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New lists and new technological tools on potentially inappropriate drugs for the elderly: an integrative review

Novas listas e novas ferramentas tecnológicas sobre medicamentos potencialmente inapropriados para idosos: uma revisão integrativa

Nuevas listas y nuevas herramientas tecnológicas sobre medicamentos potencialmente inapropiados para ancianos: una revisión integradora

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Objective: to identify new lists and new technological tools on Potentially Inappropriate Medicines for the Elderly existing in scientific productions. **Methods:** an integrative review was carried out in 2020, considering the period from 2010 to 2019, in the following databases: Scientific Eletronic Library on-line, National Library of Medicine and National Institutes of Health, Latin American and Caribbean Health Sciences Literature, Spanish Bibliographic Index of Health Sciences, Cochrane Library, Network of Scientific Journals of Latin. America, the Caribbean, Spain and Portugal, *Fundación Index Database – España*. The languages Portuguese, English and Spanish were listed and the selected articles were categorized by thematic similarities. **Results:** 42 productions were considered, most of them published in English and produced in the United States of America, Canada, Spain, Germany, Belgium and Ireland. Two thematic categories were constructed: "*Lists on potentially inappropriate medicines for the elderly*" (with 22 publications); and, "*New Technological Tools on potentially inappropriate medicines for the elderly*" (with 20 publications). As main findings, the following stood out: the relevance of having lists on these drugs adapted to specific countries and/or populations; as well as the fact that new technological tools follow a trend of development and improvement, although the usability and user coverage requirements can be improved. **Conclusion:** this review identified that the use of potentially inappropriate medicines for the elderly represents a challenge for health care, as well as the growing initiatives to expand access to information, such as the construction of large databases and repository with simplified access.
Descriptors: Potentially Inappropriate Medication List; Drug utilization; Inappropriate prescribing; Biomedical technology; Aged.

Objetivo: identificar novas listas e novas ferramentas tecnológicas sobre Medicamentos Potencialmente Inapropriados para Idosos existentes em produções científicas. **Método:** revisão integrativa realizada em 2020, considerando o período de 2010 a 2019, nas bases de dados: *Scientific Eletronic Library on-line, National Library of Medicine and National Institutes of Health*, Literatura Latino-Americana e do Caribe em Ciências da Saúde, Índice Bibliográfico Espanhol de Ciências de Saúde, *Cochrane Library*, Rede de Revistas Científicas da América Latina e Caribe, Espanha e Portugal, Base de dados da *Fundacíon Index – España*. Elencou-se os idiomas português, inglês e espanhol e os artigos selecionados foram categorizados por similaridades temáticas. **Resultados**: foram consideradas 42 produções, em sua maioria publicadas em língua inglesa e produzidas nos Estados Unidos da América, Canadá, Espanha, Alemanha, Bélgica e Irlanda. Duas categorias temáticas foram construídas: "*Listas sobre medicamentos potencialmente inapropriados para idosos*" (com 22 publicações); e "*Novas Ferramentas Tecnológicas sobre medicamentos potencialmente inapropriados para idosos*" (com 20 publicações). Como principais achados, destacou-se: a relevância de que listas sobre esses medicamentos sejam adaptadas a países e/ou populações específicas; bem como ao fato de que novas ferramentas tecnológicas seguem uma tendência de desenvolvimento e aprimoramento, embora os quesitos usabilidade e abrangência de usuários possam ser melhorados. **Conclusão:** esta revisão identificou que o uso de medicamentos potencialmente inapropriados para idosos representa um desafio para a assistência à saúde, bem como as crescentes iniciativas para expandir o acesso às informações, como a construção de grandes bancos de dados e repositório com acesso simplificado.
Descritores: Lista de Medicamentos Potencialmente Inapropriados; Uso de medicamentos; Prescrição Inadequada; Tecnologia biomédica; Idoso.

Objetivo: identificar nuevas listas y nuevas herramientas tecnológicas sobre Medicamentos Potencialmente Inapropiados para Ancianos existentes en las producciones científicas. **Método:** revisión integradora realizada en el año 2020, considerando el periodo de 2010 a 2019, en las bases de datos: *Scientific Electronic Library online, National Library of Medicine and National Institutes of Health*, Literatura Latinoamericana y del Caribe en Ciencias de la Salud, Índice Bibliográfico Español de Ciencias de la Salud, *Cochrane Library*, Red de Revistas Científicas de América Latina y el Caribe, España y Portugal, Base de datos de la Fundación Index - España. Se seleccionaron los idiomas portugués, inglés y español y los artículos seleccionados se clasificaron por similitudes temáticas. **Resultados:** Se consideraron 42 producciones, en su mayoría publicadas en inglés y producidas en Estados Unidos de América, Canadá, España, Alemania, Bélgica e Irlanda. Se construyeron dos categorías temáticas: *"Listas sobre medicamentos potencialmente inapropiados para ancianos"* (con 22 publicaciones); y *"Nuevas herramientas tecnológicas sobre medicamentos potencialmente inapropiados para ancianos"* (con 20 publicaciones). Como principales resultados destacan: la relevancia de que las listas sobre estos medicamentos se adapten a países y/o poblaciones específicas; así como, el hecho de que las nuevas herramientas tecnológicas sigan una tendencia de desarrollo y mejora, mientras que las cuestiones de usabilidad y amplitud de usuarios pueden ser mejoradas. **Conclusión:** esta revisión identificó que el uso de medicamentos potencialmente inapropiados para ancianos representa un desafío para la asistencia a la salud, así como las crecientes iniciativas para expandir el acceso a informaciones, como la construcción de grandes bancos de datos y repositorios con acceso simplificado.
Descriptores: Lista de Medicamentos Potencialmente Inapropiados; Uso de medicamentos; Prescripción Inadecuada; Tecnología biomédica; Anciano.

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INTRODUCTION

The aging of populations represents a relevant epidemiological transition, showing a growing increase in the demand for health care. It is a worldwide phenomenon and, in the case of Brazil, the number of elderly people (over 60 years old) is expected to almost double in the next 35 years, as well as the number of people over 70 years old, which will triple by 2050, reaching 13.2% of the population[1]. In Brazil, with the 2010 census, the projections for the population were revised: the number of elderly people should double in twenty years and the number of people over 70 years old will reach 16.2% of the population in 2050[2].

In this context, the elderly are considered a special therapeutic group, due to factors such as the increasing prevalence of non-communicable chronic diseases and the consequent use of medication[3]. Associated with this, it is important to consider that there is interference of the physiological changes of the aging process in the pharmacokinetics and pharmacodynamics, increasing the risk of toxicity caused by the drugs[4].

Among the particularities of drug therapy for this group, potentially inappropriate medicines for the elderly (PIM) stand out, defined as those whose risk of use is greater than the clinical benefits provided, when safer and more effective alternatives are available[5] and, due to the high potential to generate negative outcomes, such as falls and increased health costs, its prescription should be avoided[6].

The evaluation of prescriptions containing PIM can be supported by implicit or explicit methods. The former are based on clinical judgment according to patient information (health profile, presence of health problems or relevant clinical peculiarities), and propose a more in-depth pharmacotherapeutic analysis. Therefore, they require more time and depend on the professional's experience, but they provide an individualized analysis compatible with the reality of health services and the clinical variability of the geriatric population, and can be incorporated with relative ease in the therapeutic decision process, multidisciplinary clinical discussion and in pharmacotherapeutic follow-up processes. The most established implicit method is the Medication Appropriateness Index (MAI)[7-8].

Explicit methods are based on more rigidly established criteria, usually developed through reviews, expert opinions, and consensus techniques. They focus on the drug and do not take into account the clinical suitability of each patient. As they are based on less flexible criteria, they are good instruments to carry out more punctual and simpler geriatric prescription reviews. The Beers Criterion is considered one of the most important explicit

methods, listing classes and specificities of drugs and in categories, such as those potentially inappropriate[7-8].

Considering that the use of PIM has a high prevalence in several countries, ranging from 25.5% to 98.2%[9-10], knowing the updates of lists on PIM, as well as new technological tools applied to them, becomes of great importance. value to the field of practices. Thus, this study aims to identify new lists and new technological tools on Potentially Inappropriate Medicines for the Elderly existing in scientific productions.

METHODS

This is an integrative review, defined as the method that brings together the synthesis of knowledge from the relevant scientific production on a given topic, offering quick and synthesized access to the scientific results of greatest relevance to the area studied[11].

The guiding question listed was: *What is the state of the art, in scientific productions, between 2010 and 2019, about new lists and new technological tools on Potentially Inappropriate Medicines for the Elderly?*

The search was carried out in 2020 and the databases considered were: SciELO (Scientific Electronic Library on-line); PubMed/Medline (National Library of Medicine and National Institutes of Health), LILACS (Latin American and Caribbean Health Sciences Literature); IBECS (Spanish Bibliographic Index of Health Sciences); Cochrane; Redalyc (Network of Scientific Journals of Latin. America, the Caribbean, Spain and Portugal); and Cuiden (Fundación Index database – España).

The primary search in the databases consisted of the following strategy: ("Potentially Inappropriate Medication List" [All Fields] OR "*Lista de Medicamentos Potencialmente Inapropriados*] OR "*Lista de Medicamentos Potencialmente Inapropiados*" AND "aged" [All Fields]] OR "elderly" [All Fields] OR "elder people" [All Fields] OR "*anciano*" [All Fields] OR "*idoso*" [All Fields]).

However, for two databases it was necessary to reformulate the search strategy; in the case of PubMed it consisted of: 'Potentially Inappropriate Medication List aged'; and for SciELO: 'Potentially Inappropriate Medication List'.

For the composition of the corpus, the articles obeyed the following criteria:

• **Inclusion criteria:** complete research articles, in Portuguese, English and Spanish, published in scientific journals from 2010 to 2019. Regarding the theme, articles dealing with: Lists/Updates of Lists on PIM were included; Consensus; Derived Lists about PIM; Construction Studies and/or Validation of New Technological Tools applied to the theme.

