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# The influence of written medication reminder on patient experience among older adult patients: a repeat cross-sectional study

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## Abstract

**Background** Older adult patients are particularly vulnerable to medication-related issues during the discharge process. To enhance medication discharge education and patient experience, a written medication reminder, incorporating crucial medication side effects and warning signs, was implemented in medicine wards. This study aimed to examine the influence of this reminder on patient experience and medication-taking behaviors among older adults in public healthcare settings.

**Methods** Two separate rounds of cross-sectional surveys were conducted before and after the program implementation among different discharged patients in each round. The study enrolled older adult patients aged  $\geq 65$  or their caregivers discharged from the medical wards of four pilot public hospitals in Hong Kong. A structured questionnaire was administered via telephone within 14 days of the patient's discharge. The survey assessed patients' experience with the provided medication information during discharge, including the clarity, adequacy, and usefulness of the information, as well as their overall experience with inpatient services. The self-reported medication-taken behaviors, including adherence and side-effect encounters, were also measured.

**Results** A total of 1,265 responses were collected before the implementation of the medication reminder, and 1,426 responses were obtained after the implementation. Pre/post-implementation survey comparison showed significant improvement in patient experience regarding the clarity of the provided medication information ( $7.93 \pm 1.84$  vs.  $8.18 \pm 1.69$ ,  $P=0.002$ ), adequacy ( $7.92 \pm 1.93$  vs.  $8.15 \pm 1.76$ ,  $P=0.014$ ), and usefulness ( $8.06 \pm 1.80$  vs.  $8.26 \pm 1.70$ ,  $P=0.017$ ), significantly positive experience on the overall discharge information ( $\beta$  coefficient, 0.43 [95%CI, 0.30 to 0.56]) and inpatient service ( $\beta$  coefficient, 0.47 [95%CI, 0.32 to 0.61]). In addition, the side effects encounters were significantly lower in the post-implementation survey group (11.6% vs. 9.0%,  $P=0.04$ ) and no statistical difference was found in self-reported medication adherence between the two groups.

**Conclusions** The provision of written medication reminders on key medication risks effectively improved older adult patients' experience and reduced side effects without any unintended negative consequences. The findings can serve as a reference for similar settings seeking to enhance post-discharge care among older adult patients. Future studies

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could investigate the influence in other specialties and age groups and include clinical outcomes to test the program's effectiveness.

**Keywords** Discharge education, Medication adherence, Medication information, Patient experience, Side-effects

## Background

Older adult patients are at high risk of experiencing medication-related problems due to comorbidities and polypharmacy [1]. Previous research has indicated that 37% of older adult patients experience medication-related harm, with 81% of them experiencing serious events [2]. These challenges are particularly prominent during the care transition period [3]. Evidence has shown that 16% of hospital readmissions are medication-related and 40% of them are preventable [4]. After discharge, the effectiveness of older adult patients' medication therapy depends on their self-management abilities or their caregivers' abilities in daily life [5]. It's crucial that they are well-informed about the safe use of their medications [6]. Studies have shown that providing adequate information on medication management can help older adult patients feel more satisfied with care experiences, which are key indicators of care quality and safety [7, 8]. However, previous studies have found that only a small portion of older adult patients are informed about the possible side effects of their medications, despite their preference for receiving such information compared to younger patients [9, 10]. Healthcare providers (HCPs) often hesitate to provide side effects information due to concerns about non-adherence to the treatment regimen [11].

Various interventions have been implemented to enhance discharge information transfer and patient recall of information using single or a combination of verbal, written, and technology-based methods [8, 12]. Among these, written materials are increasingly viewed as a vital component of patient education [13]. However, the effectiveness of written materials in improving patient experience with medication risk information has yielded limited and inconclusive results, often based on data from a single healthcare unit and measured using the U.S.-developed HCAHPS questionnaire or a single satisfaction-related item [14–20]. Furthermore, while studies have reported that patients perceive written information as enhancing their knowledge of medication and thereby promoting self-efficacy [13], few studies have analyzed this aspect specifically for older adult patients [21]. Additionally, the majority of evidence has been generated from Western countries, warranting further investigation in Asian regions where cultural factors can influence patient-provider communications and the design of patient-centered care. Evidence suggests the presence of hierarchies between health professionals and

patients, who often assume a passive and obedient role in Asian cultures [22]. It's also important to solicit information on caregivers because East Asian cultures prioritize filial piety, wherein people assume caregiving roles when a family member becomes ill and requires assistance [23].

With the Hong Kong (HK) Hospital Authority (HA) promoting the use of information technologies, every patient has been provided prescription slips containing a QR code for accessing detailed explanations of their prescribed medication. However, regular patient experience surveys conducted over the past eight years consistently highlight the perceived inadequacy of discharge medication information, including side effects and warnings [24, 25]. The effective utilization of electronic information depends on eHealth literacy to access the electronic system and the ability to comprehend the information. Passively disseminating eHealth information presents great challenges for older adults. To enhance discharge medication education and elevate patient experiences, a written reminder called patient discharge information summary (PDIS), incorporating tailored side effects and warning signs of medications, was designed [26]. The ultimate goal of this program is to enhance patients' self-care management abilities and reduce hospital readmissions. This study aimed to examine the influence of the PDIS on patient experience and medication-taking behaviors.

