



Collaboration between hospital and community pharmacists to address drug-related problems: The HomeCoMe-program



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ABSTRACT

Background: Hospital discharge poses a significant threat to the continuity of medication therapy and frequently results in drug-related problems post-discharge. Therefore, establishing continuity of care by realizing optimal collaboration between hospital and community pharmacists is of utmost importance.

Objective: To evaluate the collaboration between hospital and community pharmacists on addressing drug-related problems after hospital discharge.

Methods: A prospective follow-up study was conducted between November 2013–December 2014 in a general hospital and all affiliated community pharmacies. Adult patients, admitted for ≥ 48 h to the neurology or pulmonology ward were eligible if they used ≥ 3 chronic prescription drugs and lived in the community pharmacies' service area. The HomeCoMe intervention program was comprised of medication verification and counseling at admission, medication screening by the hospital pharmacist during admission, outpatient pharmacy discharge consultation and support, and a community pharmacist home visit within one week post-discharge.

Results: The mean age of the 152 included patients was 67.0 ± 12.6 years and 56.6% were female. A total of 745 DRPs (4.9 ± 2.2 DRPs per patient, range: 0–11) were identified with the need for additional “Education or information” (36.1%) and “Compliance” (16.4%) issues as most common DRP-types. This led to a total of 928 recommendations (6.1 ± 3.0 per patient, range: 1–19) to solve the DRP. The majority of DRPs were identified (83.6%, $n = 623$) and solved (91.6%, $n = 682$) by the community pharmacist during the home visit. Furthermore, 52.5% ($n = 64$) of the DRPs identified during hospitalization were solved during the post-discharge home visit.

Conclusions: Collaboration between hospital and community pharmacists from hospital admission to readmission to primary care is crucial to establish continuity of care. A post-discharge community pharmacist home visit is a valuable addition to in-hospital transitional care to identify and solve drug-related problems.

1. Introduction

Hospital discharge poses a significant threat to the quality and continuity of medication therapy due to multiple changes in patients' medication regimens, reduced ability of patients to absorb information on disease management including relevant information on medication, suboptimal information transfer across settings, and insufficient follow-up.¹ This fragmented care can result in drug-related problems (DRPs) post-discharge, leading to adverse outcomes ranging from patient discomfort or dissatisfaction to preventable adverse drug events resulting in increased healthcare utilization.^{2–4} Thus, establishing continuity of care after hospital discharge is of utmost importance.

Continuity of care is a complex and interdisciplinary process.

Hospital pharmacists have been shown to play a pivotal role in informational and educational aspects of transitional care by transferring discharge information and providing patient counseling services.^{5,6} Back home, adequate follow-up is necessary as patients may be confronted with, for example, adherence problems due to inadequate knowledge or lack of understanding about their (new) treatment or regimen complexity.^{7,8} Although hospital pharmacists can effectively be deployed in outreach programs, capitalizing on the existing primary care structure might experience fewer barriers in implementation and finances. As patients need to collect their discharge prescriptions, community pharmacists are generally the first primary care provider consulted by patients post-discharge and therefore well-suited to address post-discharge DRPs and reinforce the hospital discharge plan.

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Their receipt of the complete hospital medication discharge plan is a prerequisite, as it enables them to gain a more complete clinical picture of the patient.⁹ However, in the current setting, the community pharmacist usually does not have access to this information. Therefore, close collaboration between community pharmacists and their hospital-based colleagues is necessary to facilitate timely and adequate management of DRPs.¹⁰

The HomeCoMe (Home-based Community pharmacist-led Medication management) program was designed to establish continuity of care by realizing optimal collaboration between hospital and community pharmacists.¹¹ The objective of the current study was to evaluate this collaboration on addressing drug related problems after hospital discharge.

2. Methods

2.1. Study design and setting

A prospective follow-up study was conducted in a general non-teaching hospital (Flevoziekenhuis, 385 beds), an outpatient pharmacy, and all community pharmacies in Almere, the Netherlands. The city of Almere has approximately 200,000 inhabitants. Patients were recruited in person upon admission to the neurology or pulmonology ward. The neurology and pulmonology wards were selected as they represent two “types” of patients (pulmonology: patients with a chronic, but unstable, illness and neurology: newly diagnosed patients).

