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Research paper

Understanding medication use behaviors and perspectives in an older cardiovascular patient population: Opportunities for patient-centered deprescribing

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ABSTRACT

Study objective: Describe self-reported medication use behaviors and perspectives to identify opportunities for collaborative deprescribing among older cardiovascular patients.
Design: Patient survey using convenience sampling.
Setting: Private cardiology practice in Maricopa County, Arizona, USA.
Participants: Established patients aged ≥65 years with an active medication list indicating prescription polypharmacy (≥5 medications) and/or use of ≥1 high risk medication (anticoagulant, antiarrhythmic, antihypotensive, insulin).
Intervention: Anonymous online survey.
Main outcome measures: Current medication use (prescription and over-the-counter), self-reported medication use behaviors measured by the Adherence to Refills and Medications Scale (ARMS-12), and perspectives on deprescribing.
Results: Overall, 138 participants were recruited, with a mean age of 76.7 years. All but two self-identified as Caucasian. Prescription polypharmacy was reported by 80 (58.0 %), with use of 5–9 medications by 66 (47.8 %) and use of ≥10 medications (excessive polypharmacy) by 14 (10.1 %). Approximately one-third (n = 45, 32.6 %) had ARMS = 12, indicating adherence to taking and refilling medications. More than 1 in 10 patients (11.6 %) used >1 high-risk medication. About 4 in 10 (40.6 %) used ≥5 OTC medications. Most highly prioritized reasons for continuing medications were to prolong life (40 %), feel better (17 %), and reduce stroke risk (15 %). Despite 66.7 % of patients indicating taking "just the right amount of medications," willingness to stop ≥1 medication was very high at 80.4 %.
Conclusion: Among older cardiovascular patients, prescription polypharmacy is prevalent as are medication use behaviors associated with some degree of nonadherence. Patients are supportive of deprescribing. Prioritizing what matters most to patients and focusing efforts to deprescribe potentially inappropriate medications is recommended.

1. Introduction

Polypharmacy is most frequently defined as taking 5 or more medications daily with excessive polypharmacy referring to taking 10 or more medications daily [1]. A retrospective analysis of United States (USA) physician office visits made by patients aged ≥65 years from 2009 to 2016 found that nearly 37 % included the prescription of ≥5 medications, meeting their criterion for "major polypharmacy." [2] While complex medication regimens may be indicated in the setting of multimorbidity, there are potential unintended negative consequences including increased likelihood of adverse drugs events, impaired physical and cognitive function, worsening of nutritional status, and patient/payor financial burden [3]. These consequences may be especially cumbersome and able to cause harm in older individuals. Both

Abbreviations: ARMS-12, Adherence to Refills and Medications Scale (12-item); PIM, potentially inappropriate medication.

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medication-taking ability, a person's ability to accurately follow a prescribed medication regimen, and medication adherence, the extent to which one follows agreed upon treatment recommendations, appear to be inversely correlated with pill burden [4]. While age itself has not been found to be an independent predictor of poor medication-taking ability or nonadherence, the prevalence of risk factors for medication misadventures increases with age [4]. Optimal therapeutic efficacy requires an adherence rate of at least 80 %; however, adherence to many chronic medications hovers around 50 % [5]. Deprescribing may reduce the risk of negative outcomes, while also potentially improving medication-taking ability and adherence. As such, deprescribing may strengthen desired outcomes owing to a shift of focus to medications most likely to benefit the patient in terms of survival, delayed disease progression, and quality of life.

Cardiovascular disease is the leading cause of death in the USA [6]. The American Heart Association reports that between 2015 and 2018 over 75 % of adults 60–79 years had cardiovascular disease (defined as presence of hypertension, coronary heart disease, heart failure (HF), or stroke) [7]. With an ever-expanding armamentarium of life-prolonging medications available for those with various cardiovascular conditions, the risk of polypharmacy in older adults with cardiovascular disease is increasing. However, medications only work when they are taken. Medication nonadherence is a significant problem for elderly patients with HF, with adherence rates decreasing dramatically during the first six months of therapy, resulting in poorer medical outcomes, higher hospitalization rates, and increased healthcare costs [8]. A retrospective chart review published in 2021 found that among adults ≥ 65 years of age with cardiovascular disease, 95 % met the definition of polypharmacy and 78 % had at least one potentially inappropriate medication (PIM) due to a severe potential drug-drug interaction [9]. To date there are at least three completed randomized controlled trials exploring outcomes of deprescribing among older adults focused on cardiovascular medication classes [3,10–12]. While these were relatively small studies ranging in sample size from 295 to 381 individuals, none revealed patient harm in terms of increased risk of cardiovascular events or death [3,10–12]. Although additional data is needed, available data highlights the need for intentional curation of medication regimens to either simplify, deprescribe, or ensure appropriateness of polypharmacy among older adults with cardiovascular disease [13].

Deprescribing is the process of medication withdrawal or dose reduction under the care of a healthcare professional to reduce unnecessary or potentially harmful medications with the goal of improving patient outcomes and reducing patient costs [3,14]. An important step to addressing polypharmacy is understanding patient perspectives, including barriers to medication-taking ability and adherence, that can inform and guide (de)prescribing practices [13,15–18]. Ultimately, recognition that older adults with cardiovascular disease are increasingly at risk for polypharmacy and its potentially harmful sequelae may provide the impetus for the collective healthcare community to place focused effort in this space. Prudent measures include carefully reviewing and strongly considering simplification or deprescribing of medication regimens when anticipated risks exceed potential benefits to improve outcomes in terms of patient-centered goals [3,9,19,20]. Data specific to medication use behavior among older, community dwelling adults with cardiovascular disease is sparse and could help to inform the healthcare system on how to provide optimized medication management within this high-risk population. The purpose of this study is to describe self-reported medication use behaviors and perspectives among older adults with cardiovascular disease to identify opportunities and approaches for collaborative deprescribing.