## Methods

### Study design

This study employed repeated cross-sectional surveys conducted before and after the launch of PDIS in 2017 and 2018 respectively, with different discharged patients in each round [27]. Ethical approval for the study was obtained from the Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee (ref 2017.296 and 2018.246), in compliance with the Declaration of Helsinki.

### Setting and sampling

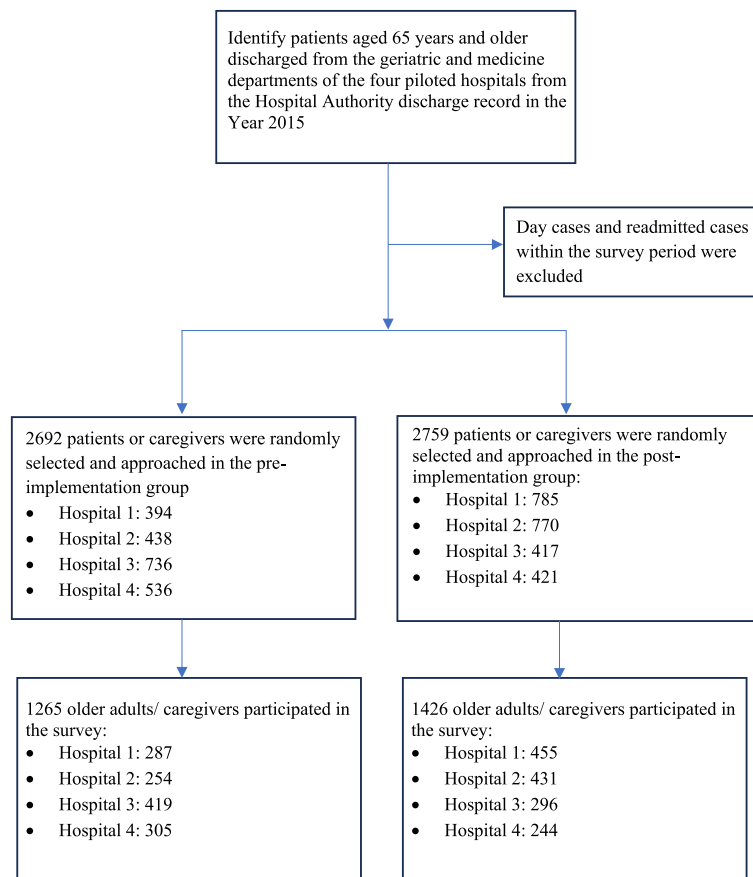
All HK public hospitals are clustered into seven geographical areas governed by HA. The PDIS was designed as a territory-wide initiative and was initially piloted and implemented in phases in the geriatric medical specialty of four public hospitals starting in January 2018 [28]. These four hospitals are general tertiary hospitals

from three clusters, with bed capacities ranging from 653 to 2,036. Patients aged 65 or above discharged from the geriatric and medicine departments of the pilot hospitals were invited to participate in surveys. Readmitted cases during the survey period and day patients were excluded from the survey (Fig. 1). The sample size estimation for the survey was based on the HA hospital inpatient discharge statistics in July 2015. A minimum of 1,450 respondents for both the pre-and post-implementation surveys were required to achieve a precision level of  $\pm 4\%$  at a 95% confidence level. The estimation was adjusted according to the size of each involved hospital. Considering a presumed 50% response rate based on previous patient experience surveys, at least 2,900 patients were randomly selected from the discharge records for both the pre-and post-implementation surveys. Surrogate responses from caregivers were allowed for patients incapable of responding on their own. Patients were contacted by telephone within 14 days of their respective discharge. The identical procedure for sample recruitment was applied for both pre- and post-implementation surveys. The pre-implementation survey was conducted

from June to December 2017, and the post-implementation survey took place from May to December 2018. Verbal consent was obtained from patients or their caregivers over the phone before proceeding with the telephone survey. To reduce non-response bias, at least five calls were made at different time points after each occasion with no response. Trained interviews provided clear information about the study’s background and the interview details and assurances regarding the confidentiality of the information collected.