• **Exclusion criteria:** observational, case-control and cohort studies; editorials; reviews; reports of experiences and theoretical reflections; dissertations; theses and monographs; abstracts published in annals of events, repeated articles, and those that had no direct relationship with the topic.

The analysis of the articles was based on Evidence-Based Practice (EBP), which is defined as an approach that associates the best scientific evidence with clinical experience and patient choice[12]. The EBP is important to support professional practice, as it describes that its implementation is essential to achieve effectiveness, reliability and safety in health practices[13].

All publications were initially filtered by reading title and abstract, thus identifying the articles that apparently addressed the topic and answered the research question. In a second phase, the articles considered were read in full and categorized by thematic similarities.

The articles were presented in tables that focus on the *reference* (identification of the title, author and year), *language and country, objective, proposal of the study* (which summarizes in a critical rereading the direction of the article - method; without the intention of copying the statements of the authors). authors of the production, therefore critical re-reading; also seeking to interpret the contributions, novelties, results and defended aspects) and, level of scientific evidence. The latter followed the classification proposed by Melnyk and Fineout-Overholt[14]: Level I – evidence from a systematic review or meta-analysis of relevant randomized controlled trials (RCTs) or from clinical guidelines based on systematic reviews of controlled RCTs; Level II – evidence obtained from at least one well-designed controlled RCT; Level III – evidence obtained from well-designed clinical trials without randomization; Level IV – evidence from well-designed cohort and case-control studies; Level V – evidence from a systematic review of descriptive and qualitative studies; Level VI – evidence from a single descriptive or qualitative study; Level VII – evidence from the opinion of authorities and/or the report of expert committees.

From the categories obtained, the articles were discussed in the light of the analytical process, with emphasis on Nóbrega and Karnikowski[15], directing the discussion to the state of the art, the main specific lines of research and gaps, dialoguing with the critical analysis of scientific evidence and the main contributions.

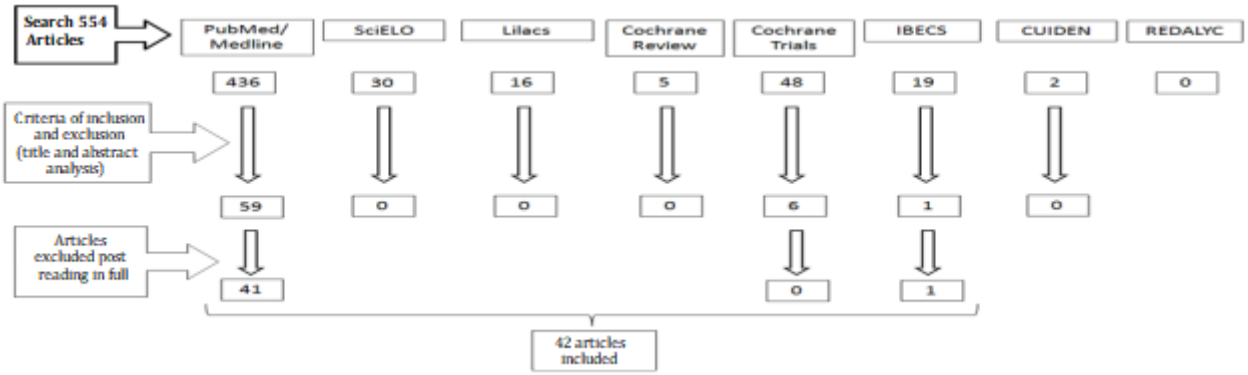
The journals involved in the publications were identified, including their scope of circulation (national/international). The countries and languages were presented in their abbreviated forms, aiming at the best configuration of the data. The countries presented the following correspondences: Germany (DEU); Argentina (ARG); Australia (AUS); Austria (AUT); Belgium (BEL); Brazil (BRA); Canada (CAN); Korea (KOR); Spain (ESP); United States of

America (USA); Ireland (IRL); Italy (ITA); Japan (JPN); Norway (NOR); Netherlands (NLD); United Kingdom (GBR); Sweden (SWE); Switzerland (CHE); Taiwan (TWN). The publication languages were represented by the abbreviations: English (en) and Spanish (sp).

RESULTS

A total of 554 references were identified and 42 of them were included for analysis. The detail is presented in the flow diagram (Figure 1).

Figure 1: Flow diagram of articles filtered, evaluated for eligibility, included and excluded. Uberaba, MG, 2021.



In the first filter step, 46 articles were excluded for being duplicates, and another 442 articles for not meeting the study typology eligibility criteria. In the second stage of the filter, 23 articles were excluded for deviating from the theme, and one for incompleteness of methodological information and results.

The 42 productions analyzed were published in 25 journals of international circulation, the most frequent being the Journal of the American Geriatrics Society, in which there were six articles, followed by the European Journal of Clinical Pharmacology, with four articles, and three articles each in the journals Geriatrics & Gerontology International and BMC Geriatrics.

The main language used by the publications was English, observed in 39 of the publications, which does not necessarily imply that all of them are from English-speaking countries, but only that the adoption of English as the main language of dissemination has been required by journals from different countries. Spanish appears as the language of the other three remaining articles, with no articles written only in Portuguese.

Most of the articles identified came from studies carried out in the United States of America (8 articles – 1 of them in partnership with Italy); Canada and Spain (five articles each); Germany, Belgium and Ireland (three articles each); Norway, Switzerland and Taiwan (two

articles each); Argentina, Australia, Austria, Brazil, Korea, Japan, Netherlands, United Kingdom and Sweden (one article each).

By production similarities, two categories were constructed, namely: "*Lists on potentially inappropriate medicines for the elderly*" and "*New Technological Tools on potentially inappropriate medicines for the elderly*", being Categories 1 and 2, respectively.

Category 1. *Lists on potentially inappropriate medicines for the elderly*

This category with 22 studies brings new lists on PIM, including translations and adaptations of pre-existing lists for specific localities and contexts.

Of the 22 publications analyzed in this category, most of them (14) presented level of scientific evidence I, due to the basis on systematic reviews; the other eight studies mentioned reviews, followed by expert consensus (Delphi Method), but did not indicate the performance or basis of systematic reviews.

Some of these new lists, in addition to expert reviews and opinions, were also guided by pre-existing PIM criteria, namely: Beers[18,23,30-32,35-36], Screening Tool to Alert doctors to the Right Treatment (START)[21,23,25-26,32,34], Screening Tool of Older Person's Prescriptions (STOPP)[18,21,23,25-26,28,32,34-35], The Norwegian General Practice (NORGEP)[23,31-32,35], lista Laroche criteria[23,32,35], PRISCUS[23,32], Winit-Watjana criteria[32,35], Korean and Austrian Criterai[23], McLeod criteria[32,35], The European Union (EU)(7)-PIM list[18], Rancourt criteria[35], Basger Criteria[32].

Of the total number of publications[16-17,19-20,22,24,27,29,33],37 did not mention pre-existing criteria.

Chart 1. Articles considered on PIM Lists from 2010 to 2019. Uberaba, 2021.

References	Language /Country	Type of Study	Objective	Proposal	Level of Evidence
01 - American Geriatrics Society 2019 Updated AGS Beers Criteria® for Potentially Inappropriate Medication Use in Older Adults. Griebling TL et al. – 2019[16]	en/USA	Validation by Delphi Method	Update the Beers Criteria and classify the evidence on drug-related problems (DRP) and adverse events in the elderly.	Update by a Panel of 13 Experts, incorporating new evidence to the 2015 version. Clinical guideline based on systematic reviews, generating the addition of 46 new criteria, including individual and specific. The authors reinforce the importance of non-pharmacological approaches, with emphasis on patients with dementia and delirium.	I
02 - Spanish list of potentially inappropriate drugs in the elderly (ES-PIA project). Harmand MGC et al. – 2019[17]	sp/ESP	Validation by Delphi Methodi	Develop and validate a Spanish PIM list.	Elaboration of the Spanish PIM list, by 25 specialists from different areas of geriatrics and gerontology, with questionnaires in two rounds. Of the 160 items initially proposed, 138 made up the final version, all with a strong level of agreement. It represents an important advance as it is adapted to the Spanish pharmacopoeia and prescribing habits.	VII
03 - Pain and Inflammation Management in Older Adults: A Brazilian Consensus of Potentially Inappropriate Medication and Their Alternative Therapies. Motter FR et al. – 201[18]	en/BRA	Validation by Delphi Method	Develop and validate a list of PIM and alternative therapies for the treatment of pain and inflammation in the elderly adapted to the Brazilian context.	Adaptation of three international lists to the Brazilian context, by a Panel of 9 Specialists in geriatric pharmacotherapy, with validation of 144 PIM at the end of the Consensus. It represents the update of the 1st List on Brazilian PIM, published in 2016. For two drugs, phenylbutazone and tizanidine, there was no consensus among experts even after the second round of the Delphi method.	VII
04 - Development of an Anticholinergic Burden Scale specific for Korean older adults.Jun K et al. – 2019[19]	en/KOR	Validation by Delphi Method	Develop the Korean anticholinergic load scale.	Clinical guideline based on a systematic review for the development of an anticholinergic scale, applied to drugs available in Korea. From 10 pre-existing tools, 655 drugs were initially analyzed, generating a final version with 56 drugs classified as strong, 23 moderate and 59 weak. Drugs with	I

