use in geriatric patients and comprised instances of over-, mis-, as well as underuse. Two phases were followed to develop an updated tool with good face validity, the content of which was validated by selected experts.

During the first phase, i.e., the development phase, the list was updated by the clinical pharmacists of the research team. A literature search was performed based on the newest recommendations of the European Society of Cardiology (ESC) Guidelines and new evidence derived from meta-analyses or randomized controlled trials (RCTs) published since November 2011 until December 2021. Input from other screening tools, such as the 2019 Updated American Geriatrics Society Beers Criteria® and the STOPP/START criteria version 2, was incorporated as well [36, 37]. We also took into account prior experiences of the clinical pharmacists using the previous version of the RASP list at the geriatric ward, where they have been collaborating closely with geriatricians since 2010. New statements were added, altered or removed, based on clinical relevance and accuracy. Statements were then uniformly formulated to identify instances of potentially inappropriate prescribing in geriatric patients (e.g., sotalol for cardioversion in acute atrial fibrillation is potentially inappropriate). All items were accompanied with a short rationale, including the most relevant references, to further facilitate the validation process but also to support end-users when performing medication reviews. To keep the screening tool usable for daily clinical practice, we decided to not include all therapeutic restrictions or contraindications for each statement. The selection depended on the complexity of the statement (e.g., when additional clinical-related information would be required) and perceived relevance of potential restrictions. This first phase resulted in a working draft of the RASP_CARDIO list.

In the second phase, three panel discussions were organized to evaluate the validity of the proposed list. Panel members were selected based on their relevant expertise regarding cardiovascular pharmacotherapy in geriatric patients. Four cardiologists (PS, TVA, WD and RW) and one cardiologist-internal medicine physician (PV) of the University Hospitals Leuven were invited. Three clinical pharmacists (JH, LH and LVDL) were present as well to moderate the discussion and to provide additional information when needed. Geriatricians were not directly involved in the first two phases. The cardiologists were requested to comment on the current selection of items, the wording of the content and the overall relevance of the tool. Proposition of new statements was also allowed. Items were retained if at least three out of five experts agreed on their inclusion. The second phase resulted in a draft which was then used in the content validation rounds afterwards.

Content validation of the RASP_CARDIO list

The modified Delphi methodology was used to achieve consensus on the finalized tool's content [36–40]. Experts were selected based on their relevant expertise in geriatric pharmacotherapy. Thirteen hospital pharmacists, five cardiologists, one internal medicine physician and ten geriatricians with relevant expertise in geriatric or cardiovascular pharmacotherapy were invited. Expertise was based on clinical activities and/or published work. All 29 experts were Europe-based (Belgium, France, Northern Ireland, Scotland, Sweden, The Netherlands and The United Kingdom) and were employed in a general or university hospital.

For the first validation round, all statements of the proposed list were adopted into an online anonymized questionnaire in English using Qualtrics, version 2020 (Qualtrics, Provo, UT). A 5-point Likert Scale was used to score the level of agreement for each statement, varying from 'strongly disagree' (score 1) to 'strongly agree' (score 5). Consensus was defined if at least 80% of the participants agreed with the statements (i.e. 'somewhat agree' (score 4) and 'strongly agree' (score 5)) [38]. A free text field was provided for each statement to provide feedback or to propose new statements. This questionnaire was then distributed by email among the experts. To improve the response rate, experts from UZ Leuven were also invited by phone.

For the second validation round, statements without consensus (< 80% agreement) after the first round were reinserted into a questionnaire with corresponding anonymized results and feedback received during the first round. If the wording of a specific statement had been altered by the research team after the first round, corrections were made directly in text and highlighted. The agreement on these statements was then scored again using the same 5-point Likert Scale. Statements which reached consensus after the first round were also displayed in the questionnaire, but without any corrections, feedback or possibility to score again [41]. The questionnaire of the second round was only distributed to participants of the first round. This process stopped when consensus was reached for all statements.

The final construct was compared to the cardiovascular segment of the second version of the STOPP/START criteria, the most used and examined screening tool in Europe [37].

Analysis

The RASP_CARDIO list was converted to an online questionnaire by Qualtrics, version 2020 (Qualtrics, Provo, UT). This software also allowed the research team to report categorical data, which were then presented as counts and percentages.