**Intervention**

In usual practice (Table 1), all discharge patients receive a discharge slip including the diagnosis of the admission, medication and follow-up arrangement, follow-up appointment letters, and referral letters for future investigations upon their discharge. For medication information, a QR code is provided on the prescription slip of each medicine including the brand and generic name, usage, regime, effectiveness, and side effects or interactions. However, there is neither a standard practice nor mandatory regulation for HCPs to verbally explain the



**Fig. 1** Flow chart for participant recruitment

**Table 1** Standard discharge process vs. PDIS incorporated discharge process

	Usual practice	New practice when incorporating PDIS
Information provided	A discharge slip (in English) including the diagnosis of the admission, medication and follow-up arrangement. A QR code is provided on the prescription slip of each medicine for information including brand and generic name, usage, regime, effectiveness, and side effects or interactions	A discharge slip (in English) together with PDIS (in Chinese) which includes the warning message of the medications' side effects and the list of follow-up appointments in public hospitals. A QR code is provided on the prescription slip of each medicine for information including brand and generic name, usage, regime, effectiveness, and side effects or interactions
Who is responsible	Mainly nurses print and explain, but sometimes the explanations are handled by doctors or pharmacists if necessary	Mainly nurses print and explain, but sometimes the explanations are handled by doctors or pharmacists if necessary
What's the content	Mainly focus on medication usage/the changes compared to the admission, and information on follow-up appointments. No standardized information on medications' side effects. Nurses sometimes provide handwritten notes/leaflets to discharged patients/caregivers for self-care management	Advised to use PDIS as a reference to communicate with discharged patients/caregivers for explaining the medications and side effects/warning signals. Nurses sometimes provide leaflets to discharged patients/caregivers for self-care management
What's the process	Mandatory provision of discharge summary (English version only) and verbally explain the content, but voluntarily hand-write notes in Chinese for remarks on important issues to discharged patients/caregivers, especially the medications	Mandatory provision of discharge summary (in English) together with PDIS (in Chinese) form for discharged patients/caregivers. Verbally explain the contents to the discharged patients or caregivers
Caregiver involvement	No standard guidelines. Usually relying on the health status of the discharged patients and the proactive involvement of caregivers	No standard guideline. Usually relying on the health status of the discharged patients and the proactive involvement of caregivers. In addition, the nurses would suggest the discharged patients passing PDIS to their caregivers if they do not involve during the discharge

information listed above. Due to information overload and complexity, patients often do not actively access medication information through QR codes after discharge home [28]. To address this issue, the PDIS was developed to augment and highlight key discharge information. The development process involved collaboration among HA representatives, HCPs including doctors, nurses, pharmacists, and the information technology department to ensure its user-friendliness. The PDIS includes two essential parts for transitional care. The first part is the Salient Medication Reminder (SMR) highlighting the most relevant and critical side effects and warning signs of prescribed medications in simple Chinese language to cater to the local population. The second part lists all follow-up appointments under the HA in the upcoming days, including the date and time, venue, and specific follow-up items like consultations or investigations. To establish a consensus on the SMR, an expert consensus conference was conducted with 13 experts in geriatric medicine nominated from seven HA clusters. They joined the expert panel discussion to review the drug statements of the proposed drug entities. The final version of the SMR for 50 drug entities was confirmed after three rounds of the Delphi survey, covering 80% of medication use in older adult patients [26].

The PDIS was incorporated into the current electronic health record and can be autogenerated along with other discharge documents. Nurses were designated to print and deliver the intervention and received notification and basic training on how to print PDIS forms through the electronic health record system, the content of the PDIS form, and the importance of including this new form in the set of discharge documents provided to patients or caregivers upon discharge. All patients were expected to receive this written reminder. It was mandatory for all nurses to print and distribute this material to their daily discharge cases. Additionally, all nurses were expected to verbally explain the side effects of each medication listed on the PDIS. The teach-back technique was not applied at the time of program introduction.

### Outcome measures

The primary outcome was the patients' experience with medication information, specifically focusing on the clarity, adequacy, and usefulness of the information regarding medication side effects, warning signs, and overall medication details. Additionally, the overall experience with discharge information and inpatient experience were assessed. The secondary outcome was the medication-taking behaviors, including self-reported adherence to medication regimens and side effects encounters.

### Data collection instrument

The questionnaire (Additional file 1) consisted of three sections: patient experience, medication-taking behavior, and patient characteristics. The patient experience section included nine items adapted from the validated assessment tool "Short-form Hong Kong Inpatient Experience Questionnaire" [29] to standardize items related to discharge medication information provision along the inpatient journey. These items assessed: (1) the clarity of all provided medication information; (2) the adequacy of the information presented; and (3) the usefulness of the information, each rated on a scale from 0 to 10 (strongly disagree to strongly agree). Two additional items from the validated tool assessed overall inpatient experience using a scale of 0 to 10, and whether the discharge information strengthened self-care with a binary response (Yes/ No). In addition, the patient experience of overall discharge information received was assessed with a score ranging from 0 to 10 (poor to excellent). The Cronbach's alpha for this section is 0.87, indicating good reliability. The section on self-reported medication-taking behavior was developed based on the MMAS-4 item [30] and literature on side effects [31]. It consisted of two items: (1) ever forgetting to take medicine, and (2) ever encountering medication side effects, both measured with a binary response (Yes/ No). Patient characteristics, including age, gender, education level, living status, employment status, government subsidy, comorbidities, and self-reported health status using the VAS of the EQ-5D-5L HK [32], were collected in the final section of the telephone interview. A pilot of 20 interviews was conducted to assess the understandability of the questionnaire from the patient's perspective and to evaluate the feasibility of the logistics involved in conducting a telephone survey. Since all pilot participants found the questionnaire satisfactory, their responses were included in the final analysis as recruited cases, and no adjustments were made to the questionnaire. The post-implementation survey was conducted six months after the implementation of the PDIS programme to ensure the new intervention was well in place.