Four hospital pharmacists were involved in this study. In the Netherlands, hospital pharmacists require an additional four years of training after graduating as a PharmD. In Almere, it is usual care for them to be involved in order verification. The involved outpatient pharmacy is owned by the largest primary care organization in the city and has an excellent relationship with the hospital.

All twenty community pharmacies of Almere owned by three separate organizations were involved in this study. This provided access to the majority of patients in the service area of this single hospital in the city, preventing selection bias. Twenty-six community pharmacists performed the post-discharge intervention. In the Netherlands, all community pharmacies keep electronic dispensing data, perform clinical risk management at time of dispensing and are generally well-informed about their patients' medication regimen due to limited pharmacy shopping behavior and local networks of pharmacy information systems.^{12,13} In Almere, all community pharmacists share the same pharmacy information system. Recently, Dutch community pharmacists were recognized as healthcare specialists equivalent to in-hospital specialists and general practitioners. Patients were enrolled between November 2013–December 2014.

2.2. Patients

Patients were eligible if they were aged 18 years or older, used three or more prescription drugs for chronic use, were admitted for at least 48 h, and were living in the service area of the participating community pharmacies. Patients were excluded if they were transferred from another hospital and/or non-eligible wards, participated in a conflicting study, refused informed consent, or were discharged to somewhere other than their own home (e.g. a nursing home or rehabilitation center).

2.3. Ethics approval

Formal ethical approval was obtained from the ethics committee of the Radboud University Nijmegen Medical Centre. Local approval was obtained from the scientific committee of Zorggroep Almere and Flevoziekenhuis.

2.4. The HomeCoMe intervention

All patients received usual care during their hospitalization, comprised of medication verification at admission and discharge performed by a pharmacy technician. For this study, the HomeCoMe-program was added to usual care. The rationale behind the program is described elsewhere.¹¹

Hospital pharmacy staff complemented the usual medication verification at admission with a structured patient consultation protocol to identify existing DRPs, such as drug-taking issues or side effects. Next, a hospital pharmacist screened high-risk medication on potential DRPs with the help of a trigger list.¹⁴ All identified DRPs were addressed and, together with information on performed actions, documented on a registration form. This form accompanied the patients throughout their hospital journey. At hospital discharge, the outpatient pharmacy collected this form together with the discharge prescription and performed a structured patient discharge consult with medication verification. Additional identified DRPs were documented and addressed. Finally, the outpatient pharmacy acted as a discharge coordinator by verifying patients' administrative information, reiterating important study information and transferring all medication-related information on paper or by fax to the patients' own community pharmacist. The outpatient pharmacists stayed in contact with the community pharmacist in case they had any questions concerning the transferred data.

Within a week post-discharge, the community pharmacist performed a home visit, since the risk of adverse events is high in the period shortly after discharge.^{15,16} During the home visit, the community pharmacist evaluated all medication that patients kept at home, including discontinued prescription drugs and non-prescription drugs. Furthermore, the community pharmacist (1) assessed patients' medication knowledge, (2) identified adherence barriers, and (3) determined patients' needs and concerns.¹¹ The visits were guided by a semi-structured protocol comprising two instruments: (1) assessment of medication knowledge based on the study of Kwint et al. and (2) identification of possible adverse drug events using a trigger list developed by Sino et al.^{17,18} An expert panel consisting of a general practitioner (GP) and four community pharmacists commented on the applicability of the protocol.

All participating community pharmacists had experience with performing medication reviews. To ensure further generalizability and robustness in conducting the home visits, pharmacists received a 1-day training course on patient-centered communication and use of the HomeCoMe protocol. The community pharmacists documented all DRPs that were identified during the post-discharge home visit, contacted the GP or specialist by phone or in person, if necessary, and discussed their recommendations with the patient.