2. Materials and methods

To examine patients' medication use behaviors and perspectives, an online survey was conducted among established cardiology patients aged 65 years and above with an active medication list indicating potential prescription polypharmacy (≥5 prescription medications) and/or use of 1 or more high risk medications (i.e., anticoagulant, antiarrhythmic, anti-hypotensive, insulin) (Supplementary Appendix A). Participants were recruited from a private cardiology practice, Cardiac Solutions, located in Maricopa County, Arizona in the greater Phoenix area encompassing the large retirement communities of Sun City and Sun City West. A convenience sample of patients scheduled for an in-office visit during a one-week time frame at any of three Cardiac Solutions offices were assessed for eligibility. To identify only established cardiovascular patients, individuals were only included if their first appointment with a Cardiac Solutions provider was >365 days before the scheduled study period. Finally, only patients whose primary language was English with an email in their patient portal were included. Patients who fulfilled the inclusion criteria were sent an email invitation to participate. The process did not allow for either email address validation or delivery verification. The survey remained open for 31 days. No reminder emails were sent.

The survey contained a minimum of 30 and maximum of 34 questions based on individual responses. The survey was designed to require 10–15 min for participant completion. Embedded in the survey was the 12-item Adherence to Refills and Medications Scale (ARMS-12), a validated questionnaire to quantify self-reported medication use taking behavior among patients with chronic disease. Permission to utilize the ARMS survey was granted through Emory University in collaboration with Pfizer to support patient care and quality improvement efforts [21]. Additionally, the survey contained six questions aimed at assessing patient perspectives about their medication regimen as well as attitudes towards deprescribing which were created from concepts adapted from the validated Patients' Attitudes Towards Deprescribing (PATD) and revised PATD (rPATD) version for older adults questionnaires [15,16]. These six questions comprised one or more of the five factor-based categories represented in the 22-item rPATD: burden, appropriateness, concerns about stopping, involvement, and global factors (Supplementary Appendix B). The survey also included questions encompassing demographics, current medication use, and recent health history.

Study data were collected and managed using REDCap electronic data capture tool hosted by nPhase and supported by Pfizer. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies.

All responses were anonymous, and the researchers compiled the survey results from REDCap into Minitab v20 for analysis. The ARMS-12 uses a 4-point Likert scale which is scored as follows: none (1), some (2), most (3), or all (4) of the time for each question, with one item reverse scored (question 12). Overall scores are determined by the summed points. Overall scores range from 12 to 48, with a score of 12 indicating adherence, and scores >12 indicating some degree of nonadherence (see Supplementary Appendix C). Data was reported using descriptive measures of means with standard deviation and median with interquartile ranges for continuous measures and counts and percentages for categorical data. For Tables 1 and 2, differences between groups for continuous variables were evaluated using a student *t*-test, with categorical variables evaluated using a chi-square test, with alpha = 0.05. This study was unfunded and approved by the Midwestern University Institutional Review Board.

3. Results

Over a period spanning 30 days, in February to March 2022, 183 participants started the questionnaire. A total of 138 completed the data elements necessary for analyses (Supplementary Appendix A). As shown in Table 1, the overall mean age was 76.7 (SD ± 6.6) years, about 50 % being female or male, and all but two patients identifying as Caucasian. About 77 % of the cohort reported having attended college for at least 2 years, with 21 % having a graduate degree. Nearly two-thirds (66 %) of the patients described their health as well/very well.

Of the 138 patients, 16 (11.6 %) reported taking ≥20 individual pills

Table 1
Characteristics of participants stratified by total daily pill count, presence of polypharmacy, and medication adherence (ARMS-12).[a]