### Statistical analysis

Data analysis was performed using IBM SPSS Statistics, version 26 (IBM Corp, Armonk, NY). Patient characteristics between pre/ post-test samples were compared using the t-test or Chi-squared test to evaluate group heterogeneity. The pre/ post-test patient experience scores on discharge medication information, overall discharge information, and inpatient experience were compared using the Mann-Whitney U test. Univariate and multiple linear regression analyses were conducted to assess the effect of this practice on patient experience with discharge information and inpatient

experience using four models: Model 1 examined the association between receiving the service and patient experience without adjusting for any covariates; Model 2 included basic demographic characteristics (age and gender); Model 3 included socioeconomic factors on top of Model 2 (education, employment, living status, and government subsidy); and Model 4 was fully adjusted by adding patient conditions (number of complications and EQ5D-VAS). All these covariates have been reported to be associated with the outcome variable in previous studies [33]. Patient perspectives on medication side effects and warning signs were compared by Chi-squared test. Patients whose answers were identified as “not applicable” (e.g., patients discharged without medication or patients who had not received any information on side effects and warning signs) were excluded from the analysis. Information usefulness for self-care and caregivers was compared by Chi-squared test excluding “not applicable” cases (e.g., patients who never told this information to caregivers or patients living alone). Self-reported medication side-effects encounters and adherence were compared by the Chi-square test. According to the statistical guideline [34], we allowed for up to 10% missing data to avoid bias in the analysis. A post hoc subgroup analysis

of patient-reported outcomes and caregiver-reported outcomes was performed. The person who conducted the statistical analysis was not involved in data collection and program implementation.

## Results

A total of 2,691 responses were received, with 1,265 (47%) and 1,426 (53%) responses collected via the pre- and post-implementation survey, respectively (Fig. 1). The response rates were 55.5% for the pre-implementation and 59.4% for the post-implementation. The demographic composition was similar between the pre- and post-implementation groups in terms of age, gender, education level, living and employment status, and the number of complications, except that 6.6% more participants were receiving government subsidies in the post-implementation group with a statistical significance (Table 2).

## Patient experience

Comparisons between the pre- and post-implementation groups revealed significant improvements in patient experience regarding the clarity ( $7.93 \pm 1.84$  vs.  $8.18 \pm 1.69$ , respectively,  $P=0.002$ ), adequacy ( $7.92 \pm 1.93$

**Table 2** Demographic information of participants between pre-and post-implementation survey groups

Characteristics	Total N= 2691	Pre-implementation N= 1265	Post-implementation N= 1426	P Value*
<b>Age, Mean (SD)</b>	77.48 (7.98)	77.37 (8.01)	77.58 (7.96)	0.487
<b>Gender, n (%)</b>				0.445
Female	1215 (45.2)	581 (45.9)	634 (44.5)	
Male	1476 (54.8)	684 (54.1)	792 (55.5)	
<b>Education, n (%)<sup>a</sup></b>				0.161
≤High school	2455 (91.2)	1168 (92.3)	1287 (90.3)	
College	71 (2.6)	29 (2.3)	42 (3.0)	
≥College	131 (4.9)	53 (4.2)	78 (5.5)	
<b>Living status, n (%)<sup>b</sup></b>				0.722
Living alone	340 (12.6)	166 (13.1)	174 (12.2)	
Living with companions	2339 (86.9)	1098 (86.8)	1241 (87.0)	
Living in institutions	3 (0.1)	1 (0.1)	2 (0.1)	
<b>Employment status, n (%)<sup>c</sup></b>				0.057
Unemployed	2601 (96.7)	1217 (96.2)	1384 (97.1)	
Employed	78 (2.9)	45 (3.6)	33 (2.3)	
<b>Government subsidy, n(%)<sup>d</sup></b>				<0.001
Yes	2143 (79.6)	969 (76.6)	1174 (82.3)	
No	548 (20.4)	296 (23.4)	252 (17.7)	
<b>Number of complications*, Mean (SD)<sup>e</sup></b>	1.48 (1.06)	1.49 (1.06)	1.47 (1.06)	0.622