2.5. Definition of outcomes and data classification

The primary study outcome was the frequency and nature of drug-related problems (DRPs) classified according to the D.O.C.U.M.E.N.T. classification using the version of Kwint et al.¹⁷ This version was adapted from the original D.O.C.U.M.E.N.T. with permission.^{19–22} Some subcategories were added to further refine the classification for the purpose of this study (e.g. on DRPs concerning patient education, [Appendix I](#) and [II](#)). Secondary outcomes were the recommendations of the community pharmacists to solve an identified DRP and physicians' acceptance rate of these recommendations.

Besides general characteristics (e.g. gender, age), the Medication Regimen Complexity Index (MRCI) was determined at hospital discharge based on the hospital discharge prescription. A higher MRCI represents a more complex medication regimen taking the number of (prescription) drugs, the dosage form, the dosing frequency and additional directions into account.²³ Finally, the LACE-score was calculated by the length of stay (L), the acuity of admission (A), the Charlson comorbidity score (C), and the number of emergency department visits

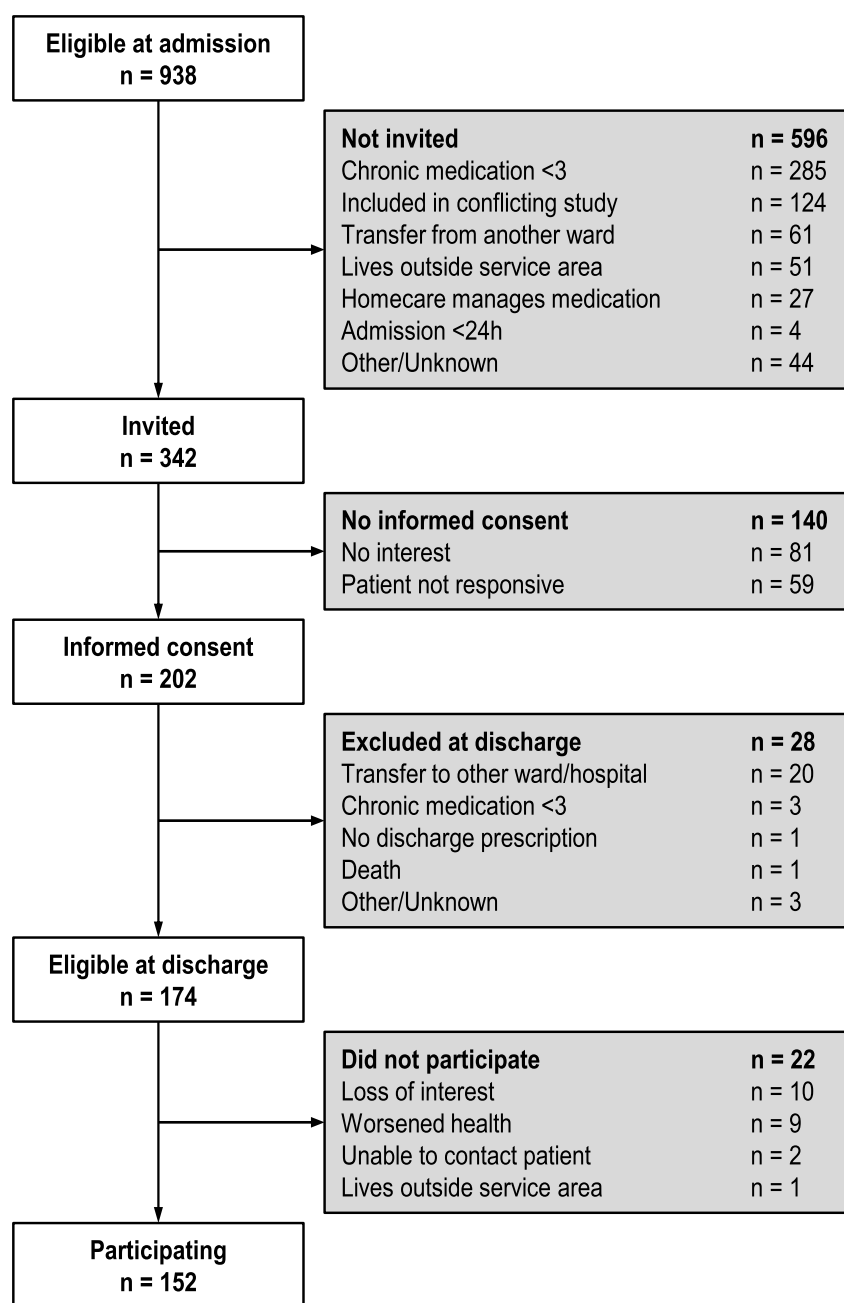


Fig. 1. Patient-flow chart.

in the last six months (E). A higher LACE-score predicts an increased risk of mortality or unplanned readmission within one year after the index hospitalization.²⁴

2.6. Data analysis

Coding and classification were independently determined by two investigators (H.E. and D.D.). Differences were resolved during discussion and, if necessary, a third investigator (either E.K. or M.B.) was consulted. Descriptive statistics were used for baseline characteristics, DRPs, pharmacists' recommendations and actions and physicians' acceptance. Pearson chi-square tests (for dichotomous independent variables) or linear regression (for continuous independent variables) were used to test for differences between hospital wards. A P-value < 0,05 was considered statistically significant. All data were analyzed using statistical software (SPSS version 24.0; SPSS Inc., Chicago, IL, USA).

3. Results

3.1. Study population