				anticholinergic action are associated with negative health outcomes, requiring more careful medical prescriptions.	
05 - Potentially Inappropriate Prescribing to Older Patients: Criteria, Prevalence and an Intervention to Reduce It: The Prescription Peer Academic Detailing (Rx-PAD) Study - A Cluster-Randomized, Educational Intervention in Norwegian General Practice. Rognstad S et al. – 2018[20]	en/NOR	Validation by Delphi Method and large randomized cluster educational intervention	Develop the Norwegian criterion (NorGeP) on PIM and apply it in an educational intervention	Elaboration of the NorGeP, explicit criteria composed of 36 PIM, and subsequent 1-year educational intervention involving 454 general practitioners. The use of this criterion showed a prevalence rate of 24.7 MPI per 100 patients ≥70 years per year. Older physicians were the ones who most generated PIM prescriptions in the pre-study period, and were the ones who best accepted the educational intervention. Highlight for drugs with anticholinergic and antipsychotic action, and interactions resulting from combinations with warfarin and those with Non-Steroidal Anti-Inflammatory Drugs (NSAIDs).	VII
06 - Uso potencialmente inapropiado de fármacos en cuidados paliativos: versión en castellano de los criterios STOPP-Frail (STOPP-Pal). Delgado-Silveira E, et al. – 2018[21]	sp/ESP	Translation/Adaptation by Delphi Method	Present an adapted and translated version of the STOPP-Frail list into Spanish	The list adapted to Spanish through Consensus by 17 experts, called STOPP-Pal, was developed for decision-making on medications in elderly people undergoing palliative care, further clarifying the semantic confusion between frailty and palliative care. There was final consensus for 27 criteria. This translated list can contribute to improving the quality of care provided to palliative care patients in different health systems in Spain and Latin America.	VII
07 - Adequate, questionable, and inadequate drug prescribing for older adults at the end of life: a European expert consensus. Morin L, et al. – 2018[22]	en/SWE	Systematic Review and Validation by Delphi Method	Identify drugs and drug classes that are most often appropriate, questionable, or inappropriate for late-life seniors.	Clinical guideline based on a systematic review for the characterization of drugs and drug classes, by forty experts from ten different countries, at three levels of adequacy (adequate, questionable and inadequate). Among the questionable drugs, an important proportion of them is represented by anticoagulants. Forty-nine drug classes were submitted to consensus, with the final inclusion of 75% of the items presented. The work reinforces the importance of studies such as RCTs for high-quality evidence, but states that the present criteria can support important clinical decisions.	I
08 - Ingredientes Farmacéuticos Activos Potencialmente Inapropiados en Adultos Mayores: Lista IFAsPIAM: Panel de Consenso Argentino. Marzi MM, et al. – 2018[23]	en/ARG	Validation by Delphi Method	Develop/Adapt a list on PIM (Potentially Inappropriate Active Pharmaceutical Ingredients in	Clinical guideline based on a systematic review for the elaboration/adaptation of foreign lists to the Argentine context, by a Panel of 10 Experts, generating the 1st Latin American List on PIM, with validation of 128 PIM at the end of the Consensus. Medications for the Nervous System represented the largest proportion of PIM (47%), followed by the Cardiovascular and Musculoskeletal groups. The IFAsPIAM	I

			Adults Major - IFAsPIAM List) adapted to the local Argentine context.	List can contribute to the rational use of medicines in the elderly, constituting a valuable tool in Argentine public health.	
09 - Development and Application of the GheOP^{3}S-Tool Addendum on Potentially Inappropriate Prescribing (PIP) of Renally Excreted Active Drugs (READs) in Older Adults with Polypharmacy. Wazzan AAA, et al. – 2018[24]	en/BEL	Validation by Delphi Method / Retrospective cross-sectional study	Expand the Ghent Older People's Prescription community Pharmacy Screening (GheOP3 S-) tool with the first addendum for PIM screening of frequently used renally excreted active drugs (DAER) and perform a cross-sectional analysis using the addendum and history of medication of a group of elderly people with polypharmacy.	Construction/Application of the GheOP3S clinical tool, through a Panel of Experts, with 61 substances included as DAER and considered inappropriate for use in elderly people with renal failure. This tool can contribute to the reduction of inappropriate prescriptions for this group of patients, with emphasis on cases of polypharmacy (concurrent use of ≥5 medications). For glomerular filtration rate ≤ 60 mL/min, the following DAERs were considered PIM: perindopril, spironolactone, metformin, allopurinol, digoxin, indapamide, hydrochlorothiazide and potassium-sparing agents and others.	VII
10 - STOPPFrail (Screening Tool of Older Persons Prescriptions in Frail adults with limited life expectancy): consensus validation. Lavan AH, et al. – 2017[25]	en/IRL	Validation by Delphi Method	Validate the Screening Tool of Older Persons Prescriptions in Frail adults	Elaboration of the STOPPFrail list, a list of explicit criteria for the use of PIM in frail older adults with limited life expectancy (LLE), by means of a Consensus by 17 experts. Initial proposal of 30 criteria; final version with 27 criteria. This list can help physicians prescribe medication to patients with LLE.	VII

			with limited life expectancy list (STOPPRail)	This list avoided generating a generalized statement about controversial treatments, as in the case of antihypertensives, thus focusing on drugs not usually used as 1st line.	
11 - Screening Tool of Older Person's Prescriptions/Screening Tools to Alert Doctors to Right Treatment Medication Criteria Modified for U.S. Nursing Home Setting. Khodyakov D, et al. – 2017[26]	en/USA	Validation by Delphi Method	Develop a set of measurable prescribing indicators, adapted from the START-STOPP criteria and underused drugs for the USA, with a focus on nursing homes.	Clinical guideline based on a systematic review for the adaptation of the START-STOPP criteria to the USA, by a panel of 17 experts. Of the 114 criteria reviewed, 53 were considered compatible with the nursing homes in the USA, 48 of them considered valid and 24 of great clinical relevance. In the end, 22 measures of medicines were obtained related to PIM and 2 related to underused medicines. One of the highlights of this modified list is the inclusion of criteria on important clinical care for initiating annual influenza vaccinations and pneumococcal vaccination at least once if you are 65 years of age or older. These are the first explicit criteria for assessing prescribing quality in US nursing homes.	I
12 - [Criteria for defining consensus achievement in Delphi studies that assess potentially inappropriate medications in the elderly]. Marzi MM et al. – 2016[27]	en/ESP	Validation by Delphi Method	Develop criteria to define the reach of consensus in Delphi studies carried out to assess PIM in the elderly.	Construction and Validation of an index (Yq) to analyze the agreement of pairs of evaluators on MPI. Pilot study with 12 drugs evaluated by Likert scale. According to the study, three criteria guarantee the achievement of a consensus: a) Number of evaluators ≥60% of the panel members, b) Yq≥0.800; c) frequency of statistical mode ≥60%. The index considers the real distances between the Likert scale categories and the developed criteria constitute a simple tool for the analysis of the Delphi questionnaires in the evaluation of the use of PIM in the elderly.	VII
13 - Intervention to Improve Appropriate Prescribing and Reduce Polypharmacy in Elderly Patients Admitted to an Internal Medicine Unit. Urfer M, et al. – 2016[28]	en/AUS	Intervention Study	Test the effectiveness of an easy checklist to support clinicians' therapeutic reasoning to reduce inappropriate prescribing	Efficacy and safety assessment of a 5-point checklist applied by ward physicians of internal medicine, comparing the proportion of PIM prescription (based on START/STOPP criteria) and polypharmacy before and after application of the checklist in 450 patients . Reduced risk of PIM prescription by 22% and actual reduction of observed polypharmacy less than 20%. The reduction of deaths in the first 30 days after hospital discharge was one of the confirmed effects of this checklist, due to the significant reduction in the risk of PIM prescriptions at hospital discharge.	VII

			and polypharmacy		
14 - Screening Tool for Older Persons' Appropriate Prescriptions for Japanese: Report of the Japan Geriatrics Society Working Group on "Guidelines for medical treatment and its safety in the elderly". Kojima T, et al. – 2016[29]	en/JPN	Validation by Delphi Method	Update and Revise the Japanese Guidelines (2005 version), and add a comprehensive list on PIM	Clinical guideline based on systematic review for the update/revision of Japan's "Guidelines for medical treatment and its safety in the elderly 2005", including a Section on PIM, adapted to the Japanese context. Among the drugs to be carefully prescribed, the classes 'antipsychotics', 'muscarinic receptor antagonists' and NSAIDs deserve to be highlighted due to the high proportion of items mentioned. This list differs from other explicit criteria (eg, Beers and STOPP) in that it is based on a systematic review.	I
15 - 2015 updated AGS Beers Criteria offer guide for safer medication use among older adults. Counsell SR– 2015[30]	en/USA	Validation by Delphi Method	Update the Beers Criteria (2015) and classify the evidence on DRP and adverse events in the elderly	Updated by an Expert Panel, incorporating new evidence into the 2012 version. Review of over 6,700 clinical trials and research studies. Organization of recommendations into an expanded set of five lists, in addition to non-drug recommendations for nursing care. Inclusion of two additional lists: one specific to "drug-drug" interactions, and the other a summary of drugs that should be avoided or administered differently in people with kidney failure.	I
16 - The Norwegian General Practice--Nursing Home criteria (NORGEP-NH) for potentially inappropriate medication use: A web-based Delphi study. Nyborg G, et al. – 2015[31]	en/NOR	Validation by Delphi Method	Develop a set of explicit criteria for the use of PIM in nursing homes.	Development of the Norwegian General Practice – Nursing Home (NORGEP-NH) list (based on the NORGEP List), a list of 34 explicit criteria for PIM use in Norwegian nursing homes, by a Panel of 49 Experts. The NORGEP-NH list can serve as a tool in the prescribing process and drug list review and can also be used for quality assessment and research purposes. Emphasis is given to the recommendation that the term 'deprescription' be adopted internationally, and to the risk of drug combinations with NSAIDs and the combination of bisphosphonates and statins, by elderly people with EVL.	VII
17 - The development of the PROMPT (PRescribing Optimally in Middle-aged People's Treatments) criteria. Cooper AJ et al. – 2014[32]	en/GBR	Validation by Delphi Method	Develop a specific prescription instrument for the middle-aged population, containing criteria	Instrument called 'PRescribing Optimally in Middle-aged People's Treatments' (PROMPT) and developed by a panel of 17 experts in internet-based consensus. Comprised of 22 recommendations, the PROMPT addresses drugs commonly used in the UK and Ireland, and aims to explore PIM burden and associated factors, identifying prescribing patterns and predictors for potentially inappropriate drug use in this age group (45-59 years).). It represents the first criteria for this age group and needs future tests to assess its effectiveness. A	VII