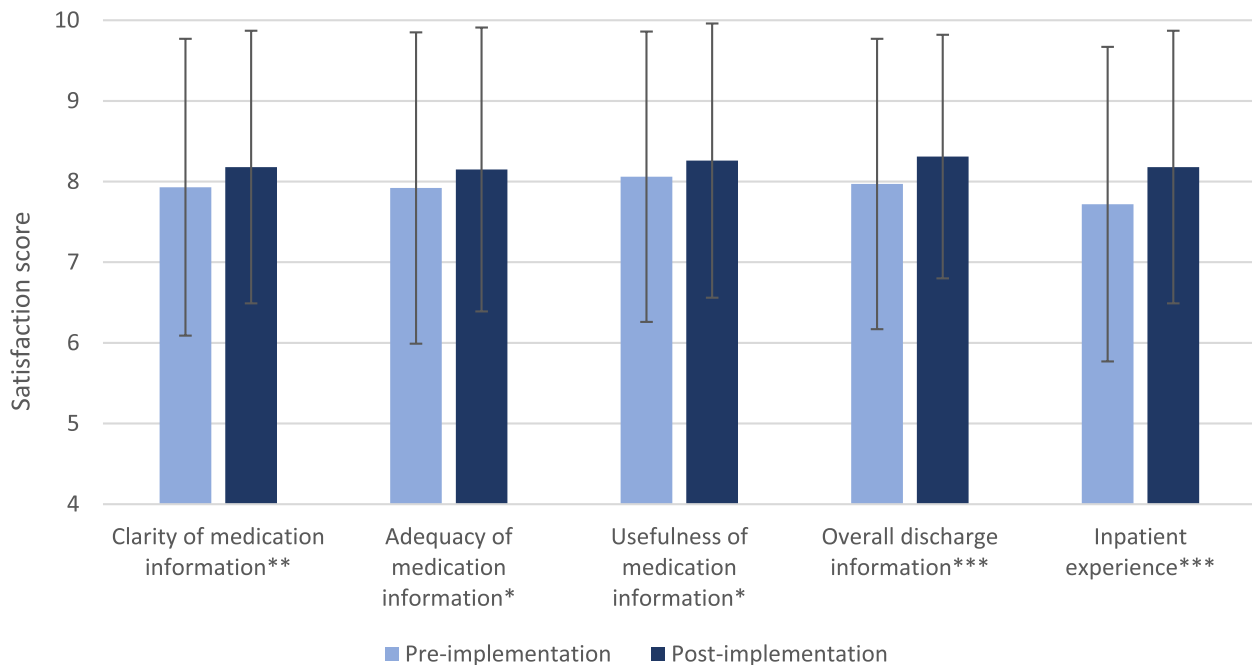
\* Complications including deaf, blindness, physical disability, learning disability, mental health disorders, heart disease, hypertension, diabetes, cancer

\* P-value was obtained from the independent sample t-test or Chi-squared test

There are <sup>a</sup>: 34, <sup>b</sup>: 9, <sup>c</sup>: 12, <sup>d</sup>: 21, and <sup>e</sup>: 22 missing values excluded from the analysis

vs.  $8.15 \pm 1.76$ , respectively,  $P=0.014$ ), and usefulness ( $8.06 \pm 1.80$  vs.  $8.26 \pm 1.70$ , respectively,  $P=0.017$ ) of discharge medication information after the implementation of PDIS. Patients in the post-implementation group exhibited significantly higher satisfaction with overall discharge information ( $7.97 \pm 1.80$  vs.  $8.31 \pm 1.51$ , respectively,  $P<0.001$ ) and inpatient experience ( $7.72 \pm 1.95$  vs.  $8.18 \pm 1.69$ , respectively,  $P<0.001$ ) (Fig. 2). When analyzing responses separately from patients (Additional file 2), improvements in the experience of medication information's usefulness ( $P<0.05$ ), overall discharge information ( $P<0.001$ ), and inpatient experience were statistically significant ( $P<0.001$ ). Only the clarity of medication

information showed significant improvement ( $P<0.05$ ) based on responses from caregivers. Statistical test was conducted using the Mann–Whitney U test. The univariate linear regression estimates (Table 3) showed that patients in the post-implementation group scored 0.346 (95% CI [0.216, 0.475]) and 0.348 (95% CI [0.201, 0.494]) higher on average than those in the pre-implementation group in terms of overall discharge information and inpatient experience, respectively, in the crude model. The estimates remained statistically significant, and the effect size increased after adjusting for all covariates for both discharge information (0.43, [0.301, 0.560]) and inpatient experience (0.467, [0.320, 0.614]) with running multiple



**Fig. 2** Patient or caregivers' satisfaction with discharge medication information, overall discharge information, and inpatient experience between pre-and post-implementation survey groups.  $P$ -value was obtained from the Mann–Whitney U test. \*:  $p < 0.05$ ; \*\*:  $p < 0.01$ ; \*\*\*:  $p < 0.001$

**Table 3** Impact of the intervention on the satisfaction of discharge information and inpatient experience estimated from the multivariate linear regression model, respectively

