

Research Article

Impact of Potentially Inappropriate Prescribing on Adverse Drug Events, Health Related Quality of Life and Emergency Hospital Attendance in Older People Attending General Practice: A Prospective Cohort Study

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Abstract

Background: Potentially inappropriate prescribing (PIP) describes medications where risk generally outweighs benefit for older people. Cross-sectional studies suggest an association between PIP and poorer health outcomes but there is a paucity of prospective cohort studies. This study investigates the longitudinal association of PIP with adverse drug events (ADEs), health related quality of life, and accident & emergency visits.

Methods: Study design: Two-year (2010–2012) prospective cohort study ($n = 904$, ≥ 70 years, community-dwelling) with linked pharmacy dispensing data. Exposure: Baseline PIP: Screening Tool for Older Persons potentially Inappropriate Prescriptions (STOPP) and Beers 2012 applied 12 months prior. Study outcomes: ADEs (patient interview), health related quality of life (EQ-5D-3L: patient questionnaire), and accident & emergency visits (general practice medical record review). Statistical analysis: Descriptive statistics: Poisson (incidence rate ratio [95% confidence interval [CI]], linear regression models [regression coefficient [95% CI]], and logistic [odds ratio [OR] [95% CI]].

Results: Of 791 participants eligible for follow-up, 673 (85%) returned a questionnaire and 605 (77%) also completed an ADE interview. Baseline STOPP PIP prevalence was 40% and 445 (74%) patients reported ≥ 1 ADE at follow-up. In multivariable analysis, ≥ 2 STOPP PIP was associated with ADEs (adjusted incidence rate ratio: 1.29 [95% CI 1.03, 1.85; $p = .03$]; poorer health related quality of life [adjusted regression coefficient: -0.11 [95% CI -0.16 , -0.06 ; $p < .001$]]; and, ≥ 1 accident & emergency visit [adjusted OR: 1.85 [95% CI 1.06, 3.24; $p = .03$]]. Baseline Beers 2012 prevalence was 26% and there was no association with adverse health outcomes in multivariable analysis.

Conclusions: Older community-dwelling people, prescribed ≥ 2 STOPP PIP are more likely to report ADEs, poorer health related quality of life and attend the accident & emergency department over 2-year follow-up.

Keywords: Adverse drug events—Potentially inappropriate prescribing—Community-dwelling

Research indicates that approximately one-fifth of all primary care prescriptions are potentially inappropriate, where risk generally outweighs the benefit (1). Explicit prescribing criteria such as the Screening Tool for Older Persons potentially Inappropriate Prescriptions (STOPP) and the American Geriatrics Society Beers 2012 criteria have been developed to identify potentially inappropriate prescribing (PIP) (2,3). The 65 STOPP criteria include drug–drug interactions, optimal dose and duration of treatment, and appropriate clinical indication. Developed

through Delphi consensus in Ireland and the United Kingdom, STOPP has been validated across different care settings in several European countries (4). The Beers 2012 criteria include 53 drugs to avoid in older people and have been widely validated internationally (3).

However, if these criteria are to have clinical utility in primary care, it is important to establish if PIP are associated with adverse health outcomes such as adverse drug events (ADEs). Older people are particularly vulnerable to these events due to their altered

pharmacokinetic profile and higher levels of polypharmacy (5,6). A recent systematic review reported an ADE-admission rate of 10.7% in older people (7). The impact of PIP on ADEs and other important outcomes, such as health related quality of life (HRQoL) and emergency hospital attendance, is unclear. Existing research has methodological limitations, in particular a paucity of prospective cohort studies, and has focused largely on inpatient and nursing home populations, with very few general practice studies (8–11).

The aim of this study is to investigate the longitudinal association of PIP, as defined by the STOPP and Beers 2012 criteria, with ADEs, HRQoL, and emergency hospital attendance in older (≥ 70 years) community-dwelling people followed up for 2 years.

Methods

The Strengthening The Reporting of Observational Studies in Epidemiology (STROBE) guidelines were adhered to in the conduct and reporting of this study (12). A more detailed description of the methods is presented in [Supplementary File 1](#).