Characteristic	Overall (n = 138)	Total daily pill count[f] <20 (n = 122)	Total daily pill count[f] ≥20 (n = 16)	P-value	No Rx polypharm (<5 Rx/day) n = 58 (%)	Rx polypharm (5–9 Rx/day) n = 66 (%)	Excessive Rx polypharm (≥10 Rx/day) N = 14 (%)	P-value	ARMS = 12 (n = 45)	ARMS > 12 (n = 93)	P-value
Age in years											
Mean (SD)	76.7 (6.6)	76.7 (6.6)	75.6 (6.5)	NS[g]	76.6 (7.2)	76.5 (6.1)	78.4 (6.4)	NS[g]	76.7 (5.9)	76.7 (6.9)	NS[g]
Median (IQR)	76 (11)	76.5 (11)	75.5 (10.3)		76.5 (12)	76 (10)	77.5 (8.8)		77 (9)	76 (11.5)	
Sex (%)											
Female	68 (49.3)	62 (50.8)	6 (37.5)	NS[g]	33 (56.9)	29 (43.9)	6 (42.9)	NS[g]	17 (37.8)	51 (54.8)	NS[g]
Male	70 (50.7)	60 (49.2)	10 (62.5)		25 (43.1)	37 (56.1)	8 (57.1)		28 (62.2)	42 (45.2)	
Ethnicity[b] (%)											
Asian/Pac Island	2 (1.5)	2 (1.6)	0	-	1 (1.7)	1 (1.5)	0	-	1 (2.2)	1 (1.1)	-
Caucasian	136 (98.6)	120 (98.4)	16 (100)	-	57 (98.3)	65 (98.5)	14 (100)	-	44 (97.8)	92 (98.9)	-
Education (%)											
<8th grade	1 (0.7)	1 (0.8)	0	-	1 (1.7)	0	0	-	0	1 (1.1)	-
<12th grade	1 (0.7)	1 (0.8)	0	-	0	1 (1.5)	0	-	0	1 (1.1)	-
High school	30 (21.7)	27 (22.1)	3 (19.8)	NS[g]	13 (22.4)	14 (21.2)	3 (21.4)	NS[g]	9 (20)	21 (22.6)	NS[g]
2 year college	46 (33.3)	42 (34.4)	4 (25)	NS[g]	21 (36.2)	19 (28.8)	6 (42.9)	NS[g]	15 (33.3)	31 (33.3)	NS[g]
4 year college	31 (22.4)	24 (19.7)	7 (43.8)	NS[g]	12 (20.7)	16 (24.2)	3 (21.4)	NS[g]	9 (20)	22 (23.7)	NS[g]
Grad degree	29 (21)	27 (22.1)	2 (12.5)	NS[g]	11 (19)	16 (24.2)	2 (14.3)	NS[g]	12 (26.7)	17 (18.3)	NS[g]
Current health (%) (self described)											
Very poor to poor	8 (5.8)	3 (2.5)	5 (31.3)	0.001[h]	2 (3.5)	1 (1.5)	5 (35.7)	–	1 (2.2)	7 (7.5)	NS[h]
Fair	39 (28.3)	33 (27.1)	6 (37.5)	NS[g]	9 (15.5)	23 (34.9)	7 (50)	0.009[g]	10 (22.2)	29 (31.2)	NS[g]
Well	72 (52.2)	67 (54.9)	5 (31.3)	NS[g]	35 (60.3)	35 (53)	2 (14.3)	0.005[h]	26 (57.8)	46 (49.5)	NS[g]
Very well	19 (13.8)	19 (15.6)	0	NS[g]	12 (20.7)	7 (10.6)	0	0.033[h]	8 (17.8)	11 (11.8)	NS[g]
OTCs daily[c]											
0–4	82 (59.4)	76 (62.3)	6 (37.5)	NS[g]	34 (58.6)	40 (60.6)	8 (57.1)	NS[g]	26 (57.8)	56 (60.2)	NS[g]
5–9	44 (31.9)	41 (33.6)	3 (18.8)	NS[g]	21 (36.2)	20 (30.3)	3 (21.4)	NS[g]	18 (40)	26 (28)	NS[g]
≥10	12 (8.7)	5 (4.1)	7 (43.8)	0.002[g]	3 (5.2)	6 (9.1)	3 (21.4)	NS[g]	1 (2.2)	11 (11.8)	NS[h]
No high risk meds[d] (%)	86 (62.3)	78 (63.9)	8 (50)	NS[g]	44 (75.9)	38 (57.6)	4 (28.6)	0.002[g]	29 (64.4)	57 (61.3)	NS[g]
Anticoagulant (%)	38 (27.5)	32 (26.2)	6 (37.5)	NS[g]	10 (17.2)	20 (30.3)	8 (57.1)	0.009[g]	12 (26.7)	26 (28)	NS[g]
Antiarrhythmic (%)	17 (12.3)	15 (12.3)	2 (12.5)	NS[h]	5 (8.6)	9 (13.6)	3 (21.4)	NS[g]	7 (15.6)	10 (10.8)	NS[g]
Meds to raise BP (%)	4 (2.9)	4 (3.3)	0	-	2 (3.5)	1 (1.5)	1 (7.1)	-	2 (4.4)	2 (2.2)	NS[h]
Insulin (%)	11 (8)	9 (7.4)	2 (12.5)	NS[h]	0	9 (13.6)	2 (14.3)	0.002[h]	3 (6.7)	8 (8.6)	NS[h]
>1 high risk med (%)	16 (11.6)	14 (11.5)	2 (12.5)	NS[h]	3 (5.2)	10 (15.2)	3 (21.4)	NS[g]	6 (13.3)	10 (10.8)	NS[g]
Hospital admission last 12 months[e]	29/134 (21.6)	25/119 (21)	4/15 (26.7)	NS[h]	10/57 (17.5)	13/63 (20.6)	6/14(42.9)	NS[g]	10/44 (22.7)	19/90 (21.1)	NS[g]
Falls last 12 months[e]	35/134 (26.1)	28/119 (23.5)	7/15 (46.7)	NS[g]	12/57 (21.1)	15/63 (23.8)	8/14 (57.1)	0.019[g]	7/44 (15.9)	28/90 (31.1)	0.039[g]

ARMS, Adherence to Refills and Medications Scale; NS, not significant; OTC, over-the-counter; Rx, prescription medication(s).

[a] Percentages rounded and may not equal 100 %.

[b] Other groups in survey but not selected: Black or African American, Hispanic or Latino, Native American or Alaskan Native, multi or biracial, not listed here.

[c] This survey specifically asked patients to report the number of non-prescription (OTC) medications they take on a regular basis including vitamins, supplements, herbals, and nutraceuticals.