Results

Development and face validity of the RASP_CARDIO list

The first version of the RASP list contained 20 statements related to the cardiovascular system [33]. The development process was split into two phases, the first of which resulted in a draft comprising 103 statements. Only ten statements of the original RASP list were retained as such. Four statements were merged into two, six statements were rewritten and 85 statements were added.

In a second development phase, the draft of the RASP_CARDIO list was then debated during three panel discussions, scheduled in August and September 2021. The first panel discussion was held between two cardiologists (TVA and WD) and three clinical pharmacists (JH, LH and LVDL). The second panel discussion was held between one cardiologist (PS), one cardiologist-internal medicine physician (PV) and three clinical pharmacists (JH, LH and LVDL). The third panel discussion was held between one cardiologist (RW) and the same clinical pharmacists from the previous rounds. The experts agreed with 76% (78/103) of the proposed statements. Two statements were added, based on the PARAGON-HF trial [42] and the 2020 European Society Cardiology Guidelines for Management of Atrial Fibrillation [43]. Twenty-two statements were rewritten and 11 statements were removed. One of the expert cardiologists of the first round suggested that quality of life should also be taken into account. Two other expert cardiologists from the first and second round also proposed prioritizing statements according to the strength of evidence. Both were discussed and not incorporated as consensus was reached that both comments fell beyond the scope of the list as an explicit tool. This second phase led to a finalized draft of 94 statements. All panel members uniformly acknowledged the usefulness of the tool as an aid for hospital-based pharmacists and prescribers.

Content validation of the RASP_CARDIO list

Expert panel member participation

Seventeen experts participated in the first validation round, 16 of whom also participated in the second round. This resulted in a participation rate of 59% (17/29) and 94% (16/17) in the first and second round respectively. More information concerning the participants is described in Table 1.

Modified Delphi validation study

The first validation round ran from December 2021 to January 2022. Consensus (≥ 80%) was achieved for 84% (79/94) of statements. The remaining 16% (15/94) of statements are displayed in Table 2 with their scores of agreement.

A subsequent proposal for the RASP_CARDIO list was then developed to proceed to the second validation round. In this draft, all statements ($n = 15$) were provided with additional information, such as updated guideline recommendations and original study findings, and eight (out of 15) statements were rephrased. Experts provided feedback and made suggestions for other criteria; more details are shown in Table 3.

The draft for the second Delphi round was then converted into an online questionnaire. Responses were collected from February 2022 until March 2022. One participant of the first round was unable to participate due to lack of time. Consensus (≥ 80%) was obtained for all statements ($n = 16$). No statements needed to be added, altered or scored again. Limited feedback was also provided (Table 4). After this second validation round, a final list of 95 statements was retained. The RASP_CARDIO list could be divided in 74 STOPP criteria and 21 START criteria. At the least, the content of the statements was compared to the 24 STOPP and 8 START criteria of the cardiovascular segment of the second version of the STOPP/START criteria. Approximately 90% (29/32) of the cardiovascular statements of the second version of the STOPP/START criteria were

Table 1 Expert participation and professional role

Professional role	Round one ($n = 17$)		Round two ($n = 16$)	
	Hospital employment			
	University	General	University	General
Hospital pharmacist	7	1	7	1
Belgium	3	1	3	1
The Netherlands	2	0	2	0
Sweden	1	0	1	0
Northern Ireland	1	0	1	0
Geriatric medicine	6	0	6	0
Belgium	6	0	6	0
Cardiology	2	0	2	0
Belgium	2	0	2	0
Internal medicine	1	0		
The Netherlands	1	0		