Study Design and Study Population

This is a 2-year prospective cohort study of older general practice (GP) patients recruited from 15 practices in the Republic of Ireland (2010–2012). At baseline (2010), a proportionate stratified random sampling approach was used to recruit patients for study participation (10). Study inclusion criteria were: (i) aged ≥ 70 years on January 1, 2010 and; (ii) in receipt of a valid general medical services (GMS) card. Exclusion criteria are presented in [Supplementary File 1](#). Each participant's GP determined eligibility for participation at baseline and at follow-up (2012). Ethical approval for this study was granted by the Royal College of Surgeons in Ireland (RCSI) Human Research Ethics committee.

Exposure: PIP

PIP was identified by applying the STOPP criteria (version-1) and the Beers 2012 ([Supplementary Tables 1 and 2](#)) to pharmacy claims data by linkage to the national Health Services Executive (HSE)-Primary Care Reimbursement Scheme (PCRS) pharmacy claims database. Baseline measurement of PIP (12 months prior) and confounding variables were included in the regression models as predictor variables ([Supplementary Figure 1](#)). A comparison of baseline PIP and PIP at follow-up (using the period of 12 months prior to the ADE interview at follow-up) indicated that PIP had remained relatively stable over time for both sets of prescribing indicators (see [Table 1](#) and [Supplementary Figure 2](#)).

Primary Outcome: ADE

Patient interviews (November 2012 to June 2013) were conducted to identify patient-reported ADEs that had occurred over the previous 6 months (see [Supplementary File 1](#) for a detailed explanation of the ADE interview). In addition, GP medical records were reviewed to identify any additional ADEs in the same time period ([Supplementary Figure 1](#)). All patient-reported ADEs were independently reviewed by two academic GPs, blinded to the prescribing criteria, who independently rated the likelihood of each patient-reported ADE being a true ADE on a Likert scale (13). Only ADEs where both reviewers rated the ADE as likely ($\geq 50\%$ likelihood) were included. These ADEs were then reviewed by an academic GP and academic pharmacist who rated each in terms of severity (mild, moderate or severe and/or life-threatening,) based on a previously

utilized classification system (14,15). Inter-rater reliability was determined using the kappa statistic.

Secondary Outcomes: HRQoL and Emergency Hospital Attendance

HRQoL was measured using the Euro Quol-5 Dimensions (EQ-5D)-3L, administered via postal questionnaire. Emergency hospital attendance was measured by reviewing the GP medical record regarding emergency admissions and accident & emergency (A&E) visits.

Confounder Variables

Potential confounders were determined a priori and recorded at baseline from the GP medical record (age, gender, comorbidity), by linkage to the HSE-PCRS pharmacy claims database (number of prescribed medication classes, medication possession ratio) and from the postal questionnaire (social class, education, deprivation, vulnerability, depression and/or anxiety, and social support).

Statistical Methods

All statistical analysis was completed using Stata version-13 (StataCorp, College Station, TX). Descriptive statistics were calculated. A multivariable Poisson regression model was used to investigate the association between count of ADEs per patient at follow-up and exposure to PIP at baseline (no PIP, one PIP, ≥ 2 PIP), with adjustment for potential confounders. Multilevel unadjusted and adjusted incidence rate ratios (95% confidence intervals [CIs], p -value) were calculated.

Multilevel linear regression was used to examine how EQ-5D utility at follow-up varied by exposure to PIP, adjusting for confounders. Multilevel unadjusted and adjusted β -coefficients were calculated. Emergency hospital attendance was examined in relation to ≥ 1 A&E visits and ≥ 1 emergency admissions in the 2-year follow-up period, adjusting for relevant confounders. A multilevel logistic regression model calculated unadjusted and adjusted odds ratios (95% CIs, p value).

Methodological Quality Assessment

The Cochrane risk of bias tool for non-randomized studies was used to assess the overall risk of bias of this prospective cohort study (16).

Results

Study Population

Of 904 baseline patients, 113 met ≥ 1 exclusion criteria at 2-year follow-up ([Figure 1](#)). Of 791 eligible participants, 605 (76.5%) completed both the ADE interview and postal questionnaire. For the GP medical record review, 859 (95%) baseline study participants were reviewed. Reasons for non-review were: 19 moved practice; 14 moved into a nursing home; nine medical record reviews were missing; and, three were long-term hospital inpatients.