			relevant to this age group	limitation of the study was the non-inclusion of drugs suitable for use under specialized care.	
18 - The St Vincent's potentially inappropriate medicines study: development of a disease-specific consensus list and its evaluation in ambulatory heart failure care. Bermingham M, et al. – 2014[33]	en/IRL	Validation by Delphi Method	Develop a list of PIM for Heart Failure (HF), the PIMHF list; to evaluate the relationship between the prescription of these PIMHF items and the clinical outcome in an outpatient HF population	Development of the PIMHF by an expert panel of 35 cardiologists, two general practitioners; four specialized nurses; and six specialist pharmacists. The final version counts 11 MPI; the medication profile of 350 patients was analyzed, and one or more Consensus PIMs were prescribed to 14.6% of these patients. The PIMHF list provides the first HF-specific drug review tool and reinforces the importance of specific MPI lists for certain clinical conditions. Of the drugs on this new list, the most prescribed to the elderly in the study were: non-dihydropyridine calcium channel blockers (n = 15, 26.3%), followed by oral corticosteroids and metformin in patients with renal dysfunction.	VII
19 - Mejorando la prescripción de medicamentos en las personas mayores: una nueva edición de los criterios STOPP-START [Improving drug prescribing in the elderly: a new edition of STOPP/START criteria]. Silveira ED et al. – 2014[34]	sp/ESP	Revision/Translation by Delphi Method	Translate a list about PIM into Spanish	Translation of the START-STOPP List (2014 version) into Spanish, through a panel of experts with geriatricians and specialized pharmacists. The translated version maintains the 87 STOPP and 34 START recommendations of the English version, and represents an advance in the quality of detection of PIM use by Hispanic-speaking professionals. The authors also reinforce that they can avoid frequent omissions (START) due to the lack of prescription drugs for cardiovascular diseases, diabetes and vitamin D calcium supplements.	VII
20 - Using published criteria to develop a list of potentially inappropriate medications for elderly patients in Taiwan. Chang CB, et al. – 2012[35]	en/TWN	Validation by Delphi Method	Describe a process for developing explicit country-specific PIM criteria	Elaboration of a list of explicit criteria on PIM based on at least three pre-existing criteria, through a Consensus by 21 experts, applied to the Taiwanese context. The final version has 24 PIM to be avoided by any elderly person (explicit criteria), in addition to 12 comorbidities associated with 6 PIM classes. Long-acting benzodiazepines and drugs with anticholinergic action received clear definitions. More prospective studies are needed to validate its use in clinical and research settings.	VII
21 - Using explicit criteria to evaluate the quality of prescribing in elderly Italian	en/USA-ITA	Validation by Delphi Method/	Establish explicit criteria for prescribing	Update of the 2002 Beers Criteria with adaptation to the Italian prescription standard, through a Consensus with nine experts, with subsequent application in the elderly at a Local Health Unit in Parma, Italy, through a retrospective cohort study. The	VII

outpatients: a cohort study. Maio V, et al. – 2012[36]		Retrospective cohort study.	PIM and assess the prevalence and factors associated with PIM, according to the criteria developed.	final version had 23 MPI, allocated into three categories, and the cohort study involved 91,741 elderly people aged ≥ 65 years, and at least one prescribed medication. 25.8% of the elderly analyzed were prescribed at least one PIM, based on these adapted criteria. As an example of the consensus results, fluoxetine, due to its long half-life and its active metabolites, was considered PIM, with its use limited to cases of failure of other therapeutic agents. The study corroborates that PIM use among outpatient elderly people is a substantial problem in this Italian locality.	
22 - Potentially inappropriate medication in geriatric patients: the Austrian consensus panel list. Mann E et al. – 2011[37]	en/AUT	Validation by Delphi Method	Develop the Austrian criterion on PIM	Elaboration of the Austrian list on PIM, by a Panel of 8 Experts in geriatric medicine, composed of 73 PIM, in addition to suggestions of therapeutic alternatives, and pharmacokinetic and pharmacological information of the listed drugs. This list can be a useful tool for clinicians to improve the quality of prescribing for the elderly, and its validity needs to be proven in validation studies.	VII

Category 2. *New Technological Tools on potentially inappropriate medicines for the elderly*

This category with 20 articles presents new technological tools on PIM, including studies aimed at the development/application/presentation of technological tools applied to the identification and support of decision-making on PIM.

Of the 20 publications analyzed, most of them (10) presented level of scientific evidence VI, as the data generated, despite the initial interventionist approach, are characterized as descriptive. Evidence levels II and VII had four publications each; level II was assigned because it was data obtained from at least one RCT and the attribution of level VII was justified by the fact that the publications presented methodological studies based on expert opinions.

Two studies were classified as level VI[43,54] because they were qualitative research, initiated by the construction of a technological tool, but with an outcome focused on the perceptions and attitudes of the interviewees.

Most of these publications (18) mentioned that their tools were based on pre-existing IPM criteria. The use of criteria in the construction of these technological tools has the following distribution: Beers (5)[39,44,50,53-54]; Beers and STOPP (4)[40,47,49,57]; Beers, STOPP-START and EU(7)-PIM(1)[46]; Beers, ACOVE, BEDNURS (1)[56]; STOP (1)[45]; START-STOPP (3)[38,41,48]; EU(7)-PIM(2)[43.55]; EU(7)PIM, FORTA, PRISCUS (1)[42]. Two studies[51-52] did not mention pre-existing PIM criteria.

The tools described in this review, which have an intervention rather than a consultation nature, are based on two main lines of action: generation of Computerized Alerts (CA) or provision of reports to support clinical decisions. Most of the tools listed (9)[39-40,45,49,51,53-54,56-57] work in this first line, generating CA and, therefore, evidencing the presence of PIM in therapies for the elderly. The second line is used by eight studies[38,41,43-44,47,50,52,55], generating reports with the presence of PIM or the recommendation to include certain drugs in the therapy, and allowing a comprehensive review of the case.

Three publications do not fit into the generation of CA or reports, namely: building a database[42], building a repository[46] and testing the applicability of an PIM algorithm to a database[48].

In some cases, these technological tools are addressed to specific groups or professionals, such as: physicians (3)[38,41,43]; assistant physicians in nursing homes (1)[56]; physicians and patients (3)[42,47,54]; medical residents in training (3)[52-54]; doctors and pharmacists (4)[40,49,53,57]. Of the 20 publications, six are not directed by the authors to any specific group[39,45-46,48,50-51].

Three publications[41,44,55] present the tools and projections for when they are applied, but do not represent studies applying them and, therefore, do not address the results achieved.

Chart 2. Articles considered on New Technological Tools on MPI from 2010 to 2019. Uberaba, 2021.

References	Language /Country	Type of Study	Objective	Proposal	Level of Evidence
01 - 'Optimising Pharmaco Therapy In the multimorbid elderly in primary CAre' (OPTICA) to improve medication appropriateness: study protocol of a cluster randomised controlled trial. Jungo KT, et al. – 2019[38]	en/CHE	Clustered ECR	Test whether the use of a systematic software-assisted drug review intervention leads to more appropriate drug use than a sham usual care intervention	Systematized review of multimorbid and polypharmacy therapy for elderly patients supported by the 'Systematic Tool to Reduce Inappropriate Prescribing'-Assistant' (STRIPA) software and underutilization assessment, involving 40 primary care units. This type of software-based review has been shown to improve decision making about appropriate therapy in multimorbid patients.	II
02 - Utilization of computerized clinical decision support for potentially inappropriate medications. Alagiakrishnan K, et al. – 2019[39]	en/CAN	Retrospective methodological/observational study	To assess the frequency of clinical interaction of medical record computerized alerts (CA) and associated prescribing behaviors in outpatient settings.	Study in two outpatient clinics for an observation period of 30 months. The performance of CA was 17.2% in both clinics, not showing clinical significance in the detection of PIM (Beers). The authors point to the phenomenon of 'alert fatigue' as the cause of the lack of clinical impact of these tools. The potential for low-cost impact points to the relevance of further studies	VI
03 - A pharmacist-physician intervention model using a computerized alert system to reduce high-risk medication use in primary care.	en/CAN	Intervention Study	To assess the applicability of an interdisciplinary pharmacist-physician intervention model to reduce the use of high-risk drugs and the clinical relevance of CA.	Knowledge translation strategy, implemented by a family health team including a medical-pharmaceutical intervention model based on CA. One or more alerts were clinically significant for 42% of patients. This intervention proved to be efficient in reducing the use of high-risk drugs in hospitalized elderly patients.	VI

Cossette B, et al. – 2019[40]					
04 - The effect of SENATOR (Software ENgine for the Assessment and optimisation of drug and non-drug Therapy in Older peRsons) on incident adverse drug reactions (ADRs) in an older hospital cohort - Trial Protocol. Lavan AH, et al. – 2019[41]	en/IRL	RCT (multinational, pragmatic, parallel-arm, prospective, open, blind endpoint)	To evaluate the effect of the Software ENgine for the Assessment and optimization of drug and non-drug Therapy in Older persons (SENATOR) in adverse drug reactions (ADRs) in elderly, multimorbid and hospitalized patients	Software evaluation that produces reports that optimize prescriptions for elderly patients, highlighting drug-drug and drug-disease interactions and providing non-pharmacological recommendations aimed at reducing the risk of incident delirium. This is the first clinical trial to examine the effectiveness of a software intervention on ADR incidents and associated health care costs during hospitalization in older adults with multimorbidity and polypharmacy. This publication presents the study's projections, but does not disclose results yet.	II
05 - Data-Driven Assessment of Potentially Inappropriate Medication in the Elderly. Friedrichs M, et al. – 2018[42]	en/DEU	Methodological Study	Develop database on PIM (PIMBase)	Development tool that integrates well-known PIM lists and unifies their rating scales. The benefits of this combination of lists are supported by pharmacovigilance data. PIMBase allows identification of PIM and is based on the address: https://pimbase.kalis-amts.de.	VII
06 - Reduction of inappropriate medication in older populations by electronic decision support (the PRIMA-eDS study): a qualitative study of practical implementation	en/DEU	Validation/Qualitative Study	Explore the use of the 'Polypharmacy in chronic diseases– Reduction of Inappropriate Medication and Adverse drug events in older populations' (PRIMA) tool for	Conducting interviews with 21 physicians using the PRIMA-eDS tool. This tool seeks to reduce the use of PIM in elderly patients with polypharmacy. After entering prescription-relevant patient data into an electronic case report form, the physician receives a comprehensive medication review with recommendations on missing indications, laboratory tests needed, evidence base of current medication, dose adjustments for dysfunction impairment, potentially harmful drug interactions, contraindications, and possible adverse drug events. The present qualitative validation concludes that the use of this tool in the future is unfeasible due to the delay in entering patient data in the form.	VI