Table 2 Statements without consensus after the first Delphi validation round

Statements	5-point Likert scale					
	1	2	3	4	5	%A1
Use of a Vaughan-Williams class I antiarrhythmic drug without an atrioventricular nodal blocking drug is potentially inappropriate	0	0	6	5	6	64.70
Ivabradine in stable angina pectoris without left ventricle dysfunction is potentially inappropriate	0	0	4	5	8	76.47
Continued use of spironolactone while an angiotensin-converting-enzyme inhibitor is discontinued in case of a moderately or severely impaired kidney function	0	2	2	9	4	76.47
Not initiating an angiotensin receptor-neprilysin inhibitor in refractory heart failure with reduced ejection fraction is potentially inappropriate	0	0	6	4	7	64.71
Refractory heart failure with reduced ejection fraction under maximally tolerated renin–angiotensin–aldosterone system inhibitor and beta-blocker therapy without starting a mineralocorticoid receptor antagonist is potentially inappropriate	0	1	3	3	10	76.27
Discharging a patient with sequential nephron blockade is mostly potentially inappropriate	0	2	2	5	8	76.47
Dihydralazine sulphate (~hydralazine.HCL) without a nitrate in heart failure with reduced ejection fraction is potentially inappropriate	1	0	4	6	6	70.58
Digoxin in heart failure with reduced ejection fraction in sinus rhythm is potentially inappropriate	0	1	5	4	7	64.71
Strict salt restriction in heart failure is potentially inappropriate	2	1	1	10	3	76.47
A proton pump inhibitor in the presence of two or more antithrombotics is recommended	2	1	1	5	8	76.47
Permanent discontinuation of anticoagulants for stroke prevention in atrial fibrillation in case of nuisance bleeds is potentially inappropriate	0	3	2	3	9	70.59
Permanent discontinuation of anticoagulants for stroke prevention in atrial fibrillation after a first episode of gastrointestinal bleeding is potentially inappropriate	0	2	2	9	4	76.47
Permanent discontinuation of anticoagulants for stroke prevention in atrial fibrillation in case of a high risk of falls is potentially inappropriate	1	1	2	6	7	76.47
Permanent discontinuation of a statin because of patient-reported myopathy is potentially inappropriate	0	2	4	4	7	64.71
Not giving an angiotensin-converting-enzyme inhibitor or an angiotensin-receptor blocker but other antihypertensives as first-line treatment of arterial hypertension with a high cardiovascular risk is potentially inappropriate	0	2	3	6	6	70.58

1 strongly disagree, *2* somewhat disagree, *3* neither disagree nor agree, *4* somewhat agree, *5* strongly agree, *%A1%* agreement after the first Delphi validation round

Table 3 Expert feedback and suggestions of the first Delphi validation round

Participant number	Suggestion
1	Add iron for HFrEF Mention loop diuretics as cornerstone of treatment of HFrEF
2	I miss the use of SGLT-2 inhibitors in heart failure
3	I miss the use of SGLT-2 inhibitors in heart failure (independent of their indication in diabetes)
4	For atrial fibrillation, please also use the HAS-BLED score to have an idea of bleeding risk. If HAS-BLED > CHA_2DS_2VASC, one should be cautious when using/starting DOACs For HFrEF: latest guideline suggests starting four drugs at once
5	Be careful in frail elderly, especially with a short life expectancy

HFrEF heart failure with reduced ejection fraction, *HAS-BLED* hypertension, abnormal renal and liver function, stroke, bleeding, labile INR, elderly, drugs, or alcohol, *CHA2DS2VASC* congestive heart failure, hypertension, age, diabetes mellitus, prior stroke or TIA or thromboembolism, vascular disease, age 65–74 years, sex category, *DOAC* direct oral anticoagulants

included in the RASP_CARDIO list. Only one START criteria, 'beta-blocker with ischemic heart disease', and two STOPP criteria, 'Angiotensin-converting-enzyme inhibitors or angiotensin II-receptor blockers in patients with hyperkalaemia' and 'Phosphodiesterase type-5 inhibitors (e.g. sildenafil, tadalafil, vardenafil) in severe heart failure characterized by hypotension, i.e. systolic BP < 90 mmHg, or concurrent nitrate therapy for angina (risk of cardiovascular collapse)' were lacking in our list. This represented a 66% (63/95) increase in cardiovascular statements compared to the STOPP/START criteria version 2 [37]. The complete

Table 4 Expert feedback and suggestions of the second Delphi validation round

Participant number	Suggestion
1	Diuretics as cornerstone of congestion, yet not of HFrEF per se I agree with all other statements: the use of iron in HFrEF, the importance of SGLT-2 in HF and the HAS-BLED versus CHADS-VASC score. Being careful in frail elderly
2	I would like to refer to the information on the website 'www.bcfi.com'. There is no reimbursement for empagliflozin for chronic HF (current situation on 01/02/2022) For the statement about the use of Proton Pump Inhibitors, it seems appropriate to initiate these drugs in the presence of one antiplatelet agent instead of dual antiplatelet therapy