Study Participants' Socio-demographic Characteristics

For the primary outcome of ADE, a total of 286 (47%) were male. The mean age was 77 years, median age was 79 years (Inter Quartile Range 76, 83) and the majority were classified as skilled in terms of social class ($n = 473$, 78%). Patients were largely of White Irish background (97.4%), with 2.6% ($n = 16$) from another Caucasian background. [Table 1](#) presents the descriptive statistics for the study population.

Table 1. Study Participants' Descriptive Statistics for Primary Outcome ADE

	Baseline (n = 904)	Follow-up (n = 605)
Age	Median (IQR) 77 (74, 81)	Median (IQR) 79 (76, 83)
Deprivation	1.49 (-0.6, 3.1)	1.36 (-0.64, 2.88)
Number of drug classes	6 (3,8)	6 (4,8)
Medication Possession Ratio	0.83 (0.69, 0.91)	0.87 (0.77, 0.94)
Gender	Number (%)	Number (%)
Male	415 (46)	286 (47)
Female	489 (54)	319 (53)
Marital status*		
Married	403 (45)	275 (45)
Separated and/or divorced	45 (5)	29 (5)
Widowed	293 (32)	199 (33)
Never married and/or single	162 (18)	102 (17)
Living arrangements [†]		
Husband and/or wife and/or partner	393 (44)	249 (42)
Family and/or relatives	116 (13)	73 (12)
Live alone	343 (38)	240 (40)
Other	40 (5)	33 (6)
Education [‡]		
Basic education	555 (61)	355 (59)
Upper and post-secondary	343 (38)	247 (41)
Social class		
Unskilled	342 (38)	132 (22)
Skilled	562 (62)	473 (78)
Charlson comorbidity index [§]		
0	358 (40)	252 (41)
≥1	544 (60)	353 (59)
Number of STOPP PIP		
0	526 (58)	323 (53)
1	215 (24)	157 (26)
≥2	163 (18)	125 (21)
Number of Beers PIP		
0	450 (74)	466 (77)
1	96 (16)	115 (19)
≥2	59 (10)	24 (4)

Notes: ADE = adverse drug event; IQR = Inter Quartile Range; PIP = potentially inappropriate prescribing; STOPP = Screening Tool for Older Persons potentially Inappropriate Prescriptions.

*Marital status missing n = 1 (baseline).

[†]Living arrangements missing n = 1 (baseline), n = 10 (follow-up).

[‡]Education missing n = 3 (follow-up).

[§]Charlson missing n = 2 (baseline).

Exposure to PIP as Defined by the Beers 2012 Criteria

A total of 35 (66%) of the Beers 2012 criteria were applied. At baseline, 450 (74%) participants were prescribed no PIP, 96 (16%) one PIP and 62 (10%) ≥2 PIP. The most frequently prescribed PIP indicators are presented in [Supplementary Table 3](#). Benzodiazepines, antipsychotics and non-COX selective non-steroidal anti-inflammatory drugs (NSAIDs) were the frequently prescribed. In multivariable analysis ≥2 Beers 2012 PIP was not associated with ADEs (adjusted incidence rate ratio 1.00 [95% CI 0.78, 1.29]), poorer HRQOL (adjusted coefficient -0.05 [95% CI -0.11, 0.003]), A&E visits