[d] High risk medication categories: Anticoagulant: warfarin/Coumadin®/Jantoven®, apixaban/Eliquis®, rivaroxaban/Xarelto®, dabigatran/Pradaxa®, edoxaban/Savaysa®, enoxaparin/Lovenox®, fondaparinux/Arixtra®; antiarrhythmic: sotalol/Betapace®/Betapace AF®, amiodarone/Cordarone®/Pacerone®, dronedarone/Multaq®, dofetilide/Tikosyn®, propafenone/Rythmol®, flecainide/Tambocor®, procainamide/Procan®/Procanbid®, mexiletine/Mexitil®, quinidine; medications to raise blood pressure: midodrine/ProAmatine®, fludrocortisone/Florinef®, droxidropa/Northera®, pyridostigmine/Mestinon®; insulin: Lantus®, Toujeo®, Tresiba®, Levemir®, Basaglar®, Humulin/Novolin N®, Humulin/Novolin R®, Entuzity®, Humalog®, Novolog®, Apidra®, Fiasp®.

[e] 4 patients were missing data for hospitalizations and falls in last 12 months, with change in denominator for each category shown.

[f] Total daily pill count is the sum total of the number of individual pills (e.g., capsules, tablets) taken by the patient each day encompassing both prescription and non-prescription (OTC) medications including vitamins, supplements, herbals, and nutraceuticals.

[g] Student *t*-test for continuous measure (age), Chi-square test for categorical variables. NS defined as $P > 0.05$. Dash lines where test was not completed because of sample size.

[h] Fisher's exact test.

a day. The mean number of pills per day was 12.2 (SD 9.3) and median 11 (IQR 6.5) including both prescription and OTC medications. Prescription polypharmacy (≥5 medications) was reported by 80 (58.0 %), with use of 5–9 medications reported by 66 (47.8 %) and use of ≥10 medications (excessive polypharmacy) by 14 (10.1 %). Approximately one-third (n = 45, 32.6 %) had ARMS = 12, indicating adherence to taking and refilling medications. Of the high-risk medications, the most commonly used was anticoagulants (27.5 %), followed by antiarrhythmics (12.3 %). More than 1 in 10 patients (11.6 %) used >1 high-risk medication. Of the 35 patients reporting a fall, 11 (31.4 %) also reported anticoagulant use. About 4 in 10 (40.6 %) used ≥5 OTC medications.

Table 2
Perspectives surrounding medication use and opportunities for deprescribing stratified by total daily pill count, presence of polypharmacy, and medication adherence (ARMS-12).[a]

Characteristic	Overall n = 138	Total daily pill count[b] < 20 n = 122	Total daily pill count[b] ≥ 20 n = 16	P-value	No Rx polypharmacy (<5 Rx/day) n = 58 (%)	Rx polypharmacy (5–9 Rx/day) n = 66 (%)	Excessive Rx polypharmacy (≥10 Rx/day) n = 14 (%)	P-value	ARMS = 12 n = 45	ARMS > 12 n = 93	P-value
How do you feel about the medication regimen you currently take? (%)											
I take just the right amount of medications	92 (66.7)	86 (70.5)	6 (37.5)	0.010[c]	47 (81)	37 (56.1)	8 (57.1)	0.01[c]	32 (71.1)	60 (64.5)	NS[c]
I take too many medications	30 (21.7)	24 (19.7)	6 (37.5)	NS[c]	6 (10.3)	19 (28.8)	5 (35.7)	0.019[c]	9 (20)	21 (22.6)	NS[c]
I take too few medications	0	0	0	-	0	0	0	-	0	0	-
I do not know if I take the right amount of medications	16 (11.6)	12 (9.8)	4 (25)	NS[d]	5 (8.6)	10 (15.2)	1 (7.1)	NS[d]	4 (8.9)	12 (12.9)	NS[d]
If my doctor said it was possible, I would be willing to stop one or more of my regular medications (%)											
Strongly agree/ agree	111 (80.4)	100 (82)	11 (68.8)	NS[c]	48 (82.8)	54 (81.8)	9 (64.3)	NS[c]	32 (71.1)	79 (85)	NS[c]
Unsure	19 (13.8)	15 (12.3)	4 (25)	NS[d]	7 (12.1)	8 (12.1)	4 (28.6)	NS[d]	9 (20)	10 (10.8)	NS[c]
Strongly disagree/ disagree	8 (5.8)	7 (5.7)	1 (6.3)	NS[d]	3 (5.2)	4 (6.1)	1 (7.1)	-	4 (8.9)	4 (4.3)	NS[d]
I believe one or more of my medications is causing side effects (%)											
Strongly agree/ agree	42 (30.4)	31 (25.4)	11 (68.8)	<0.001[c]	11 (19)	23 (34.9)	8 (57.1)	0.012[c]	12 (26.7)	30 (32.3)	NS[c]
Unsure	27 (19.6)	25 (20.1)	2 (12.5)	NS[d]	10 (17.2)	13 (19.7)	4 (28.6)	NS[d]	6 (13.3)	21 (22.6)	NS[c]
Strongly disagree/ disagree	69 (50)	66 (54.1)	3 (18.8)	0.015[d]	37 (63.8)	30 (45.5)	2 (14.3)	0.002[d]	27 (60)	42 (45.2)	NS[c]

ARMS, Adherence to Refills and Medications Scale; NS, not significant; Rx, prescription medication(s).
[a] Percentages rounded and may not equal 100 %.
[b] Total daily pill count is the sum total of the number of individual pills (e.g., capsules, tablets) taken by the patient each day encompassing both prescription and non-prescription (OTC) medications including vitamins, supplements, herbals, and nutraceuticals.
[c] Chi-square test. NS defined as P > 0.05. Dash lines where test was not completed because of sample size.
[d] Fisher's exact test.