in primary care. Rieckert A, et al. – 2018[43]			evidence-based electronic decision support (eDS), analyzing attitudes and perceptions physicians, to optimize the tool and prepare it for future implementation.		
07 - A Cloud Based Potentially Inappropriate Medication Management System Using Patient Owned Personal Health Records. Lee HÁ, et al. – 2018[44]	en/TWN	Methodological Study	Design a cloud-based personal health management platform ("My Health Bank").	Development of a platform that allows the analysis and storage of information in two databases, one for the health insurance medication table and the other for the PIM. The authors believe that this tool will increase medication safety and improve the self-reliance management of the elderly. This publication presents the study's projections, but does not disclose results yet.	VI
08 - Polimedication: applicability of a computer tool to reduce polypharmacy in nursing homes. García-Caballero TM, et al. – 2018[45]	en/ESP	Methodological Study / Observational Retrospective	Assess the effect of therapeutic alerts on PIM detection	Processing of medical prescriptions from 115 institutionalized elderly people in a nursing home to assess the generation of therapeutic alerts about PIM in order to minimize analysis time. Of the total number of alerts (average: 10.04 alerts/patient), 12.12% were considered relevant, with a time spent of 6.26min/patient and savings of €32.77 per resident/year on medications. The use of this tool provided significant savings in pharmaceutical expenses, in addition to reducing medication review time.	VI
09 - European repository of explicit criteria of potentially inappropriate medications in old age. Ivanova I, et al. – 2018[46]	en/BEL	Methodological Study	Build a European repository of explicit PIM criteria suitable for electronic assessment	Construction of a repository contemplating the description of the PIM, drug information, clinical information and the level of evidence. It was possible to insert most of the original criteria from three selected PIM lists in the repository. The authors hope that in the future, developers of new PIM lists will take semantic interoperability into account and consider the suitability of the criteria for electronic use.	VI

10 - Effect of the Tool to Reduce Inappropriate Medications on Medication Communication and Deprescribing. Fried TR, et al. – 2017[47]	en/USA	RCT	To examine the effects of the Tool to Reduce Inappropriate Medication (TRIM) in reducing PIM use and shared decision making.	Evaluation of a web tool that connects an electronic medical record to a clinical decision support system, with an emphasis on communication and medication prescription. These automated algorithms identify discrepancies in medication reconciliation, PIM, and potentially inappropriate regimens. The authors point out that the association of this tool with electronic medical records improved shared decision-making and reduced medication reconciliation errors, but did not change the prescription.	II
11 - Application of the STOPP/START criteria to a medical record database. Nauta KJ, et al. – 2017[48]	en/NLD	Intervention Study	Test computer algorithms to apply PIM criteria to a medical records database.	Application of computer algorithms based on the STOPP/START criteria and defined by the Anatomical-Therapeutic-Chemical codes, to a Dutch primary care database, with patients aged ≥65 years using ≥5 chronic drugs and coded diagnoses International Classification Codes for Primary Care (ICPC). In total, 65% of the criteria could be converted into a computer algorithm. The inapplicability of the other criteria resulted from the lack of information on the severity of a condition and the insufficient coverage of ICPC codes.	VI
12 - Reduction in targeted potentially inappropriate medication use in elderly inpatients: a pragmatic randomized controlled trial. Cossette B, et al. – 2017[49]	en/CAN	RCT	To assess change in MPI use with an AC-based pharmacist-physician intervention model compared to usual clinical care.	Single-site RCT through CA based on two PIM criteria. The primary endpoint was cessation of PIM or dose reduction. A significantly higher number (absolute difference of 30% 48h after use of alerts) of interruption and reduction of PIM dosage was observed in the intervention group.	II
13 - Quality of Provider Practices for Older Adults in the Emergency Department (EQUiPPED).	en/USA	Intervention Study	Assess the effectiveness and sustainability of the Enhancing Quality of Provider Practices for Older Adults in the Emergency	Educational intervention (didactic lectures) and clinical decision support (with PIM criteria) based on informatics, with drug order sets embedded in electronic medical records, dose adjustments for renal failure, PIM prescribing guidance and links to content synthesized geriatric. The proportion of PIM use dropped from 11.9% to 5.1% (pre and post intervention). The authors classified the intervention as sustainable and stated that a multicomponent program has an influence	VII

Stevens M, et al. – 2017[50]			Department initiative (EQUIPPED) to reduce MPI usage	on the generation of safer prescriptions for elderly people who are discharged from the emergency room.	
14 - Evaluating the Impact of Medication Safety Alerts on Prescribing of Potentially Inappropriate Medications for Older Veterans in an Ambulatory Care Setting. Vanderman AJ, et al. – 2017[51]	en/USA	Intervention Study	Assess changes in PIM prescribing in pre-implementation and post-implementation of CA.	AC-based intervention to reduce PIM prescription, with 1539 pre-alert patients and 1490 post-alert patients; 1952 and 1897 PIM prescribed, respectively. There was no significant difference in the rate of new pre-alert and post-alert PIMs overall, but there was a significant reduction in the rate of the 10 most common newly prescribed PIMs, from 9.0% to 8.3% (P = 0.016). The study concludes that CA use may decrease the incidence of more frequently prescribed PIM in older adults who receive care in an outpatient setting.	VI
15 - PIM-Check: development of an international prescription-screening checklist designed by a Delphi method for internal medicine patients. Desnoyer A, et al. – 2017[52]	en/CHE	Validation by Delphi Method	Develop an electronic prescription screening checklist	Development of an electronic tool, based on literature review, semi-structured interviews and consensus by 40 physicians and 25 clinical pharmacists. The final checklist includes 160 statements; 17 medical domains; 56 pathologies; algorithm of approximately 31,000 lines was developed. PIM-Check is the first electronic prescription screening checklist designed to detect PIM in internal medicine.	VII
16 - Knowledge Translation Strategy to Reduce the Use of Potentially Inappropriate Medications in Hospitalized Elderly Adults.	en/CAN	Intervention Study	To evaluate the effect of a knowledge translation (kt) strategy to reduce PIM use in hospitalized elderly.	Intervention based on the distribution of educational materials, presentations by geriatricians, medical-pharmaceutical interventions by CA and comprehensive geriatric assessments. A 3.5% (P<0.001) absolute decrease in patient-days with at least one PIM was observed immediately after the intervention. The authors point out that this strategy resulted in a decrease in the use of PIM in elderly adults in the hospital.	VII

Cossette B, et al. – 2016[53]					
17 - Physicians' use of computerized clinical decision supports to improve medication management in the elderly - the Seniors Medication Alert and Review Technology intervention. Alagiakrishnan K, et al. – 2016[54]	en/CAN	Intervention Study	Create an AC of physician-acceptable medications and deploy them into an outpatient Electronic Medical Record (EMR); and figure out how to deploy this tool with the least disruption to the workflow and the most attention from the clinician.	Pre-production, development and post-production optimization of an electronic medical clinical decision support tool embedded in electronic medical records (with criteria on PIM) and Cockcroft-Gault formula to estimate glomerular filtration rates (GFR). The "Seniors Medication Alert and Review Technologies" (SMART) intervention generates chart messages and order entry alerts, exposing MPI, decreased GFR, and the possible need for medication adjustments. About 36% of eligible cases triggered at least one SMART alert, with a GFR alert, with ~25% of alerts ignored and ~15% generating evidence verification. This tool has proven acceptable to specialist and primary care physicians, with no significant negative impacts on workflow.	VII
18 - Polypharmacy in chronic diseases-Reduction of Inappropriate Medication and Adverse drug events in older populations by electronic Decision Support (PRIMA-eDS): study protocol for a randomized controlled trial. Sönnichsen A, et al. – 2016[55]	en/DEU	Methodological study/RCT	Develop the PRIMA-eDS tool to help clinicians reduce inappropriate prescribing and test its effectiveness in a large-scale RCT.	Construction and effectiveness testing of the PRIMA-eDS tool that comprises an indication check and recommendations for polypharmacy and PIM reduction based on systematic reviews and guidelines on PIM, SFINX interactions database, PHARAO database on adverse effects and RENBASE database on renal dosage. The tool was built, and the RCT designed (3500 patients and 325 general practitioners involved). The main hypothesis is that reduced polypharmacy and inappropriate prescribing can reduce hospitalizations or deaths. This publication presents the study's projections, but does not disclose results yet.	II
19 - Quality of prescribing in Belgian nursing	en/BEL	Methodological/cross-sectional	Develop a computerized assessment tool to	Development of an electronic tool for the detection of PIM use and underused medications by elderly residents in nursing homes by combining three PIM criteria and a list of drug interactions. Most PIMs	VI

homes: an electronic assessment of the medication chart. Elseviers MM, et al. – 2014[56]		observational study	monitor the quality of prescribing in Belgian nursing homes.	were detected by the ACOVE criteria for underutilization with 58% of patients having at least one PIM. Using the BEDNURS and Beers criteria, at least one PIM was observed in 56% and 27% of patients, respectively. The study concludes that the development of a combined assessment tool and the implementation of a computerized PIM monitoring system is highly recommended to improve care in nursing homes.	
20 - Electronic surveillance and pharmacist intervention for vulnerable older inpatients on high-risk medication regimens. Peterson JF, et al. – 2014[57]	en/USA	Intervention study (pilot)	Develop and evaluate an electronic tool to assist clinical pharmacists in reviewing PIM in hospitalized older adults	Development and application of computerized panel on PIM. There was signaling of subjects with at least one administered PIM or a high calculated anticholinergic score. The panel also displayed the cumulative administration of narcotics and benzodiazepines over 48 hours. Intervention applied to elderly people (≥65 years) admitted to general medicine, orthopedics and urology services for 3 weeks in 2011. After the intervention, 22% of patients had signs of using at least one PIM and physicians approved 78% of the recommendations subsequent pharmaceuticals. This tool allowed clinical pharmacists to quickly review the medication regimens of hospitalized older adults and provide a timely point-of-care intervention when indicated.	VII

DISCUSSION

The use of medicines by the elderly is increasingly attracting the interest of scientific investigations, which is easy to understand – one of the main therapeutic resources today and the age group with the highest growth rate. In turn, there is irrational use, with consequent risks. This scenario shows the need for more information and more tools to be made available, in order for the elderly to benefit from their drug therapies with the highest possible level of safety.