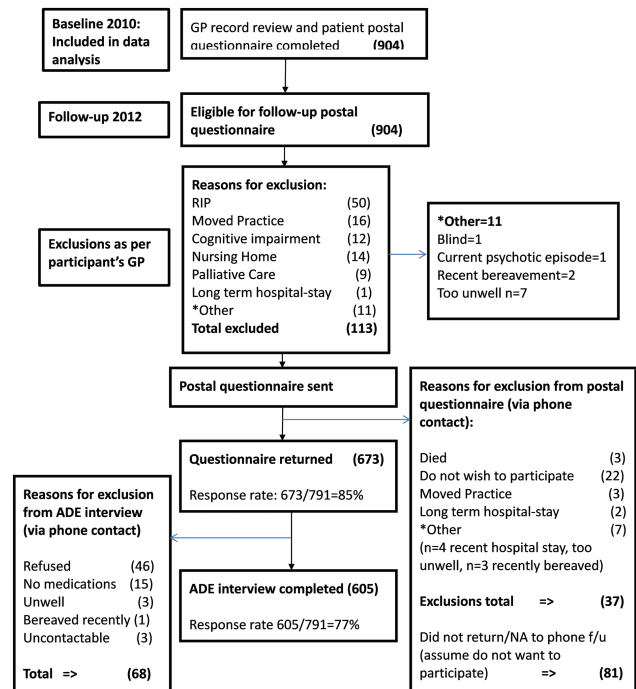


Figure 1. Flow of patients: prospective cohort study (2010–2012).

(adjusted OR 1.54 [95% CI 0.88, 2.71]) or emergency admission (adjusted OR 0.72 [95% CI 0.41, 1.28]) ([Supplementary Table 4](#)).

The remainder of this results section focuses on the impact of PIP identified by the STOPP criteria on subsequent adverse health outcomes.

Exposure to PIP as Defined by the STOPP Criteria

A total of 51 (78%) of the 65 STOPP criteria were applied. There was inadequate clinical information to apply 14 criteria. At baseline, the prevalence of ≥1 PIP was 40% (n = 243), with 362 (60%) participants prescribed no PIP, 142 (24%) one PIP and 101 (16%) ≥2 PIP. The 10 most frequently prescribed STOPP PIP are presented in [Supplementary Table 5](#). The three most frequently prescribed were proton pump inhibitors for peptic ulcer disease at maximum therapeutic dosage for more than 8 weeks, calcium channel blockers prescribed to patients with chronic constipation and long-term use of NSAIDs for pain relief.

Primary Outcome: ADE

At follow-up, 428 (71%) of 605 participants reported ≥1 ADE during the 6-month outcome measurement period. An additional 17 participants (2.8%) had an ADE recorded in their GP medical record, that was not reported by the participant. Of the 445 (74%) participants with ≥1 ADE, 96 (16%) reported one ADE, 94 (16%) reported two, 64 (11%) reported three, 52 (9%) reported four, 38 (6%) reported five, 101 (17%) reported ≥6 ADEs. The median number of ADEs was 2 (Inter Quartile Range 0, 4). Thirty percent of patient-reported symptoms were established as an ADE after independent review. Inter-rater agreement was 94% and the kappa statistic was 0.87 (95% CI 0.85, 0.90). The majority (n = 424, 95.2%) of ADEs were rated as mild in terms of severity with inter-rater agreement of 84%. The remainder were rated as moderate (n = 11, 2.5%) and severe and/or life threatening (n = 10, 2.3%). Of 10 severe ADEs, nine resulted in emergency hospital admission. No recorded ADE resulted in death.

The main medication classes associated with ADEs and the main adverse effects reported by patients are presented in [Supplementary Table 6](#). The commonest ADEs according to drug classes were: (i) antithrombotic agents ($n = 243$, 41%) associated with easy bruising, difficulty stopping a small cut bleeding and indigestion and/or heartburn; (ii) diuretics ($n = 162$, 27%) associated with getting up at night to urinate, passing urine more often and dry mouth; and, (iii) beta-blockers ($n = 145$, 24%) associated with cold hands and feet, fatigue and dizziness.

Poisson Multilevel Regression Model Examining the Effect of PIP on ADEs

In unadjusted regression analysis, compared to no PIP, ≥ 2 STOPP PIP was associated with increasing numbers of ADEs at follow-up (unadjusted incidence rate ratio 2.27 [95% CI 1.83, 2.81], $p < .001$). While this association diminished when adjusted for confounders, it remained statistically significant (adjusted incidence rate ratio 1.29 [95% CI 1.03, 1.60], $p = .03$) ([Table 2](#)). The number of drug classes, comorbidity and deprivation were also all independently associated with this outcome.