Compared with those taking <20 individual pills per day, those taking ≥20 pills per day were more commonly male (62.5 % vs. 49.2 %), more likely to have at least a four-year college degree (56.3 % vs. 41.8 %), and to report very poor to poor health (31.3 % vs. 2.5 %). Those taking ≥20 individual pills per day were also much more likely to report a fall within the past 12 months (46.7 % vs. 23.5 %) and to be taking anticoagulants (37.5 % vs. 26.2 %). Similarly, excessive prescription polypharmacy was associated with reporting very poor or poor health (35.7 % vs. 3.5 % for those with no polypharmacy), a hospital admission in the past year (42.9 % vs. 17.5 %), and a fall in the past year (57.1 % vs. 21.1 %).

Age and educational levels were similar among patients with ARMS = 12 and ARMS >12, although a larger proportion of the group with ARMS >12 were female (54.8 % vs. 37.8 %). Health status generally declined with indicators of medication nonadherence, with fair to very poor health reported by 24.4 % of self-reported adherent patients and 38.7 % of patients with self-reported medication use behavior indicating some degree of nonadherence. Nearly one-third (31.1 %) of patients with some degree of nonadherence and 15.9 % of adherent patients reported a fall in the previous year, although the percentages with a hospital admission were similar in the two groups. Additional information on responses to ARMS-12 is available (Supplementary Appendix C).

Unexpectedly, neither total daily pill count ≥ 20 nor the presence of prescription polypharmacy were predictors of nonadherence (i.e., ARMS > 12) in our population with an equal proportion of patients having both risk factors (n = 5/45 for ARMS = 12, 11.1% and n = 10/93 for ARMS > 12, 10.8%) (Fig. 1). All but 1 patient (n = 15/16, 93.8%) who reported total daily pill count ≥ 20 also reported prescription polypharmacy.

Patient's perspectives on medications are shown in Table 2. Overall, two-thirds of patients (66.7 %) reported taking just the right amount of medications, 21.7 % said they take too many, and 11.6 % said they did not know. No patient reported taking too few medications.

Reports of taking just the right amount of medication were much less common among patients taking ≥20 individual pills daily (37.5 %) or those having prescription polypharmacy (i.e., taking ≥5 prescription medications daily) (56 %–57 %) compared with those taking fewer than 20 individual pills (70.5 %) or those without prescription polypharmacy (81.0 %). Those with ARMS-12 indicating adherence were somewhat more likely than those with indicators of some degree of nonadherence (ARMS >12) to report taking the right amount of medication (71.1 % vs. 64.5 %, respectively).

Most patients (80.4 %) strongly agreed or agreed that they would be willing to stop one or more regular medications if the doctor said it was possible. Unexpectedly, agreement was lower, although still a majority view, among those taking ≥20 individual pills daily (68.8 %) or ≥10 prescription medications (64.3 %). Of ARMS = 12 versus ARMS >12 patients, respectively, 71.1 % and 85.0 % reported willingness to stop at least one medication. Disagreement with stopping was uncommon at about 5 %–9 % across all subgroups examined.

Report of belief (agree/strongly agree) in one or more medications causing side effects was expressed by only 30 % of respondents overall. As expected, this belief was more common among those taking ≥20 individual pills daily compared with <20 (68.8 % vs. 25.4 %) and those

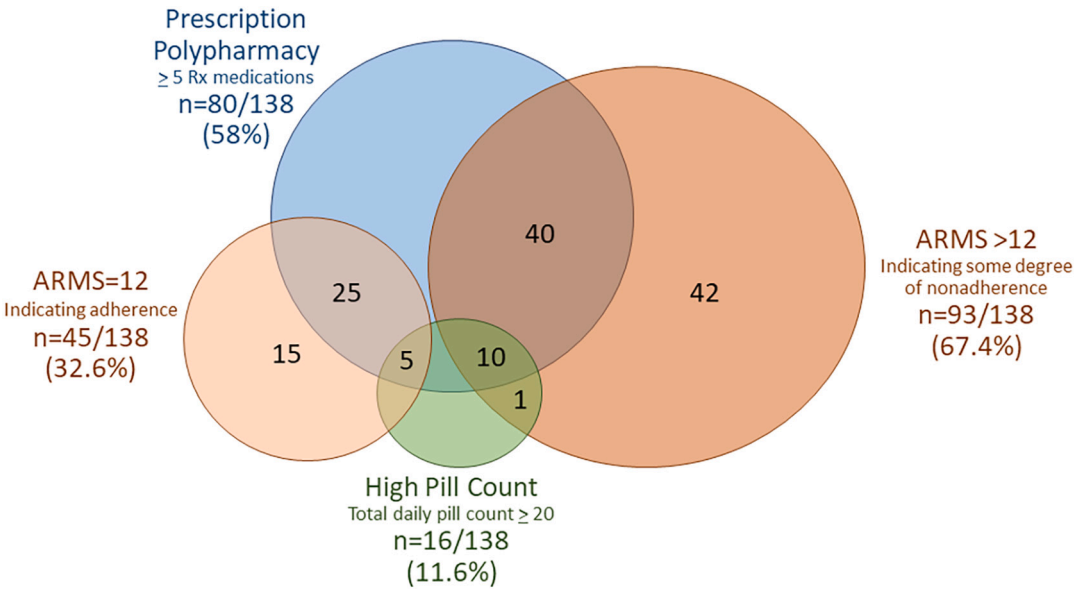

Fig. 1. Confluence of risk factors impacting adherence in older adults (n = 138). ARMS, Adherence to Refills and Medications Scale; Rx, prescription.

with ≥10 prescription medications (57.1 %) or 5–9 prescription medications (34.9 %) than those without prescription polypharmacy (19.0 %). Expressing agreement or being unsure about this belief was much more common among those with indicators of some degree of nonadherence (54.9 %) than adherent patients (40.0 %).