HFrEF heart failure with reduced ejection fraction, *SGLT-2 inhibitors* sodium-glucose co-transporter-2 inhibitors, *HAS-BLED* hypertension, abnormal renal and liver function, stroke, bleeding, labile INR, elderly, drugs, or alcohol, *CHADSVASC* congestive heart failure, hypertension, age, diabetes mellitus, prior stroke or TIA or thromboembolism, vascular disease, age 65–74 years, sex category

list of statements with supporting references has been added to the Supplementary Appendix (Annex 1).

Discussion

Our tool is among the first with a focus on a high-risk medication class in the specific subgroup of geriatric patients. The tool is intended for use in all patients with a geriatric profile, regardless of the setting (i.e., hospital, ambulatory, community). In contrast to previous screening tools, which commonly screen for a wide variety of drug classes in a broader group of older adults, the RASP_CARDIO list has been specifically developed with a focus on potentially inappropriate over-, under- or misuse of cardiovascular medications in geriatric patients. Our validated list identifies 95 of such clinically relevant situations. We specifically focused on cardiovascular medications for this update, because optimizing their use might be more strongly associated with clinical outcomes such as fewer readmissions [31]. Importantly, this list should be integrated in a patient-centered, multifaceted and multidisciplinary approach. For example, this might be achieved by a clinical pharmacist who systematically applies the RASP_CARDIO list during a comprehensive medication review step, in conjunction with other care components such as a medication reconciliation, patient education and the provision of transitional care [26, 28, 44].

Despite the overabundance of screening tools, we have chosen to develop our new list based on our earlier published work in 2014, the RASP list, for a number of reasons [33]. Firstly, the target audience of both lists was the same, i.e., geriatric patients. Secondly, even in 2014, the RASP list had already a larger focus on cardiovascular therapies compared to other explicit screening tools at that time [30]. Accordingly, all but three cardiovascular statements of the STOPP/START criteria version 2 ($n=32$) were adopted by the finalized RASP_CARDIO list. Only one START statement on beta-blockers with ischaemic heart disease and two STOPP criteria about angiotensin-converting-enzyme inhibitors or angiotensin II-receptor blockers and phosphodiesterase type-5 inhibitors were not included in the final construct. The RASP_CARDIO list thus contained 63 cardiovascular statements more than the STOPP/START criteria version 2 [37]. Thirdly, we have previous experience in using the RASP list in research setting. In three controlled investigations, a significant positive impact was seen on prescribing appropriateness, quality of life as well as emergency department visits [30, 34, 35]. Fourth, the RASP list has already been used in our hospital and its statements are even incorporated into the prescribing software of the nexuzhealth hospitals [45], substantially facilitated by involving in-house stakeholders in their development and validation process [46].

The cardiovascular segment of the RASP list 2014 ($n=20$) was expanded to 103 statements after literature research and 94 statements after panel discussions. During panel discussions, statements were removed ($n=11$) because of perceived insufficient/weak evidence or clinical irrelevance. Two statements on the use of sacubitril/valsartan and atrioventricular nodal blocking agents were added. Assessing quality of life and life expectancy fell beyond the scope of the list as an explicit screening tool, which should never replace clinical judgment or a comprehensive geriatric assessment [28]. We also refrained from rearranging the statements according to the strength of evidence, largely because of the limited evidence base in geriatric patients.

After the first Delphi validation round, only one new statement about the use of dapagliflozin (DAPA-HF [47]) and empagliflozin (EMPEROR-REDUCED [48]) was added, to improve outcome in heart failure with a reduced ejection fraction [49]. No items were added in the second validation round. Together with the high grade of agreement obtained in the first (84%, 79/94) and second (100%, 16/16) validation round, we believe this sole addition demonstrated the effectiveness of our approach in evaluating and adjusting the tool in collaboration with local expert cardiologists, before commencing the actual Delphi consensus study.