Secondary Outcomes: HRQoL

A total of 673 participants completed the EQ-5D at follow-up. Eleven (1.6%) had missing data and so were excluded resulting in 662 included in the statistical analysis. Median participant EQ-5D utility was 0.80 (Inter Quartile Range 0.66, 1). In multilevel linear regression analysis, adjusted for confounders, there was a statistically significant reduction in EQ-5D utility β -coefficient for patients with ≥ 2 PIP of -0.11 (-0.16 , -0.06), $p < .001$) ([Table 2](#)). Other variables, independently associated with this outcome, were increasing age and vulnerability.

Secondary Outcomes: A&E Visits and Emergency Hospital Admission

A total of 806 participants had available A&E visits and emergency admission data. In logistic regression analysis, following adjustment for confounders, one PIP (adjusted OR 1.82 [95% CI 1.15, 2.89], $p = .01$) and ≥ 2 PIP (adjusted OR 1.85 [95% CI 1.06, 3.24], $p = .03$) were significantly associated with an increased odds of patients attending A&E at least once over the 2-year follow-up period ([Table 2](#)).

A total of 199 (25%) participants had ≥ 1 emergency admission recorded during follow-up. Of these 136 (17%) participants had one emergency admission, 44 (5%) two and 19 (2%) ≥ 3 emergency admissions. Following adjustment for confounders, ≥ 2 PIP was not associated with emergency admission (adjusted OR 1.00 [95% CI 0.63, 1.61], $p = .99$). The number of drug classes at baseline,

deprivation and previous emergency hospital attendance were all independently associated with this outcome.

Methodological Quality Assessment

A summary is presented in [Table 3](#). Overall; the risk of bias was low with an overall response rate of 76.5% for all three outcome measurements which is considered very high.

Discussion

Principal Findings

The prevalence of patient-reported ADEs was 74%, most frequently easy bruising, urinary frequency, ankle swelling, fatigue, and muscle pains. The majority (95%) were considered to be clinically mild. There was a modest longitudinal association between ≥ 2 STOPP PIP and increasing numbers of ADEs, clinically important poorer HRQoL and these patients were almost twice as likely to attend the A&E department. There was no association with emergency admission which is unsurprising considering the small number of ADE-related admissions ($n = 9$) recorded in this study. It would be interesting to examine this outcome in a larger sample with more power to answer this specific question. Overall, this study found no association between Beers PIP and ADEs, poorer HRQoL or emergency hospital attendance.

According to one review, the minimally important difference for the EQ-5D (ie, the change in score that is clinically meaningful) was 0.074 (ranging from -0.011 to 0.140) (17). This suggests that the association of PIP on HRQoL reported in this adjusted analysis of -0.11 is likely to be clinically important. It may be postulated that ADEs considered mild by clinicians (eg, easy bruising, urinary frequency, muscle pains) have an adverse impact on patients' HRQoL. Poorer HRQoL can also have important implications for future health; one study that recruited 439 older people from two health systems reported that a reduction in EQ-5D of 0.05 increased the risk of death at 5-year follow-up (18).

Context of This Research in Comparison With Previous Literature

Explicit measures of PIP and future ADEs

A recent cross-sectional study in Sweden ($n = 813$, aged ≥ 65 years) demonstrated an association between STOPP PIP and ADEs (PIP vs no PIP: 2.47 [95% CI 1.65, 3.69]) (8). In 2010, a retrospective Irish cohort study ($n = 931$, aged ≥ 70 years) reported an association between patients taking ≥ 2 STOPP PIP and ADEs (OR ≥ 2 PIP vs no PIP: 2.21 [1.02, 4.83]) (10). Similar studies examining the impact of the Beers criteria on ADEs have had mixed results, with one study

Table 2. Statistical Analysis: STOPP PIP and Adverse Health Outcomes Regression Models

	ADEs [†]	HRQoL (EQ-5D) [‡]	≥ 1 ED Visits [§]	≥ 1 Emergency Admission [§]
	Adjusted IRR, 95% CI	Adjusted Coefficient, 95% CI	Adjusted OR, 95% CI	Adjusted OR, 95% CI
1 PIP	0.85 (0.70, 1.03)	-0.002 (-0.04 , 0.04)	1.82 (1.15, 2.89)*	0.88 (0.59, 1.31)
≥ 2 PIP	1.29 (1.03, 1.60)*	-0.11 (-0.16 , -0.06)**	1.85 (1.06, 3.24)*	1.00 (0.63, 1.61)

Notes: STOPP PIP exposure at baseline, adjusted for confounders. Outcomes: ADEs, HRQoL (EQ-5D), ED visits, emergency admission.