Model	Satisfaction on discharge information (N = 2525)		Satisfaction on inpatient experience (N = 2518)	
	Coefficient	95% CI	Coefficient	95% CI
Model1: No covariates	.346	[.216, .475]	.348	[.201, .494]
Model2: With demographics (age, gender)	.348	[.218, .477]	.347	[.201, .494]
Model3: With demographics + socioeconomics <sup>a</sup>	.348	[.217, .478]	.364	[.216, .513]
Model4: With demographics + socioeconomics + complications + EQ-VAS	.430	[.301, .560]	.467	[.320, .614]

<sup>a</sup> Socioeconomics includes education, employment status, living status, and government subsidy. Statistical results were obtained by running univariate linear regression and multiple linear regression models

linear regression models. A similar pattern was observed when considering only participants who responded for themselves regarding satisfaction with discharge information (0.428, [0.271, 0.586]) and inpatient experience (0.493, [0.316, 0.670]). Regarding responses from caregivers, the estimates became statistically significant after adjusting for all confounders for discharge information (0.362, [0.130, 0.594]) and inpatient experience (0.28, [0.013, 0.548]), but not in the crude model (Additional file 3).

### Perspectives of the information on medication side effects and warning signs

Table 4 shows patients' perceptions of information on side effects and warning signs by conducting the Chi-squared test. In terms of information adequacy, a significantly higher percentage of patients in the post-implementation group reported receiving "just the right amount" of information on side effects (86.4% vs. 95.7%, respectively,  $P < 0.001$ ) and warning signs (92.3% vs. 96.6%, respectively,  $P = 0.004$ ). Regarding information clarity, a higher percentage of patients in the post-implementation group rated "very clear" on both side effects (68.8% vs. 73.3%) and warning signs (70.3% vs. 76.9%), with the difference in warning signs reaching marginal significance ( $P = 0.058$ ). In terms of information usefulness, a significantly higher percentage in the post-implementation group rated "very useful" for warning signs (69.5% vs. 76.3%,  $P = 0.002$ ), although the increase for side effects (68.2% vs. 73.0%) did not reach statistical significance. There was no statistically significant evidence regarding information usefulness for self-care. However, a significantly higher percentage of respondents in the post-implementation group indicated that the information was very useful for their caregivers (53.1% vs. 60.6%,  $P = 0.013$ ). The same pattern was observed when analyzing patient-reported answers but not caregiver-reported answers regarding the adequacy and usefulness of information on warning signs (Additional file 4).

### Medication-taking behaviour

Table 4 shows that no statistically significant difference was found in the percentage of patients who reported medication adherence when comparing the pre- and post-implementation groups using the Chi-squared test. In addition, the Chi-squared test showed that the percentage of people who reported experiencing side effects was significantly lower in the post-implementation group (11.6% vs. 9.0%,  $P = 0.036$ ), indicating that receiving risk information may not induce more experiences of side effects but rather reduce side effects experiences among older adult patients. Among the 111 participants (9%)

reporting side-effect encounters, the majority of them (86.4%) adhered to their medication regimens.

## Discussion

### Summary of main findings

Our results showed that older adult patients or their caregivers who received the written medication reminder were more satisfied with discharge medication information, overall discharge information, and inpatient experience compared to the pre-implementation of PDIS in which patients were only provided with the QR code to access medication information. In addition, our evidence suggests that enhancing risk information communication did not induce unwanted outcomes such as medication regimen nonadherence or an increase in side effects experiences. Specifically, for both side effects and warning signs, although the perceived information adequacy was enhanced, the information clarity should be improved to ensure better understanding among older adult patients and caregivers. The medication risk information was perceived to be more useful to caregivers rather than patients themselves for self-care purposes.

The passive distribution of eHealth information alone might not facilitate patients' access to medication information or improve their experience with discharge instructions for older adult patients because it is contingent upon their abilities to navigate electronic systems and understand the provided information [35]. The improved patient experience after providing an enhanced structure of written information on medication side effects and warning signs, supported by nurses' verbal explanations, echoed the previous evidence of the positive association between the delivery of written medication information and patient experience [15, 16]. Moreover, this study enriched the existing evidence base by introducing findings within a new cultural context—the Asian older adult patients and their caregivers. However, there remains a need for further improvement in the perceived clarity of information on side effects and warning signs in this vulnerable group which echoed previous evidence [36]. This might be due to the prevalence of low health literacy among older adult patients [37]. The format of the risk information applied also impacts comprehension. Previous evidence has shown that patients might overestimate the possibility of side effects when presenting risk information with qualitative terms [38]. Potential strategies to enhance patient understanding include employing the teach-back method to confirm comprehension [39], utilizing written materials with appropriate visual aids such as instructional graphics [40], and involving consumers in the design of the information [41]. These strategies support the refinement