The search for updating through a comprehensive analysis of scientific publications is shown to be one of the most acceptable and promising ways, allowing to know successful initiatives that can be reproduced, and others that are not so successful, but which, even so, become data and point out what not to do.

The classification of findings into two thematic categories allowed a clearer analysis of two important aspects on the PIM theme; the first, presenting the state of the art regarding the new lists of drugs that pose risks to the elderly, in addition to adaptations for local contexts, for subgroups or for specific clinical conditions. The second category presents scientific efforts for new tools to reach the field of practice, promoting the integration of health care for the elderly, safe drug therapy and ways to educate professionals and patients.

There were efforts by several countries to develop or adapt PIM criteria for their contexts. One of the reasons for these local initiatives is that many drugs on important international lists may be unavailable in certain countries. This scenario was observed in Brazil, where only 60% of the drugs mentioned in the Beers criterion are marketed in the country, based on the National List of Essential Medicines (2013), creating a bias in the results of several Brazilian studies[58].

In addition to the search for specific lists for the elderly in each country or region, the elaboration of a list for subgroups was observed. This is the case of the Norwegian list NORGEP NH31, adapted from the national list (NORGEP[20]) on PIM, and aimed at institutionalized elderly people. This initiative was motivated after a Norwegian study pointed out the high prevalence of PIM use (31% of the analyzed population) in nursing homes[59]. A similar adaptation involved the START-STOPP criteria for institutionalized North American elderly people[26], which explains the existence of subgroups within special age groups, such as the elderly.

In the relevance of special subgroups contained in the large group of elderly, three other subgroups should be highlighted: elderly in palliative care[21], elderly with HF[33] and elderly with renal failure[24]. The elaboration of lists on specific PIM such as these demonstrate the scope of

the theme and the need for continuous innovations so that various developments can be studied.

As for studies that showed clinical convergence, two publications[22,25] agreed to discontinue anticoagulants in elderly people with limited life expectancy, as the risk of bleeding and the cost of treatment outweighed the potential benefits for patients, but recommended the analysis of specific cases, as the risk of stroke.

One of the publications[30] addresses the relevance of geriatric nursing care in patients with 'behavioral problems', avoiding the use of antipsychotics, except in cases of inefficiency of non-pharmacological measures, or risks to the patient or others. Although nursing has a fundamental role in the provision of care and in detecting the use of PIM, only one study[33], aimed at the elderly with HF, had specialized nurses in the composition of its panel of experts, which signals the need for greater appreciation of the inter and transdisciplinary work.

Regarding Category 2, in general terms, all the technological tools listed aim at some aspect related to the use or detection of PIM in the elderly, characterized as individuals aged ≥65 years. Only one study[32] addressed an age group transitioning to senescence, that of middle-aged individuals (defined as age between 45 and 64 years), indicating the existence of evidence[60] that multimorbidity is also prevalent in this group, but so far, studies related to PIM have been little considered for these individuals.

In this category, there was a case of cumulative scientific contribution related to the PRIMA-eDS tool, aimed at reducing PIM prescriptions. The first publication[55] presents the construction of this tool and designs an ECR; the second publication[43] is a qualitative study on the attitudes and perceptions of assistant physicians who used the tool in their clinical practices. Although the tool is considered capable of generating clinical reports and recommendations of great scope and quality, the qualitative validation this study showed that the physicians interviewed found it unfeasible to apply the tool in question in their practices, due to the delay in entering patient data in the form[43].

Cumulative contributions such as this one reinforce the importance of new investigative findings in the construction of knowledge and overcoming gaps and, although a tool can be discarded after the judgment of practical infeasibility, a lot of knowledge is generated by its development and tests, contributing to future successes.

The analysis of the technological tools of this review reveals another important data; although there are at least three professional groups that work directly with drug therapies in clinical practice, only two of these groups had tools aimed at the best performance of their

work: physicians, including medical residents, and pharmacists, with no mention of nurses in any of the publications.

The construction of tools that signal the risks of drug therapy for the elderly also for nurses can represent a big step towards greater safety and rational use of medicines in this public. Analyzing the profile and purpose, it is evident, as in the case of the STRIPA[38], SENATOR[41], PRIMA-eDS[43] and TRIM[47] tools, an important power of detection and decision support for physicians and pharmacists about PIM prescription. However, none of these tools was able to reach the role of nursing in the reception of elderly patients, aiming at the detection of PIM in the first stage of the care itinerary.

It is worth noting the insignificant participation of Latin American countries in international publications on the PIM theme, with emphasis on Brazil, with only one study found focused on Category 1. This finding is consistent with the report Science and Engineering Indicators 2020[61], by the National Science Foundation (USA), and presented by Pesquisa FAPESP magazine, which shows that Brazil, despite having advanced six positions between 2000 and 2018, occupies the 11th position in the ranking of countries that produce the most international scientific publications, in a list led by China, followed by the USA and India.

This review highlights the importance of continually drawing up new lists on PIM, ensuring compatibility with specific contexts and the availability of medications in each location, in addition to showing that the technological tools applied to the safety of medication use in the elderly can be improved, with emphasis on usability and inclusion of a larger audience of users, including nurses.

Two possible knowledge gaps were also found; the first one is the lack of a list on PIM applied to obese elderly people, justified by the possibility of body deposits of certain active principles, it is worth noting that aging, analyzed separately, causes a reduction of 20 to 30% in muscle mass (sarcopenia) and bone mass (osteopenia/osteoporosis)[62], and a 20 to 30% increase in total body fat (2 to 5%/decade, after age 40)[63].

The second gap refers to technological tools that allow the outpatient evaluation of signs and symptoms in elderly patients, and that establish a possible causal relationship with the use of PIM. A tool of this nature can contribute to quick assessments in medical, nursing and pharmaceutical consultations in Primary Health Care, minimizing aggravations resulting from the non-detection of PIM use.

CONCLUSION

This study identified that there is an important national and international movement focused on the elaboration and adaptation of lists on PIM applied to specific countries, populations and subgroups. New technological tools for detecting and evaluating PIM follow a trend of development and improvement, and make evident the need for these efforts to continue.

This review also identified initiatives to expand access to PIM information, such as building large databases and repository with simplified access for professionals and patients.

The sum of these initiatives builds, gradually and cumulatively, a scenario of greater safety for the elderly in their drug therapies, whether in primary health care environments or hospitals with greater technological density, in addition to adding important educational value by allowing, in many cases, the possibility of updating for future health professionals.

As limitations, there was the non-use of databases such as the Web of Science and CINAHL, the latter specific to nursing, and the non-inclusion of languages other than Portuguese, English and Spanish. In turn, the present study brings evidence and new contributions on the PIM theme, through the analysis of publications with varied methodological designs, in addition to covering works published around the world.

REFERENCES

1. Instituto Brasileiro de Geografia e Estatística. Projeções populacionais 2010-2050 [Internet]. Rio de Janeiro: IBGE; 2008. [cited in 05 Apr 2021]. Available from: https://www.ibge.gov.br/apps/populacao/projecao/index.html
2. Instituto Brasileiro de Geografia e Estatística. Projeção da população do Brasil por sexo e idade: 2000-2060 [Internet]. Rio de Janeiro: IBGE; 2013. [cited in 05 Apr 2021]. Available from: https://ftp.ibge.gov.br/Projecao_da_Populacao/Projecao_da_Populacao_2013/nota_metodologica_2013.pdf
3. Ramos LR, Tavares NU, Bertoldi AD, Farias MR, Oliveira MA, Luiza VL, Pizzol TD, Arrais PS, Mengue SS. Polypharmacy and polymorbidity in older adults in Brazil: a public health challenge. Rev Saúde Pública [Internet]. 2016 Dec [cited in 05 Apr 2021]; 50(Suppl2):9s. DOI: 10.1590/S1518-8787.2016050006145
4. Vrdoljak D, Borovac JA. Medication in the elderly - considerations and therapy prescription guidelines. Acta Med Acad. [Internet]. 2015 [cited in 07 Apr 2021]; 44(2):159-68. DOI: 10.5644/ama2006-124.142
5. Oliveira MG, Amorim WW, Borja-Oliveira CR de, Coqueiro HL, Gusmão LC, Passos LC. Consenso brasileiro de medicamentos potencialmente inapropriados para idosos. Geriatr, Gerontol Aging. [Internet]. 2016 [cited in 07 Apr 2021]; 10(4):1-14. DOI: http://dx.doi.org/10.5327/Z2447-211520161600054
6. Stockl KM, Le L, Zhang S, Harada AS. Clinical and economic outcomes associated with potentially inappropriate prescribing in the elderly. Am J Manag Care. [Internet]. 2010 Jan [cited in 07 Apr 2021]; 16(1):e1-10. Available from: https://www.ajmc.com/view/ajmc_2010jan_stocklweb_e1_e10