ADE = adverse drug event; CI = confidence interval; HRQoL = health related quality of life; IQR = Inter Quartile Range; OR = odds ratio; PIP = potentially inappropriate prescribing; STOPP = Screening Tool for Older Persons potentially Inappropriate Prescriptions.

[†]Adjusted for age, gender, deprivation, education, social class, number of medications, comorbidity, and medication adherence.

[‡]Additionally adjusted for vulnerability, social support, and depression.

[§]Additionally adjusted for vulnerability and prior healthcare utilization.

* $p < .05$, ** $p < .001$.

Table 3. Methodological Quality Assessment of the Prospective Cohort Study

Methodological Quality Criteria	Definitely Yes	Probably Yes	Probably No	Definitely No
Was selection of exposed and non-exposed cohorts drawn from the same population?	*			
Can we be confident in the assessment of the exposure?	*			
Can we be confident that the outcome of interest was not present at the start of the study?	*			
Did the study match exposed and unexposed for all variables that are associated with the outcome of interest or did the statistical analysis adjust for these prognostic variables?	*			
Can we be confident in the assessment of presence or absence of prognostic factors?		*		
Can we be confident in the assessment of the outcome?	*			
Was the follow-up of the cohort adequate?	*			
Were co-interventions similar between groups?	*			

demonstrating an association (9,11). The current study builds on existing research by demonstrating a longitudinal association with STOPP PIP and ADEs for older people attending GP.

A recent inpatient Italian study ($n = 871$, ≥ 65 years) reported that the prescription of ≥ 2 STOPP PIP was associated with future ADEs (adjusted OR 2.36 [95% CI 1.10, 5.06]), while the same number of Beers 2003 PIP was not (adjusted OR 2.15 [95% CI 0.90, 5.14]) (19). In Ireland, a prospective A&E study ($n = 600$, ≥ 65 years) compared the measurement of PIP with STOPP and the 2003 Beers criteria in predicting subsequent ADEs at 4-month follow-up (20). The prescription of ≥ 1 STOPP PIP was associated with ADEs (adjusted ORs 1.85 [95% CI 1.51, 2.26]) while ≥ 1 Beers 2003 PIP was not (adjusted OR 1.28 [95% CI 0.95, 1.72]) (20).

Two large-scale retrospective studies using older iterations of the Beers criteria did not demonstrate any association between Beers PIP and ADEs. In a retrospective cohort study ($n = 5,152$ aged ≥ 65 years) of patients admitted to 81 hospitals in Italy between 1997 and 1998 use of Beers 2003 PIP was not associated with ADEs or mortality (21). In a French study ($n = 2,018$ aged ≥ 70 years) of patients admitted to a single acute geriatric unit Beers 1997 PIP was not associated with ADEs (22). The current study did not demonstrate any association between PIP identified by the Beers 2012 and subsequent adverse health outcomes. However, it's important to note that due to international variations in prescribing practices and medication availability, several of the U.S. Beers criteria were not applicable in this study setting. In addition, the prevalence of patients prescribed at ≥ 1 Beers 2012 PIP was lower at 26% compared to 40% prescribed ≥ 1 STOPP PIP.

PIP and other adverse health outcomes

In Ireland, a retrospective cohort study reported a statistically significant association between ≥ 2 STOPP PIP and poorer EQ-5D scores (adjusted $\beta -0.09$ [SE 0.02]) (10). The current study adds to this limited previous research by demonstrating a clinically significant reduction in HRQoL in older people taking ≥ 2 STOPP PIP over time. Previous research examining PIP and healthcare utilization has focused on other care settings with methodological limitations. A U.S. retrospective cohort study of older community-dwelling people ($n = 17,971$) reported that ≥ 1 PIP increased the odds of a hospital admission (OR 1.99, 95% CI 1.76, 2.26) and emergency room visits (OR 1.98, 95% CI 1.77, 2.20) compared to no PIP (23). In a second U.S. study ($n = 7,594$, ≥ 65 years) patients receiving nursing home care and prescribed ≥ 1 PIP were more likely to be hospitalized (adjusted OR 1.27; 95% CI, 1.10, 1.46) and to die (adjusted OR 1.46; 95% CI, 1.31, 1.62) (24).