As shown in Fig. 2, about 64 %–76 % of patients expressed a willingness to take medications daily with reasons ranging from reduced risk of hospitalization to prolonging life. Interestingly, recommendations from doctor or lowering family burden were less commonly indicated at 38 % each. When asked to prioritize by selecting the most important rationale for willingness to take medications, to prolong life was the highest at 40 %, followed by feeling better at 17 % (Fig. 3).

4. Discussion

Among our cohort of older, community dwelling adult cardiovascular patients, there was a high prevalence of prescription and OTC polypharmacy with the majority of patients indicating at least one medication use behavior that may serve as a barrier to adherence as measured by the ARMS-12. Although most participants felt that they take "just the right amount" of medications, the overwhelming majority would be willing to discontinue at least one of their medications if their doctor indicated it would be possible. Approximately 1 in 5 patients reported a hospitalization in the past year and 1 in 4 reported a fall within the last 12 months; the incidence of these events was more

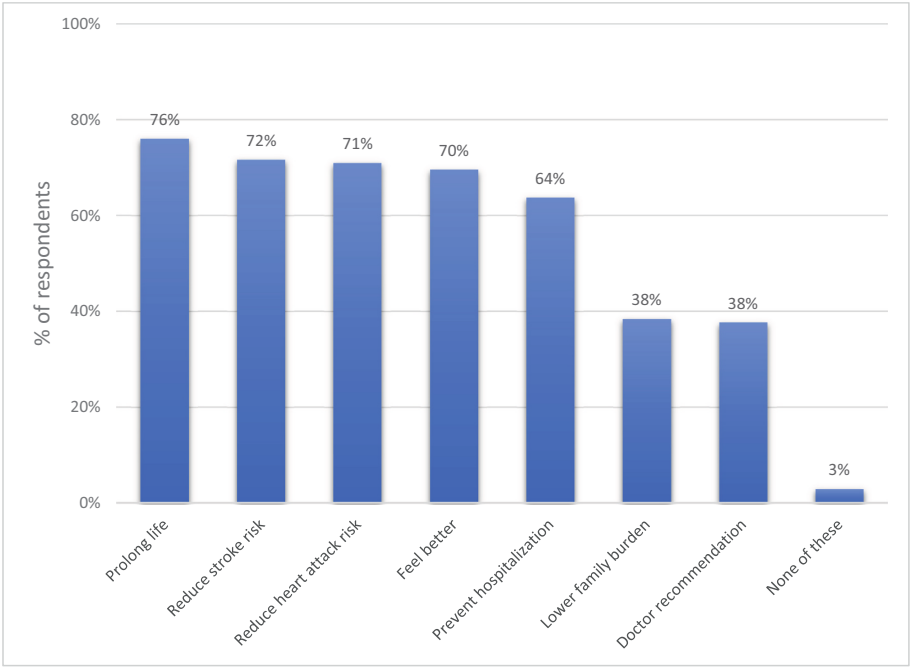

Fig. 2. Reasons patients were willing to take medications regularly, n = 138.[a,b]
[a] Percentages rounded and may not equal 100 %.
[b] Between ARMS-12 groups, there was no >2–3 % difference for any reason.

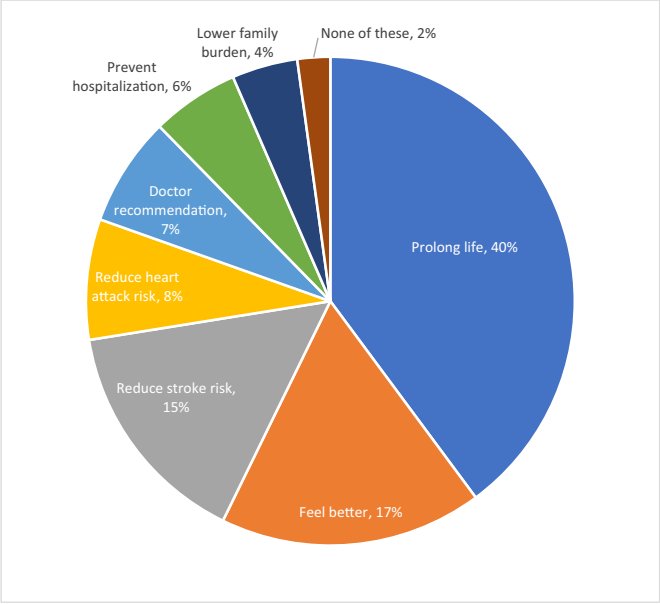

Fig. 3. Most important reason patients were willing to take medications regularly, n = 138.[a]
[a] Percentages rounded and may not equal 100 %.

prevalent in patients with higher daily pill burden and increasing degrees of prescription polypharmacy. This cohort indicated their primary reason for willingness to continue medications was to increase quantity of life, followed by quality of life and prevention of major cardiovascular events, namely stroke and heart attack. These results are like those reported in Australian and Danish cohorts with similar patient characteristics and reinforce the potential opportunity to improve care with simplified medication regimens using collaborative deprescribing to prevent medication-related complications, improve outcomes, and reduce costs [3,18,19]. Best practices advise practitioners to consider patient specific factors including overall physiological status, stage of life, and goals of care amidst global considerations including competing risks and lag time to benefit when engaging in collaborative deprescribing [3,22–25].