A total of 938 patients were eligible for inclusion in the study (Fig. 1). A total of 342 patients were invited to participate, of which 152 patients (response 44.4%) received the home visit. The mean age of the patients was 67.0 ± 12.6 years and 56.6% were female (Table 1). The most common admission diagnosis was cerebrovascular accident for the neurology patients (38.7%) and chronic obstructive pulmonary disease (COPD) exacerbation due to pneumonia for the pulmonology patients (27.3%). All patients received the interventions at admission and during hospitalization. The majority of patients received a discharge consult at the outpatient pharmacy (84.2%). Discharge during out-of-office hours was the most common reason for patients not being consulted (n = 12). On average, pharmacists visited their patients

Table 1
Baseline sociodemographic, medical and medication-related characteristics of 152 patients.

Female, (% (n))	56.6 (86)
Age, year (mean, (SD))	67.0 (12.6)
Admission diagnosis (% (n))	
Cerebrovascular accident	19.1 (29)
COPD exacerbation due to pneumonia	13.8 (21)
Transient ischemic attack	8.6 (13)
COPD exacerbation	7.2 (11)
Asthma exacerbation due to pneumonia	6.6 (10)
Pneumonia	6.6 (10)
Neuralgia	3.3 (5)
Radicular syndrome	2.6 (4)
Other	32.2 (49)
Medication characteristics at discharge (mean per patient, (SD))	
Prescription medication in use	9.3 (4.5)
Non-prescription medication in use	0.5 (0.8)
Medication started	1.8 (1.4)
MRCI ^a	28.0 (14.3)
LACE-score at discharge (mean per patient, (SD)) ^b	9.2 (2.6)
(L)ength of stay, days	4.2 (2.7)
(A)cuity of admission; admission through ED (% (n)) ^c	92.1 (139)
(C)omorbidities; Charlson score	3.3 (2.3)
(E)D visits in the last six months	0.3 (0.6)
Patients that received a discharge consult at the outpatient pharmacy (n, %)	84.2 (128)
Time between discharge and home visit, days (mean, SD)	6.9 (3.6)

^a MRCI: Medication Regimen Complexity Index.

^b LACE-score: L + A + C + E provides the final score.

^c Patients receive 3 points for an acute hospital admission and zero points for an elective admission.

6.9 ± 3.6 days post-discharge. Sooner availability of the pharmacist (n = 16) or patient (n = 12) or discharge during out-of-office hours (n = 5) resulted in the visits taking place after the predetermined 7 days post-discharge. The home visits took pharmacists 28 ± 11 [range 8–66] minutes on average.