**Table 4** Comparison of the patient or caregivers' perceptions of medication side effects and warning signs and medication-taking behaviors between pre-and post-implementation survey groups

Items	Total N = 2691	Pre-test N = 1265	Post-test N = 1426	P Value*
<b>Perspectives of the Information on Medication Side Effects and Warning Signs</b>				
<b>Clarity, n (%)</b>				
Side effects	963 (35.8)	423 (33.4)	540 (37.9)	0.152
Very clear	687 (71.3)	291 (68.8)	396 (73.3)	
To some extent	258 (26.8)	121 (28.6)	137 (25.4)	
No	18 (1.9)	11 (2.6)	7 (1.3)	
Warning signs	930 (34.6)	458 (36.2)	472 (33.1)	0.058
Very clear	685 (73.7)	322 (70.3)	363 (76.9)	
To some extent	232 (24.9)	130 (28.4)	102 (21.6)	
No	13 (1.4)	6 (1.3)	7 (1.5)	
<b>Adequacy, n (%)</b>				
Side effects	957 (35.6)	418 (33.0)	539 (37.8)	< 0.001
Just right amount	877 (91.6)	361 (86.4)	516 (95.7)	
Not enough	80 (8.4)	57 (13.6)	23 (4.3)	
Warning signs	927 (34.4)	454 (35.9)	473 (33.2)	0.004
Just right amount	876 (94.5)	419 (92.3)	457 (96.6)	
Not enough	51 (5.5)	35 (7.7)	16 (3.4)	
<b>Usefulness, n (%)</b>				
Side effects	955 (35.5)	415 (32.8)	540 (37.9)	0.257
Very useful	677 (70.9)	283 (68.2)	394 (73)	
To some extent	264 (27.6)	126 (30.4)	138 (25.6)	
No	14 (1.5)	6 (1.4)	8 (1.5)	
Warning signs	926 (34.4)	453 (35.8)	473 (33.2)	0.002
Very useful	676 (73.0)	315 (69.5)	361 (76.3)	
To some extent	236 (25.5)	135 (29.8)	101 (21.4)	
No	14 (1.5)	3 (0.7)	11 (2.3)	
<b>Usefulness to self-care, n (%)</b>				
Very useful	2649 (98.4)	1255 (99.2)	1394 (97.8)	0.089
Very useful	1524 (57.5)	746 (59.4)	778 (55.8)	
To some extent	982 (37.1)	438 (34.9)	544 (39)	
No	143 (5.4)	71 (5.7)	72 (5.2)	
<b>Usefulness to the caregivers, n (%)</b>				
Very useful	1543 (57.3)	679 (53.7)	864 (60.6)	0.013
Very useful	885 (57.4)	355 (53.1)	530 (60.6)	
To some extent	557 (36.1)	263 (39.4)	294 (33.6)	
No	101 (6.5)	50 (7.5)	51 (5.8)	
<b>Medication-taking Behaviours</b>				
<b>Self-reported side effects encounter, n (%)</b>				
Yes	2318 (86.1)	1083 (85.6)	1235 (86.6)	0.036
Yes	237 (10.2)	126 (11.6)	111 (9.0)	
No	2081 (89.8)	957 (88.4)	1124 (91.0)	
<b>Self-reported medication adherence, n (%)</b>				
Yes	2326 (86.4)	1086 (85.8)	1240 (87.0)	0.385
Yes	2227 (95.7)	1044 (96.1)	1183 (95.4)	
No	99 (4.3)	42 (3.9)	57 (4.6)	

\* P-value was obtained from the Chi-squared test

of our program and offer avenues for future evaluation studies.

Furthermore, according to patients' feedback, discharge medication information regarding side effects

and warning signs was found to be more beneficial for caregivers in their role of caring for patients. This may be attributed to the possibility that family members of older adult patients often assist in various medication

management activities, including medication administration, adverse reaction identification, and seeking information clarification after discharge [42]. Therefore, it is crucial to involve caregivers in patient education, especially when older adult patients, who may be discharged with cognitive deficits, are unable to receive and retain self-care knowledge [43]. However, a systematic review evaluating family involvement in medication management for older patients across care transitions revealed that communication between family members and HCPs was often disorganized, placing an increased burden on caregivers for post-discharge care [44]. Consequently, future research on evidence-based strategies for supporting caregivers' roles is needed.

One concern that HCPs had regarding communicating medication risk information at discharge was the potential decrease in medication adherence and an increase in more side effects symptom experiences [11]. However, our study showed that providing information on possible side effects/ warning signs did not result in reduced medication adherence or an increase in side-effect encounters, which is consistent with previous evidence from Western countries [45]. It is possible that acknowledgment of potential side effects may actually reassure patients and encourage adherence to their medication regime. Nevertheless, it is important to note that this evidence may not support a one-size-fits-all approach, as patients' preferences towards risk information may vary. Previous evidence indicated that some patients did not want to receive side effects information due to anxiety about the negative impact [46]. Strategies to offset the fear of risk information could involve providing both benefit and risk information to patients and applying techniques like clinician-expressed empathy to reassure patients with continuing support [47].