Similar to the Danish and Australian cohorts, > 80 % of our cohort indicated they would be willing to stop one or more of their regular medications if their doctor indicated this was possible [18,19]. In an Australian cohort of 180 patients with median age 78, who were 96 % Caucasian, with 86 % completing a minimum of secondary education, and 94 % classified as having polypharmacy (≥5 meds), 89 % indicated they would be willing to stop ≥1 medication if their doctor said it was possible [19]. In a Danish cohort of 100 patients with median age 75, with 77 % completing a minimum of higher education, and 100 % prescribed ≥10 medications, 85 % indicated they would be willing to stop ≥1 med if their doctor said it was possible [18]. These findings underscore the opportunity to streamline medication regimens for simplicity, including number of total pills per day, to achieve shared goals. Surveys conducted in Australian, Danish, and Italian populations indicate that most adults would feel comfortable taking 8 pills per day, ranging from 61 to 98 %, respectively [15,17,18]. In our population of cardiovascular patients aged ≥65 years, the mean number of pills taken per day was 12.2 including both prescription and OTC medications. This indicates an opportunity for holistic deprescribing within the older adult population in our practice.

To the authors knowledge, this study is one of the first efforts to quantify OTC polypharmacy in an older adult cardiovascular population. Our survey specifically asked patients to report the number of non-prescription (OTC) medications including vitamins, supplements, herbals, and nutraceuticals. In our cohort, 40 % of older adults were taking 5 or more OTC agents. While OTCs may have legitimate medical uses with clear indications, they also may be PIMs leading to negative unintended consequences by means of drug-drug or drug-disease state interactions. A common misnomer among patients is that OTCs are harmless [26]. In a retrospective chart review of 404 cardiovascular patients aged ≥65 years admitted to a cardiology service, home medication lists revealed an average of 11.6 medications, with 95 % having polypharmacy, and 77.5 % having ≥1 severe potential drug-drug interactions [9]. Notably, several OTC agents (e.g., NSAIDs, proton pump inhibitors, minerals) were implicated as PIMs with therapy modifications recommended [9]. In cardiovascular patients, there are multiple OTCs that are potentially inappropriate due to a high likelihood of worsening disease state control or increased adverse events. One example of this is ibuprofen in a patient who has chronic pain, high blood pressure, atrial fibrillation, and heart failure and is on an anticoagulant therapy, as ibuprofen may increase bleeding risk, blood pressure, fluid retention, and renal taxing [27]. This illustrates an example of therapeutic competition in which the treatment of one condition adversely affects a coexisting condition [3]. In general, supplements, herbals, and nutraceuticals have insufficient clinical data supporting their use [26]. Additionally, these agents can contribute to the overall cost of care and deplete funds that could otherwise be utilized for higher value, evidence-based medications [26]. Counseling offered by pharmacists is crucial when OTCs are purchased without advice from a prescriber [28]. Furthermore, pharmacists are well trained on interactions and adverse effects of medications, which can lead to improved medication safety and health literacy.

There are multiple tools available to measure medication nonadherence, however none is considered the gold standard [5]. According to the World Health Organization, there are multiple factors leading to medication nonadherence which can be stratified into five categories: (1) socioeconomic factors, (2) therapy-related factor, (3) patient-related factors, (4) condition-related factors, and (5) health system/health care related factors [5]. While a number of self-reported adherence tools are available, the ARMS-12 has been tested across a number of chronic disease states, including cardiovascular conditions, to assess medication use behaviors [21,29]. The ARMS-12 tool contains 8 measures on self-administration of medication regimens, as well as 4 measures related to scheduling of refills. Such factors made it well suited for this study to provide insight on both medication-taking ability and adherence.

In our cohort, nearly one-third of patients scored the lowest ARMS-12 score (ARMS = 12) indicating adherence while the remaining two-thirds had responses indicating mediation use taking behaviors reflective of some degree of nonadherence. Similar to our results, in a study of 1,967 patients admitted for acute coronary syndrome or acute decompensated HF, 70.7 % indicated at least some degree of medication nonadherence leading up to their hospitalization as measured by the ARMS-12 questionnaire [29]. In this study, adherence was significantly lower among patients with lower health literacy, numeracy, health competence, and more depressive symptoms, as well as those who were younger, non-White race, male, or with less social support. In our population, a “perfect” ARMS-12 score was seen more frequently among patients who were male, completed 4 or more years of college, or who took <10 OTC products daily. Notably, forgetting to take medications (especially those dosed more than once daily) and planning ahead for refills were two key contributors to medication use taking behavior associated with diminished ability and adherence (Supplementary Appendix C). From this data we see that the ARMS-12 is a simple and pragmatic way to reliably identify tangible and modifiable behaviors as a means to explore opportunities for education and/or intervention that could be used at the point of care delivery.