Strengths and Limitations

This cohort study was carefully conducted adhering to the STROBE reporting guidelines. Methodological quality assessment indicates that the risk of bias is low. Use of linked national pharmacy claims data adds to the robustness of the calculation of the exposure variable (PIP) and confounder variables (eg, number of prescribed medication classes). Previous studies have often relied on self-report medication use which may not be as accurate, especially in older populations (25). ADEs were ascertained by a detailed patient interview and corresponding GP medical record review. All reported ADEs were independently reviewed and verified by two academic GPs, blinded to the prescribing criteria. In addition, each ADE was assessed regarding severity. A corresponding review of each study participant's GP medical record allowed for accurate recording of both comorbidity and emergency hospital attendance. As a result, this study was able to include several confounders in statistical analysis that were not included in previous studies such as medication adherence, deprivation and social support.

There are several limitations. First, this study included 15 GPs in one region of Ireland and as such may not be generalizable to other settings. A subset of the STOPP and Beers 2012 could not be applied to the pharmacy claims database due to inadequate clinical information. However, this issue is common to previous studies conducted in this area (26). The prevalence of reported ADEs was high (74%) when compared to previous studies, which ranged from 4.2% to 62% (27). However, previous community-based research has usually depended on patient self-report surveys to ascertain ADEs, rather than the symptom-based interview and medical record review utilized for this study (11,27). In addition, reported ADE prevalence at follow-up was broadly similar to that reported at baseline (78%), which used an identical process of ADE measurement (10).

Clinical and Future Research Implications

With increasing levels of multimorbidity and associated polypharmacy, optimizing safe prescribing for older people will be a key challenge for prescribers into the future. This study indicates that STOPP PIP has an independent association, beyond that of polypharmacy alone, with adverse health outcomes for older people.

One difficulty in deprescribing is the lack of evidence-based guidance to support this process, and the issue of clinical guidelines adopting a "single disease" focus that do not take the realities of multimorbidity and polypharmacy into account (28). Other barriers include concern about stopping medications started by different clinicians and knowledge gaps regarding which medications should be prioritized for cessation (29). Explicit prescribing criteria such as STOPP that are

linked to future adverse health outcomes offer a useful and evidence-based tool for clinicians to support medication reviews and deprescribing decisions. There is some randomized controlled trial evidence to support this approach. A recent Irish primary care randomized controlled trial ($n = 196$ patients aged ≥ 70 years) used the STOPP criteria to identify PIP and then implemented a multifaceted intervention involving pharmacist-led academic detailing and GP-led medication reviews supported by a web-based algorithm (30). This reduced PIP at 6-month follow-up (% with no PIP; intervention arm 47.5% vs control arm 22.7%: OR 3.1 95% CI 1.4, 6.5, number needed to treat [NNT] = 4) but was largely due to dose reduction or cessation of proton pump inhibitors (30). Another trial of 400 hospitalized patients aged ≥ 65 years which used screening with the STOPP and/or START criteria followed by recommendations to participants' attending physicians as the intervention, reduced PIP significantly at hospital discharge and 6-month follow up (absolute risk reduction 35.7%) (31).

Finally, as new evidence emerges drugs that were once considered potentially inappropriate may no longer be, highlighting the importance of revising prescribing indicators sets regularly. The STOPP criteria have recently been updated to reflect this and future studies should aim to use the most up to date version (32).

Conclusions

This study indicates that PIP identified using the STOPP criteria are associated with future ADEs, poorer HRQoL and A&E visits in older community-dwelling people. While there will be a clinical indication for a proportion of medications identified as potentially inappropriate, the STOPP criteria offer an evidence-based support for prescribers in conducting medication reviews for older people.

Supplementary Material

Supplementary material can be found at: <http://biomedgerontology.oxfordjournals.org>

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Conflict of Interest

The authors' have no conflicts of interest to declare.

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