3.2. DRPs and recommendations

For the 152 patients, a total of 745 DRPs were identified, with a mean number of 4.9 ± 2.2 DRPs per patient [range, 0–11] (Table 2, Appendix III). Three patients did not experience any DRPs. The community pharmacist identified the majority of DRPs during the home visit (83.6%, n = 623). The other 16.4% (n = 122) were identified during hospitalization: by hospital pharmacy technicians at admission (n = 7), during the hospital pharmacist screening (n = 29), or at hospital discharge (n = 86). The latter were either identified by the pharmacists of the outpatient pharmacy (72.1%, n = 62) or a pharmacy technician of the outpatient pharmacy (27.9%, n = 24).

The most frequently identified types of DRPs overall were the need for additional “education or information” (36.1%, n = 269), “compliance” issues (16.4%, n = 122) and inadequate “drug selection” (11.7%, n = 87). Overall, the most frequent identified *DRP subtypes* were “confusion about therapy” (19.5%, n = 145), “taking too little” (8.2%, n = 61) and “condition not adequately treated” (8.2%, n = 61). The *DRP subtypes* “dose too high” and “demonstration of device needed” were more common for pulmonology patients, whereas “confusion about therapy” was more common for neurology patients (p < 0.05).

The three major *DRP-types* identified during hospitalization were inadequate “drug selection” (26.2%, n = 32), need for additional “education or information” (21.3%, n = 26) and possible “toxicity or adverse reaction” (17.2%, n = 21), whereas the most frequently identified DRPs during the home visit were need for additional “education or information” (39.0%, n = 243), “compliance” (17.7%, n = 110) and

Table 2
Number and types of DRPs identified during the HomeCoMe-program.

DRP Type and subtype ^a	Hospital (n = 122)	Home visit (n = 623)	Total (n = 745)
	% (n)	% (n)	% (n)
D(rug selection)	26.2 (32)	8.8 (55)	11.7 (87)
Duplication	1.6 (2)	0.6 (4)	0.8 (6)
Drug interaction	3.3 (4)	1.0 (6)	1.3 (10)
Wrong drug	0.8 (1)	–	0.1 (1)
Wrong dosage form	0.8 (1)	0.2 (1)	0.3 (2)
Lack of indication or unclear indication	13.1 (16)	5.3 (33)	6.6 (49)
Lack of effectiveness	0.8 (1)	0.2 (1)	0.3 (2)
Contraindication/intolerance	5.7 (7)	0.8 (5)	1.6 (12)
Other drug selection problem	–	0.8 (5)	0.7 (5)
O(ver or underdose)	1.6 (2)	2.7 (17)	2.6 (19)
Dose too high	0.8 (1)	0.5 (3)	0.5 (4)
Dose too low	–	0.3 (2)	0.3 (2)
Other dose problem	0.8 (1)	1.9 (12)	1.7 (13)
C(ompliance)	9.8 (12)	17.7 (110)	16.4 (122)
Taking too little	4.1 (5)	9.0 (56)	8.2 (61)
Taking too much	3.3 (4)	1.8 (11)	2.0 (15)
Intentional drug misuse	–	0.3 (2)	0.3 (2)
Difficulty using dosage form	1.6 (2)	4.8 (30)	4.3 (32)
Other compliance problem	0.8 (1)	1.8 (11)	1.6 (12)
U(ntreated indications)	16.4 (20)	9.0 (56)	10.2 (76)
Condition not adequately treated	12.3 (15)	7.4 (46)	8.2 (61)
Preventive therapy required	3.3 (4)	1.6 (10)	1.9 (14)
Other untreated indication problem	0.8 (1)	–	0.1 (1)
M(onitoring)	0.8 (1)	3.9 (24)	3.3 (25)
Laboratory monitoring	0.8 (1)	3.4 (21)	3.0 (22)
Non-laboratory monitoring	–	0.3 (2)	0.3 (2)
Other monitoring problem	–	0.2 (1)	0.1 (1)
E(ducation or information)	21.3 (26)	39.0 (243)	36.1 (269)
Patient drug information request	9.0 (11)	6.9 (43)	7.2 (54)
Confusion about therapy	5.7 (7)	22.2 (138)	19.5 (145)
Demonstration of device needed	5.7 (7)	6.7 (42)	6.6 (49)
Disease management or advice	0.8 (1)	2.6 (16)	2.3 (17)
Other education or information problem	–	0.6 (4)	0.5 (4)
N(on-clinical)	6.6 (8)	11.7 (73)	10.9 (81)
T(oxicity or adverse reaction)	17.2 (21)	7.2 (45)	8.9 (66)
Dose related	–	1.0 (6)	0.8 (6)
Caused by drug interaction	0.8 (1)	–	0.1 (1)
Toxicity/adverse reaction evident	14.8 (18)	5.5 (34)	7.7 (52)
Risk of adverse effects with prolonged use	–	0.2 (1)	0.1 (1)
Possible drug treatment in response to adverse effect	–	0.2 (1)	0.1 (1)
Other toxicity/adverse effect problem	1.6 (2)	0.5 (3)	0.7 (5)