Guidelines promote the initiation of medications for therapy optimization but rarely discuss when medication discontinuation should be considered. This puts older adults at risk for therapeutic competition, polypharmacy, adverse drug reactions, and harmful prescribing cascades [3,30]. Older adults are often underrepresented in clinical trials,

have significant known heterogeneity in treatment efficacy and safety, and may have limited life expectancy [31]. When deprescribing, several clinical tools and frameworks have been developed. The 2019 American Geriatric Society BEERS criteria® is probably the most well-known tool, with information related to PIMs as well as medications to use with caution in older adults [27]. An additional tool, the START/STOPP criteria for potential prescribing omissions and PIMs in older people, is used widely in older adults to improve prescribing practices [32]. The idea of incorporating a patient's "lag time to benefit," the time between when a preventative medication will improve a health outcome and mortality, may also be helpful [25]. A tool for clinical practice that incorporates time to benefit that was developed by the University of California San Francisco is available at www.ePrognosis.com [33]. For example, deprescribing statins for primary prevention, a medication with a lag-time to benefit of ~3 years, may improve a patient's quality of life with little effects on their overall morbidity and mortality, while withdrawal of evidence-based therapy for heart failure with reduced ejection fraction could quickly lead to clinical deterioration [34]. Clinical tools, along with shared decision making, can help clinicians achieve collaborative deprescribing in older adults and help actualize the suggested 5Ms mnemonic which highlights meaningful care issues in older adults (Mind, Mobility, Medications, Multimorbidity, and Matters Most) [3].

There is a paucity of real-world data exploring patient perspectives for simplification of drug therapy in the setting of polypharmacy and multimorbidity despite estimates that patients taking ≥7 medications have an approximately 80 % risk of an adverse drug event and that 20–65 % of older adults receiving polypharmacy take at least one PIM [3,17]. A Cochrane Systematic review published in 2018 exploring interventions to improve the appropriate use of polypharmacy for older people identified 32 relevant trials from 12 countries involving, in aggregate, only 28,672 people [13]. The authors' concluded that based on the available data it is unclear whether interventions to improve appropriate polypharmacy result in clinically significant improvement. Similar to interventions to improve appropriate use of polypharmacy for older adults, proven efforts to improve medication taking ability and adherence have not yet been identified [4]. Despite this, current experts recommend a holistic systems approach to improve adherence. The idea of shared decision making could greatly benefit older adults with patient specific values, goals of care, physical function, multimorbidity, and medication burden all taken into account [35]. What "matters most" to patients should be central to collaborative deprescribing practices that includes comprehensive medication review, focused questions on medication use behavior and patient goals, and assurance of appropriate polypharmacy, when the anticipated benefits of continuing/starting medications exceed the potential risks.

The perspectives of 750 geriatricians, general internists, and cardiologists on deprescribing cardiovascular medications in older adults were recently explored in a national survey [36]. Over 80 % shared that they had recently considered deprescribing a cardiovascular medication citing adverse drug reactions as the most common impetus. Geriatricians were more likely to report deprescribing in the setting of limited life expectancy. Shared barriers to deprescribing included concern over interfering with another physicians' plan of care and perceived patient reluctance towards deprescribing. In our study 80.4 % of patients indicated a willingness to stop one or more mediations if their doctor said it was possible suggesting that provider perceptions may not match patient viewpoints. This data underscores the importance of collaborative care that involves all prescribers and the extended interprofessional healthcare community that supports patients, including pharmacists [3].

This study has several limitations. First, the study design restricted inclusion to patients with either prescription polypharmacy (≥5 prescription medications) or those taking at least one high risk medication, which reduces generalizability to patients outside these circumstances. Next, the respondents were predominantly Caucasian with ~77 % completing at least a 2-year college degree which reduces the generalizability of reported results to minority populations and/or those with less education. While the ARMS-12 is a validated medication adherence scale used in its entirety in this survey, the complete 22-item rPATD was not utilized to gain insights on deprescribing, which could impact the survey results. Only a small number of those sent an email opened and completed the survey, however we do not know how many emails were received, making the response rate unknown. Furthermore, our convenience sample only included patients representative of one week of care provided in our practice and produced a smaller N than was expected, perhaps related to the invitation method via e-mail which could go to spam, be ignored, or be not interesting to the patient. Distribution of invitations via email may favor individuals who are more affluent, technology savvy, have regular internet access, or who routinely review and respond to email communication. As with any self-reported survey data, social desirability bias is a limitation, as individuals have the tendency to provide survey responses that they perceive as favorable. Ultimately, additional research exploring the attitudes, beliefs, and experiences of older adults regarding polypharmacy and willingness to deprescribe that encompass a larger, more heterogenous population is needed. Published survey work to date that most closely aligns with this research has included 100–180 individuals of largely homogenous populations [15,17–19]. Lastly, the focus on this research was to gather patient perspectives via a survey, therefore this data is not able to inform on specific methods to mitigate polypharmacy among older adults.

5. Conclusions

Polypharmacy is prevalent among older adults with cardiovascular disease spanning both prescription and OTC medications with many patients self-reporting medication use behaviors that are associated with less-than-optimal adherence. The potential consequences of polypharmacy are numerous requiring providers to seek a balance between aggressively treating disease and avoiding medication-related harm. Resolution of these issues is complex and easier said than done. Prudent measures include comprehensive medication review, focused questions on medication use behavior and patient goals, and assurance of appropriate polypharmacy and/or collaborative deprescribing. Prioritizing what matters most to patients and focusing efforts to deprescribe PIM to resolve, or at a minimum to improve, polypharmacy is recommended.

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