We believe the results of our validation study are valid. Firstly, an European panel of experts with recognized knowledge in geriatric medicine was involved during the validation process. Importantly, most experts, including all geriatricians and cardiologists, were active in Belgium. Accordingly, prescribing practices in Belgium might have

influenced their opinion during the Delphi panel. Yet, most statements were based on references from the European Society of Cardiology. Moreover, the upstream team effort with expert cardiologist has allowed an up-to-date, cardiology-oriented evidence-based approach. Secondly, we have chosen to develop and validate our tool particularly for use in geriatric patients. Most other tools have been developed for broader patient group, commonly starting from the age of 65 years. A notable exception is the STOPPfrail tool, which however only contained five cardiovascular items and which is solely focused on deprescribing [32]. We hypothesize that this high-risk subgroup of older adults is more likely to derive a clinical benefit from a targeted review focusing on high-risk medications such as cardiovascular medications and one that is not limited to overuse [31].

Importantly, the RASP_CARDIO list has some limitations as well. Firstly, while the expert group was sufficiently large to acquire appropriate results in the Delphi process, not all stakeholders were represented. Patients, caretakers, specialist nurses and primary care prescribers were not involved, which might have impacted the content of the tool [31]. Yet, we were more interested in the upstream opinion of hospital-based healthcare providers as they will largely be the downstream end-users of the tool. Secondly, specific monitoring recommendations were not taken into account for each statement where a suggestion is made to add an extra medication. This renders it necessary to implement suggestions with caution in this high-risk patient population. The target of our study was to develop a list that would be usable in daily clinical practice. This implies that some decisions were made to shorten the size of the tool. Thirdly, some experts considered the list to be too exhaustive and hence time-consuming to implement in routine clinical practice. Therefore, it might be useful to offer the list as part of a clinical decision support software (CDSS) of the hospital [28, 34, 50]. However, there are several factors that we need to bring into account for translating the content of the RASP_CARDIO list into a workable CDSS framework. Firstly, some statements rely on clinical information (e.g. renal function, diagnosis) and this information needs to be readily available from the electronic patient health record. Secondly, CDSS may lead to alert fatigue which should be mitigated by ensuring a sufficiently high specificity of the clinical rules included in the CDSS [51]. We fully agree with the comment of some experts regarding the large amount of statements and are translating these statements into clinical rules [46, 51]. This exercise should also facilitate its incorporation in an already existing European repository of computer-applicable explicit criteria on potentially inappropriate medications, taking into account semantic interoperability [52]. In this regard, however, we should consider the neutral findings of SENATOR and OPERAM. These two multicenter European trials examined the clinical impact of pharmacotherapy optimization software interventions based on STOPP/START criteria version 2. In both trials, the degree of potentially inappropriate prescribing was reduced, but without any impact on clinical outcomes [24, 25]. We acknowledge these study findings and hypothesize that prioritizing cardiovascular therapies in geriatric patients with patient-tailored CDSS support might increase the odds of finding positive results regarding clinical outcome, particularly when the medication review is performed by trained healthcare providers.

Given our previous experiences, we recommend to use this tool as an educational aid, a template for CDSS services and an interventional aid in investigations for all-comer geriatric patients admitted to the hospital [31]. Future studies are needed to show if the list can provide a measurable clinical benefit. Currently we are performing the ASPIRE trial (the effect of a trAnSitional Pharmacist Intervention in geRiatric Inpatients on hospitals visits after discharge) (NCT04617340), where the RASP_CARDIO list will be used in the intervention arm to provide additional support to clinical pharmacists [53]. In addition, it is our aim to adapt the content of the other segments of the RASP list 2014 (e.g., the central nervous system section), using the same approach. Additionally, the current update and validation study of the RASP_CARDIO list underlies the need to regularly review the statements (e.g., every five years) in function of new published evidence.

Conclusion

The RASP_CARDIO list has been developed to optimize cardiovascular pharmacotherapy in geriatric patients and contains 95 statements, which were found to be valid according to selected experts. Future studies are needed to evaluate whether the list, used as part of a hospital-wide intervention or when integrated in CDSS can provide a measurable clinical benefit such as a reduction in drug-related hospital admissions.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s41999-022-00701-w.

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Declarations

Conflict of interest Marisa Alcaide and Marta Caparros are employed by Fundacion Gregal. There are no other conflict of interest.

Ethical approval The study was approved by the Ethical Committee (MP017238).

Informed consent Informed consent was provided for the panel discussions.

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