^a See Appendix I for D.O.C.U.M.E.N.T.-classification and Appendix III for the extended table containing the sub-subtypes DRPs.

“non-clinical” (11.7%, n = 73) issues. The overall number of DRPs and *DRP-types* were similar between both wards.

The total 745 identified DRPs led to 928 recommendations: a mean of 6.1 ± 3.0 per patient [range, 1–19] and a mean of 1.2 ± 0.4 per *DRP* [range 1–4] (Table 3, Appendix IV). Providing “education and information” was the most common recommendation (57.0%, n = 528), followed by “recommendations for drug change” (26.0%, n = 243). Of these, the most important *subtypes* were initiating a “counseling session” (27.0%, n = 254) or “education session” (18.0%, n = 168) and “drug change (initiation/cessation)” (17.0%, n = 158).

Examples of DRPs identified within the HomeCoMe-program are shown in Box 1.

Table 3
Number and types of recommendations for solving the identified.

Type of recommendations ^a	Total = 928% (n)
Recommendations for drug change	26.0 (243)
Dose increase	1.7 (16)
Dose decrease	1.4 (13)
Drug change (initiation/cessation)	17.0 (158)
Drug formulation change	1.8 (17)
Drug brand change	0.5 (5)
Dose frequency/regimen change	3.3 (31)
Other therapy change recommendation	0.3 (3)
Referral	2.8 (26)
Refer to prescriber	2.0 (19)
Refer to hospital	0.1 (1)
Refer for medication review	–
Other referral required	0.7 (6)
Education and information	57.0 (528)
Education session	18.0 (168)
Counseling session	27.0 (254)
Instruction session	6.5 (61)
Written summary of medication/-regimen	0.2 (2)
Commence system	4.5 (42)
Other written information	0.1 (1)
Monitoring	3.9 (36)
Laboratory test	3.1 (29)
Non-laboratory test	0.8 (7)
No recommendation necessary	5.0 (46)
Collection of spare medication	5.3 (49)

^a See [Appendix II](#) for D.O.C.U.M.E.N.T.-classification and [Appendix IV](#) for the extended table containing subtypes of recommendations.

3.3. Pharmacists' actions and physician' acceptance

The 928 recommendations resulted in 768 actions to solve the identified DRPs. Pharmacy technicians or pharmacists discussed the DRP with the patient (71.2%, n = 547), contacted the general practitioner (GP) or specialist (25.4%, n = 195), or corrected the DRP without discussion (3.4%, n = 26). The majority of the 195 pharmacist actions presented to the physicians were accepted (62.0%, n = 122). GPs indicated for 10% (n = 20) of the presented pharmacists' actions that they were unable to assess it adequately, with “patient is monitored by a specialist” (n = 15) as their most common explanation.

These actions resulted in solving the DRPs, with the majority being solved in ambulatory care (91.6%, n = 682). Furthermore, 52.5% (n = 64) of the DRPs that were identified during hospitalization were solved post-discharge during the home visit.