7. Page RL 2nd, Linnebur SA, Bryant LL, Ruscin JM. Inappropriate prescribing in the hospitalized elderly patient: defining the problem, evaluation tools, and possible solutions. Clin Interv Aging. [Internet]. 2010 Apr [cited in 07 Apr 2021]; 5:75-87. DOI: 10.2147/cia.s9564
8. Mimica Matanović S, Vlahovic-Palcevski V. Potentially inappropriate medications in the elderly: a comprehensive protocol. Eur J Clin Pharmacol. [Internet]. 2012 Aug [cited in 08 Apr 2021]; 68(8):1123-38. DOI: 10.1007/s00228-012-1238-1
9. Kaur S, Mitchell G, Vitetta L, Roberts MS. Interventions that can reduce inappropriate prescribing in the elderly: a systematic review. Drugs Aging. [Internet]. 2009 [cited in 08 Apr 2021]; 26(12):1013-28. DOI: 10.2165/11318890-000000000-00000
10. Onda M, Imai H, Takada Y, Fujii S, Shono T, Nanaumi Y. Identification and prevalence of adverse drug events caused by potentially inappropriate medication in homebound elderly patients: a retrospective study using a nationwide survey in Japan. BMJ Open [Internet]. 2015 Aug [cited in 08 Apr 2021]; 5(8):e007581. DOI: 10.1136/bmjopen-2015-007581
11. Souza MT, Silva MD, Carvalho R. Integrative review: what is it? How to do it?. Einstein (São Paulo) [Internet]. 2010 [cited in 21 July 2021]; 8(1):102-106. DOI: https://doi.org/10.1590/S1679-45082010RW1134
12. Saunders H, Vehvilainen-Julkunen K. Nurses' evidence-based practice beliefs and the role of evidence-based practice mentors at University Hospitals in Finland. WorldViews Evid Based Nurs. [Internet]. 2017 [cited in 08 Apr 2021]; 14(1):35-45. Available from: https://sigmapubs.onlinelibrary.wiley.com/doi/abs/10.1111/wvn.12189
13. Barría RM. Implementing Evidence-Based Practice: a challenge for the nursing practice. Invest Educ Enferm. [Internet]. 2014 May/Aug [cited in 08 Apr 2021]; 32(2):191-93. Available from: http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0120-53072014000200001
14. Melnyk BM, Fineoutoverholt E. Making the case for evidence-based practice. Philadelphia: Lippincott Willians Wilkins;2005. Evidence-based practice in nursing & healthcare: a guide to best practice. p. 324.
15. Nóbrega OT, Karnikowski MGO. A terapia medicamentosa no idoso: cuidados na medicação. Ciênc. Saúde Colet. [Internet]. 2005 abr [cited in 03 May 2020]; 10(2):309-13. DOI: https://doi.org/10.1590/S1413-81232005000200008
16. American Geriatrics Society. American Geriatrics Society 2019 Updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. J Am Geriatr Soc. [Internet]. 2019 [cited in 20 May 2021]; 67(4):674-94. DOI: 10.1111/jgs.15767
17. Harman Gonzalez-Colaço M, Aldea-Perona AM, Boada-Fernández Del Campo C, Areosa-Sastre A, Rodríguez-Jiménez C, García Sánchez-Colomer M, et al. Spanish list of potentially inappropriate drugs in the elderly (ES-PIA project). Eur J Clin Pharmacol. [Internet]. 2019 Aug [cited in 20 May 2021]; 75(8):1161-76. DOI: 10.1007/s00228-019-02684-3
18. Motter FR, Hilmer SN, Paniz VMV. Pain and inflammation management in older adults: a brazilian consensus of potentially inappropriate medication and their alternative therapies. Front Pharmacol. [Internet]. 2019 Dec [cited in 20 May 2021]; 10:1408. DOI: 10.3389/fphar.2019.01408
19. Jun K, Hwang S, Ah YM, Suh Y, Lee JY. Development of an anticholinergic burden scale specific for korean older adults. Geriatr Gerontol Int. [Internet]. 2019 Jul [cited in 21 May 2021]; 19(7):628-34. DOI: 10.1111/ggi.13680
20. Rognstad S, Brekke M, Gjelstad S, Straand J, Fetveit A. Potentially Inappropriate prescribing to older patients: criteria, prevalence and an intervention to reduce it: the Prescription Peer Academic Detailing (Rx-PAD) study - a cluster-randomized, educational intervention in norwegian general practice. Basic Clin Pharmacol Toxicol. [Internet]. 2018 Oct [cited in 21 May 2021]; 123(4):380-91. DOI: 10.1111/bcpt.13040

21. Delgado-Silveira E, Mateos-Nozal J, Muñoz MG, Rexach LC, Vélez-Díaz-Pallarés M, Albeniz JL, et al. Uso potencialmente inapropriado de fármacos en cuidados paliativos: versión en castellano de los criterios STOPP-Frail (STOPP-Pal). Rev Esp Geriatr Gerontol. [Internet]. 2018 [cited in 25 May 2021]. Available from: https://pesquisa.bvsalud.org/portal/resource/pt/ibc-188963
22. Morin L, Laroche ML, Vetrano DL, Fastbom J, Johnell K. Adequate, questionable, and inadequate drug prescribing for older adults at the end of life: a European expert consensus. Eur J Clin Pharmacol. [Internet]. 2018 [cited in 25 May 2021]; 74(10):1333-42. DOI: 10.1007/s00228-018-2507-4
23. Marzi MM, Pires MS, Quaglia NB. Ingredientes farmacéuticos activos potencialmente inapropiados en adultos mayores: Lista IFAsPIAM: Panel de Consenso Argentino. Value Health Reg Issues [Internet]. 2018 [cited in 25 May 2021]; 17:38-55. Available from: https://www.valuehealthregionalissues.com/article/S2212-1099(18)30003-7/pdf
24. Wazzan AAA, Tommelein E, Foubert K, Bonassi S, Onder G, Somers A, et al. Development and application of the GheOP^{3}S-Tool addendum on Potentially Inappropriate Prescribing (PIP) of Renally Excreted Active Drugs (READs) in older adults with polypharmacy. Drugs Aging [Internet]. 2018 [cited in 25 May 2021]; 35(4):343-64. DOI: 10.1007/s40266-018-0530-x
25. Lavan AH, Gallagher P, Parsons C, O'Mahony D. STOPPFrail (Screening Tool of Older Persons Prescriptions in Frail adults with limited life expectancy): consensus validation. Age Ageing [Internet]. 2017 Jul [cited in 26 May 2021]; 46(4):600-7. DOI: 10.1093/ageing/afx005
26. Khodyakov D, Ochoa A, Olivieri-Mui BL, Bouwmeester C, Zarowitz BJ, Patel M, et al. Screening tool of older person's prescriptions/screening tools to alert doctors to right treatment medication criteria modified for U.S. Nursing Home setting. J Am Geriatr Soc. [Internet]. 2017 Mar [cited in 26 May 2021]; 65(3):586-91. DOI: 10.1111/jgs.14689
27. Marzi MM, Pires M, Quaglia N. [Criteria for defining consensus achievement in Delphi studies that assess potentially inappropriate medications in the elderly]. Rev Fac Cien Med Univ Nac Cordoba [Internet]. 2016 [cited in 26 May 2021]; 73(2):90-7. Available from: https://pubmed.ncbi.nlm.nih.gov/27420143/
28. Urfer M, Elzi L, Dell-Kuster S, Bassetti S. Intervention to improve appropriate prescribing and reduce polypharmacy in elderly patients admitted to an Internal Medicine Unit. PLoS One [Internet]. 2016 Nov [cited in 27 May 2021]; 11(11):e0166359. DOI: 10.1371/journal.pone.0166359
29. Kojima T, Mizukami K, Tomita N, Arai H, Ohrui T, Eto M, et al. Working group on guidelines for medical treatment and its safety in the elderly. Screening tool for older persons' appropriate prescriptions for japanese: report of the Japan Geriatrics Society Working Group on "Guidelines for medical treatment and its safety in the elderly". Geriatr Gerontol Int. [Internet]. 2016 Sep [cited in 27 May 2021]; 16(9):983-1001. DOI: 10.1111/ggi.12890
30. Counsell SR. 2015 updated AGS Beers Criteria offer guide for safer medication use among older adults. Geriatr Nurs. [Internet]. 2015 Nov/Dec [cited in 27 May 2021]; 36(6):488-9. DOI: 10.1016/j.gerinurse.2015.10.010
31. Nyborg G, Straand J, Klovning A, Brekke M. The Norwegian General Practice-Nursing Home criteria (NORGEP-NH) for potentially inappropriate medication use: A web-based Delphi study. Scand J Prim Health Care [Internet]. 2015 Jun [cited in 27 May 2021];33(2):134-41. DOI: 10.3109/02813432.2015.1041833
32. Cooper JA, Ryan C, Smith SM, Wallace E, Bennett K, Cahir c, et al. The development of the PROMPT (PRescribing Optimally in Middle-aged People's Treatments) criteria. BMC Health Serv Res. [Internet]. 2014 [cited in 28 May 2021]; 14:484. DOI: https://doi.org/10.1186/s12913-014-0484-6
33. Bermingham M, Ryder M, Travers B, Edwards N, Lalor L, Kelly D, et al. The St Vincent's potentially inappropriate medicines study: development of a disease-specific consensus list