Since the PDIS programme was a hospital-wide initiative in the four pilot hospitals, it was expected that all patients would receive the written medication information. However, we observed that a majority of patients or caregivers selected "not applicable" when asked about their perspective on side effects and warning signs, indicating that they may not have received this information from nurses. One possible reason could be that patients may ignore this written material if it is not accompanied by oral notification from HCPs. Research showed that HCPs often consider written information as an alternative to oral communication [48] even though we required nurses to explain the critical information on PDIS. However, it is crucial to recognize that oral notification cannot be substituted with written materials, especially when patients are typically passive and rarely initiate discussions about possible side effects in a culture with hierarchies between health professionals and patients

[22]. Time constraints are a common barrier that may contribute to the lack of communication [49]. Additionally, nurses may perceive their role in medication education as secondary to physicians or pharmacists due to a perceived lack of professional knowledge and confidence [50]. Research has shown that interdisciplinary collaboration among physicians, nurses, and pharmacists is effective in managing patient medications [51]. Future research is warranted to have a comprehensive investigation of the determinants of program implementation from the HCPs' side and design corresponding strategies to maximize the program's influence.

#### **Limitations and strengths**

There are several limitations of our study. Firstly, a repeated cross-sectional survey design was adopted instead of a follow-up survey. This may reduce the accuracy of findings regarding individual changes in behavior and experience over time. However, this design helps avoid certain limitations of a one-group design such as testing bias due to familiarity with the assessment instrument, loss of follow-up, and time-consuming procedures [52]. Secondly, participants differed significantly on some characteristics. These factors were adjusted for in the analysis, but there remains a concern that groups may differ by other important unmeasured covariates such as patients' medication profiles. Future studies could investigate program effectiveness stratified by the complexity of patient medication profiles or clinical conditions. Thirdly, recall bias may exist because responses were measured subjectively. Medication adherence and side effects experiences may not have been accurately reported. Nonetheless, the primary outcome of our study, patient satisfaction, was not affected. Future studies using validated medication adherence measures are warranted to provide more objective outcomes. Lastly, the implementation process, such as how well nurses communicated this information to patients, may impact the outcomes. However, this study was unable to report this information due to a primary focus on patient-reported data. Future studies should aim to formulate a comprehensive evaluation of the program implementation.

This study has several strengths. To our knowledge, this is the first study conducted in East Asia investigating the relationship between patient experience and medication discharge education using written materials, as well as the nocebo effect after providing medication risk information to older adult patients. In the context of growing interest in digital health technologies, our study results enrich the current evidence base by highlighting the influence of traditional written medication materials on discharge education for older adults. Moreover, this study recruited a large sample from multiple hospitals.

This multi-center approach enhanced the generalizability of our findings and served as a valuable reference for similar settings aiming to enhance post-acute care for older adults.

## Conclusions and Implications

Well-informed patients and caregivers may better differentiate temporary or insignificant side effects from severe reactions, therefore developing appropriate care-seeking behavior such as self-caring for the former and acquiring professional services for the latter. Medication education on risk information has the potential to empower patients and caregivers without causing unwanted nonadherence to medication regimens or increased experiences of side effects, therefore improving patient experience with discharge information and inpatient experience. Complementing the passive provision of electronic medication information with written reminders along with nurses' explanations of key medication side effects and warning signs appears beneficial for post-discharge management among older adult patients. Future studies could investigate the influence of written medication information in other specialties and age groups, and include clinical outcomes as indicators to test the effectiveness of this intervention. Studies investigating perspectives from the provider and comparing the patient-provider differences could also contribute to a deeper understanding of the feasibility of the intervention.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12877-024-05253-1>.

Supplementary Material 1.  
Supplementary Material 2.  
Supplementary Material 3.  
Supplementary Material 4.

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## Authors' contributions

ELYW, KST, and EKY conceived the study design. ELYW and KST were the project in-charge of leading the study. YXW, ELYW, and AWLC extracted the data and conducted the analysis with input from all authors. HQ provided statistical advice. YXW and ELYW drafted the manuscript and all authors edited the manuscript. All authors read and approved the final manuscript.

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## Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available. They contain information that could compromise research participant privacy but are available from the corresponding author upon reasonable request. The study reported in the manuscript was not pre-registered.

## Declarations

### Ethics approval and consent to participate

The present study was conducted in collaboration with Hong Kong Hospital Authority. For the patient experience telephone survey involving human participants, verbal informed consent to participate in the study was sought before the subjects agreed to join the telephone interviews. The script used in this study when obtaining verbal consent was approved by the Hospital Authority's Cluster Clinical Research Ethics Committee. Ethical approval for the study has been sought and approved by the Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee (ref 2017.296 and 2018.246) in compliance with the Declaration of Helsinki.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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