4. Discussion

This study showed that the HomeCoMe-program, which combines in-hospital transitional care with a post-discharge community pharmacist home visit, successfully identified and solved drug-related problems (DRPs). The majority of DRPs (83.6%, n = 623) were identified post-discharge despite the in-hospital efforts. Furthermore, the community pharmacist solved over half of the DRPs identified during hospitalization in primary care. The numerous DRPs identified from hospital admission to readmission in primary care illustrate the complexity of transitional care, the necessity of professional collaboration across healthcare settings, and especially adequate follow-up in primary care.

Box 1

Examples of pharmacist collaboration across settings to address DRPs during the HomeCoMe-program

Gender, age (years)	Identified by	DRP example	How was DRP addressed
Male, 62	Hospital pharmacy technician at admission	Used atorvastatin 40 mg and reported muscle pains and sweating	The hospital pharmacist reported the adverse drug reaction to a junior physician, who disregarded this continued atorvastatin during hospitalization. The community pharmacist was informed on the adverse effects reported by the patient. During the home visit the patient told that these side effects started after switching from the originator drug to a generic brand. The community pharmacist addressed patients' concerns and explained the composition of the tablets. The patient was offered the option to restart the original drug. Patient, however, was reassured and decided to adhere to the regimen of the prescribed generic atorvastatin.
Female, 75	Hospital pharmacist's risk screening	Used fentanyl patches 12mcg for a considerable amount of time, but lacked a laxative	The hospital pharmacist reported to a junior physician that preventive therapy was required. He decided that the risk was low during hospitalization and the DRP was transferred at discharge to the community pharmacist. During the home visit the community pharmacist discussed the necessity of a laxative with the patient and presented the recommendation to the general practitioner. He accepted the initiation of a laxative. However, the patient refused to pay for the unreimbursed laxatives. Therefore, the community pharmacist provided nutritional and lifestyle advises to stimulate regular bowels and scheduled a follow-up telephone call for reevaluation. The constipation was under control with these advises.
Male, 89	Outpatient pharmacist at discharge	Reported using medication irregularly	DRP was identified at discharge but there was no time to counsel the patient on adherence at discharge and transferred to the community pharmacist. During the home visit the community pharmacist that although he was aware of the importance of his medication, he did sometimes forget to take the medication. The pharmacist removed practical adherence barriers by offering a multidrug dispensing system.
Female, 56	Outpatient pharmacist at discharge	Pantoprazole 40 mg was prescribed, but the NSAID was discontinued and patient had no known risk factors	The outpatient pharmacist contacted the specialist and recommended the cessation of pantoprazole. The specialist accepted the recommendation. The pharmacist explained the irrelevance of using a proton pump inhibitor with the patient and the pantoprazole was discontinued. The community pharmacist was informed not to reinstitute the PPI.
Male, 57	Outpatient pharmacy technician at discharge	Worried about the side effects of dipyridamole 200 mg and how to act if they occur	The pharmacy technician called in the outpatient pharmacist who addressed patients' concern. He indicated headache as being the most common side effect and reassured the patient that if it occurs, it most likely will be temporary. Furthermore, he assured the patient that he should always contact information his specialist if he was in doubt about continuing treatment due to possible side effects. With this additional information the patient decided to initiate the use of dipyridamole that was confirmed during the home visit by the community pharmacist.
Female, 94	Outpatient pharmacy technician at discharge	Is confused at discharge due to several medication changes	At hospital discharge the patient was provided with a discharge medication list and counseled on the regimen changes. During the home visit, the community pharmacist reinforced that information by reiterating the highlights and by verifying and addressing patients' knowledge gaps.