and its evaluation in ambulatory heart failure care. Eur J Heart Fail. [Internet]. 2014 Aug [cited in 28 May 2021]; 16(8):915-22. DOI: 10.1002/ejhf.132
34. Delgado Silveira E, Montero Errasquín B, Muñoz García M, Vélez-Díaz-Pallarés M, Lozano Montoya I, Sánchez-Castellano C, et al. [Improving drug prescribing in the elderly: a new edition of STOPP/START criteria]. Rev Esp Geriatr Gerontol. [Internet]. 2015 Mar/Apr [cited in 28 May 2021]; 50(2):89-96. DOI: 10.1016/j.regg.2014.10.005
35. Chang CB, Yang SY, Lai HY, Wu RS, Liu HC, Hsu HY, et al. Using published criteria to develop a list of potentially inappropriate medications for elderly patients in Taiwan. Pharmacoepidemiol Drug Saf. [Internet]. 2012 Dec [cited in 28 May 2021]; 21(12):1269-79. DOI: 10.1002/pds.3274
36. Maio V, Del Canale S, Abouzaid S; GAP Investigators. Using explicit criteria to evaluate the quality of prescribing in elderly Italian outpatients: a cohort study. J Clin Pharm Ther. [Internet]. 2010 Apr [cited in 28 May 2021]; 35(2):219-29. DOI: 10.1111/j.1365-2710.2009.01094.x.ID: 20456742
37. Mann E, Böhmdorfer B, Frühwald T, Roller-Wirnsberger RE, Dovjak P, Dückelmann-Hofer C, et al. Potentially inappropriate medication in geriatric patients: the Austrian consensus panel list. Wien Klin Wochenschr. [Internet]. 2012 Mar [cited in 29 May 2021]; 124(5-6):160-9. DOI: 10.1007/s00508-011-0061-5
38. Jungo KT, Rozsnyai Z, Mantelli S, Floriani C, Löwe AL, Lindemann F, et al. 'Optimising PharmacoTherapy In the multimorbid elderly in primary CAre' (OPTICA) to improve medication appropriateness: study protocol of a cluster randomised controlled trial. BMJ Open [Internet]. 2019 [cited in 22 May 2021]; 9:e031080. DOI: 10.1136/bmjopen-2019-031080
39. Alagiakrishnan K, Ballermann M, Rolfson D, Mohindra K, Sadowski CA, Ausford A, et al. Utilization of computerized clinical decision support for potentially inappropriate medications. Clin Interv Aging [Internet]. 2019 Apr [cited in 22 May 2021]; 14:753-62. DOI: 10.2147/CIA.S192927
40. Cossette B, Taseen R, Roy-Petit J, Villemure MP, Grondin M, Ricard G, et al. A pharmacist-physician intervention model using a computerized alert system to reduce high-risk medication use in primary care. Eur J Clin Pharmacol. [Internet]. 2019 Jul [cited in 22 May 2021]; 75(7):1017-23. DOI: 10.1007/s00228-019-02660-x
41. Lavan AH, O'Mahony D, Gallagher P, Fordham R, Flanagan E, Dahly D, et al. The effect of SENATOR (Software ENgine for the Assessment and optimisation of drug and non-drug Therapy in Older peRsons) on incident adverse drug reactions (ADRs) in an older hospital cohort - Trial Protocol. BMC Geriatr. [Internet]. 2019 Feb [cited in 23 May 2021]; 19(1):40. DOI: 10.1186/s12877-019-1047-9
42. Friedrichs M, Shoshi A, Kleine M. Data-driven assessment of potentially inappropriate medication in the elderly. Stud Health Technol Inform. [Internet]. 2018 [cited in 23 May 2021]; 253:125-9. Available from: https://pubmed.ncbi.nlm.nih.gov/30147056/
43. Rieckert A, Sommerauer C, Krumeich A, Sönnichsen A. Reduction of inappropriate medication in older populations by electronic decision support (the PRIMA-eDS study): a qualitative study of practical implementation in primary care. BMC Fam Pract. [Internet]. 2018 Jul [cited in 23 May 2021]; 19(1):110. DOI: 10.1186/s12875-018-0789-3
44. Lee HA, Chao LR, Rau HH, Yang SD, Hsu CY. A cloud based potentially inappropriate medication management system using patient owned personal health records. Stud Health Technol Inform. [Internet]. 2018 [cited in 23 May 2021]; 250:208-12. Available from: https://pubmed.ncbi.nlm.nih.gov/29857437/
45. García-Caballero TM, Lojo J, Menéndez C, Fernández-Álvarez R, Mateos R, Garcia-Caballero A. Polimedication: applicability of a computer tool to reduce polypharmacy in nursing homes. Int Psychogeriatr. [Internet]. 2018 Jul [cited in 23 May 2021]; 30(7):1001-8. DOI: 10.1017/S1041610217002411

46. Ivanova I, Elseviers M, Wauters M, Christiaens T, Vander Stichele R. European repository of explicit criteria of potentially inappropriate medications in old age. Geriatr Gerontol Int. [Internet]. 2018 Aug [cited in 27 May 2021]; 18(8):1293-97. DOI: 10.1111/ggi.13331
47. Fried TR, Niehoff KM, Street RL, Charpentier PA, Rajeevan N, Miller PL, et al. Effect of the Tool to Reduce Inappropriate Medications on Medication Communication and Deprescribing. J Am Geriatr Soc. [Internet]. 2017 Oct [cited in 27 May 2021]; 65(10):2265-71. DOI: 10.1111/jgs.15042
48. Nauta KJ, Groenhof F, Schuling J, Hugtenburg JG, van Hout HPJ, Haaijer-Ruskamp FM, et al. Application of the STOPP/START criteria to a medical record database. Pharmacoepidemiol Drug Saf. [Internet]. 2017 [cited in 27 May 2021]; 26(10):1242-47. DOI: 10.1002/pds.4283
49. Cossette B, Éthier JF, Joly-Mischlich T, Bergeron J, Ricard G, Brazeau S, et al. Reduction in targeted potentially inappropriate medication use in elderly inpatients: a pragmatic randomized controlled trial. Eur J Clin Pharmacol. [Internet]. 2017 Oct [cited in 27 May 2021]; 73(10):1237-45. DOI: 10.1007/s00228-017-2293-4
50. Stevens M, Hastings SN, Markland AD, Hwang U, Hung W, Vandenberg AE, et al. Enhancing Quality of Provider Practices for Older Adults in the Emergency Department (EQUiPPED). J Am Geriatr Soc. [Internet]. 2017 Jul [cited in 28 May 2021]; 65(7):1609-14. DOI: 10.1111/jgs.14890
51. Vanderman AJ, Moss JM, Bryan WE 3rd, Sloane R, Jackson GL, Hastings SN. Evaluating the impact of medication safety alerts on prescribing of potentially inappropriate medications for older veterans in an ambulatory care setting. J Pharm Pract. [Internet]. 2017 Feb [cited in 28 May 2021]; 30(1):82-8. DOI: 10.1177/0897190015621803
52. Desnoyer A, Blanc AL, Pourcher V, Besson M, Fonzo-Christe C, Desmeules J, et al. PIM-Check: development of an international prescription-screening checklist designed by a Delphi method for internal medicine patients. BMJ Open [Internet]. 2017 Jul [cited in 28 May 2021]; 7(7):e016070. DOI: 10.1136/bmjopen-2017-016070
53. Cossette B, Bergeron J, Ricard G, Éthier JF, Joly-Mischlich T, Levine M, et al. Knowledge Translation Strategy to Reduce the Use of Potentially Inappropriate Medications in Hospitalized Elderly Adults. J Am Geriatr Soc. [Internet]. 2016 Dec [cited in 30 May 2021]; 64(12):2487-94. DOI: 10.1111/jgs.14322
54. Alagiakrishnan K, Wilson P, Sadowski CA, Rolfson D, Ballermann M, Ausford A, et al. Physicians' use of computerized clinical decision supports to improve medication management in the elderly - the Seniors Medication Alert and Review Technology intervention. Clin Interv Aging [Internet]. 2016 Jan [cited in 30 May 2021]; 11:73-81. DOI: 10.2147/CIA.S94126
55. Sönnichsen A, Trampisch US, Rieckert A, Piccoliori G, Vögele A, Flamm M, et al. Polypharmacy in chronic diseases-Reduction of inappropriate medication and adverse drug events in older populations by electronic Decision Support (PRIMA-eDS): study protocol for a randomized controlled trial. Trials [Internet]. 2016 [cited in 30 May 2021]; 17:57. DOI: 10.1186/s13063-016-1177-8
56. Elseviers MM, Vander Stichele RR, Van Bortel L. Quality of prescribing in Belgian nursing homes: an electronic assessment of the medication chart. Int J Qual Health Care [Internet]. 2014 Fev [cited in 30 May 2021]; 26(1):93-9. DOI: 10.1093/intqhc/mzt089
57. Peterson JF, Kripalani S, Danciu I, Harrell D, Marvanova M, Mixon AS, et al. Electronic surveillance and pharmacist intervention for vulnerable older inpatients on high-risk medication regimens. J Am Geriatr Soc. [Internet]. 2014 Nov [cited in 30 May 2021]; 62(11):2148-52. DOI: 10.1111/jgs.13057
58. Lopes LM, Figueiredo TP, Costa SC, Reis AMM. Utilização de medicamentos potencialmente inapropriados por idosos em domicílio. Ciênc Saúde Colet. [Internet]. 2016 nov [cited in 3 June 2021]; 21(11):3429-38. DOI: https://doi.org/10.1590/1413-812320152111.14302015

59. Halvorsen KH, Granas AG, Engeland A, Ruths S. Prescribing quality for older people in Norwegian nursing homes and home nursing services using multidose dispensed drugs. Pharmacoepidemiol Drug Saf. [Internet]. 2012 Sept [cited in 3 June 2021]; 21(9):929-36. Available from: https://pubmed.ncbi.nlm.nih.gov/21913280/
60. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B: Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet [Internet]. 2012 Jul [cited in 5 June 2021]; 380(9836):37-43. DOI: 10.1016/S0140-6736(12)60240-2
61. Fundação de Amparo à Pesquisa do Estado de São Paulo. Dados. Publicações científicas por países: contagem por autoria e por artigo [Internet]. São Paulo: FAPESP; [2020] [cited in 23 June 2021]. Available from: https://revistapesquisa.fapesp.br/wp-content/uploads/2020/01/095_dados_288.pdf
62. Li Z, Heber D. Sarcopenic obesity in the elderly and strategies for weight management. Nutr Rev. [Internet]. 2012 Jan [cited in 23 June 2021]; 70(1):57-64. Available from: https://pubmed.ncbi.nlm.nih.gov/22221216/
63. Tchernof A, Després JP. Pathophysiology of human visceral obesity: an update. Physiol Rev. [Internet]. 2013 Jan [cited in 23 June 2021]; 93(1):359-404. Available from: https://pubmed.ncbi.nlm.nih.gov/23303913/

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