Although not all DRPs would have had a serious clinical impact, the extent of these problems indicates that harm is still likely to occur regularly since DRPs are linked to various adverse outcomes such as hospital readmission.²⁵ In this study over 15% of the DRPs were identified within the hospital: upon admission, during hospitalization, and at discharge. Two prominent *DRP-subtypes* were “lack of indication or unclear indication” and “condition not adequately treated”, both indicating that involvement of hospital pharmacy staff benefits adequate medication reconciliation and optimization processes. In the past decade, outpatient pharmacies have been established within hospitals to facilitate care transitions for patients at discharge.²⁶ The outpatient pharmacy in this study had a substantial part in addressing DRPs, but also acted as a discharge coordinator by promoting direct patient communication at discharge, ensuring transfer of the complete discharge medication information to the community pharmacist and scheduling the outpatient follow-up visit.

Earlier studies on post-discharge follow-up used a variety of definitions, *DRP-classification* methods, inclusion criteria and interventions, which hinders direct comparison with in our study.^{9,27} However, they enable elucidation of the crucial components of the rigorous approach used in the HomeCoMe-program to address and solve DRPs during the home visit. Compared to pharmacists or nurses outreaching from the hospital, deploying a community pharmacist post-discharge has several advantages. First, patients' own community pharmacist has the advantage of being committed to their patient and the ability of performing additional check-ups. Second, it created the opportunity to address an identified *DRP* immediately during the patient interview or discuss with the general practitioner. Furthermore, in contrast to earlier studies with research pharmacists, patients were familiar with their community pharmacist that possibly increased their receptiveness to pharmacists' advices.²⁸ Moreover, compared with a telephone follow-up, the privacy of patients' own home is possibly beneficial due to face-to-face encounters.²⁹ Patients might feel more comfortable at home and therefore more likely to share experiences and concerns about their medicines.¹⁷ Finally, interdisciplinary collaboration across healthcare settings was established by providing the community pharmacists with full access to patients' clinical and medication records from the hospitalization. This minimized the risk for information gaps and provided them with background information to adequately address the identified DRPs, for instance by monitoring patient progress, verifying medication regimes and performing adequate follow-up.

The need for additional “education or information” was the most frequent type of *DRP* identified during the home visits, with “confusion about therapy” as its major contributor. Consistent with literature, patients indicated being confused about various aspects of their therapy, e.g. therapy duration, prescription indications and/or their medication regimen (*Appendix III*).^{30,31} Hospital discharge is a stressful event during which patients can easily be overloaded with information, are confronted with medication changes, and wish to go home as soon as possible.^{32,33} Therefore, it can be questioned whether providing medication counseling at discharge has the right timing. Post-discharge follow-up enables identification of any knowledge gaps and reiteration of important discharge information. Furthermore, “compliance” issues were frequently identified during the home visits with “Taking too little” as the major *subtype* responsible for those, indicating that non-adherence was common. Addressing these in the privacy of patients' own home may be better than in a busy community pharmacy.

The home visit took place within one week post-discharge on average. This is the right timing as preventable adverse drug events (*pADEs*), such as adverse drug reactions and inappropriate prescribing frequently occur within the first 14 days after discharge.³⁴ We showed that community pharmacists frequently needed to address possible adverse drug reactions or inadequately treated conditions and clarify possible unclear indications during the home visit. Moreover, this supports the efforts made to tailor the HomeCoMe-protocol in addressing the concerns of the individual patient. Also, as performing (home)

medication reviews is gradually becoming common practice in several countries, community pharmacists' skills in patient-oriented communication have improved.^{35,36} Furthermore, Dutch community pharmacists were recently recognized as healthcare specialists equivalent to in-hospital specialists and general practitioners. Therefore, as discharged patients are generally home-dwelling, community pharmacists can be regarded as the natural partner of patients' primary care physicians in providing adequate post-discharge follow-up.

4.1. Strengths and limitations

This study had several strengths. The HomeCoMe-program capitalized on the existing collaboration between the single hospital and all community pharmacies in the service area and expanded this by structuring the communication pathways within and between these healthcare settings. This optimal local infrastructure enabled us to implement the program and illustrates the possibilities of integrating in-hospital transitional care activities with post-discharge follow-up and monitoring. Next, the community pharmacists received a one-day training session on how to perform the home visits, on top of their previous experiences in conducting medication reviews. Furthermore, the principal investigator supported them throughout the entire project. This resulted in consistently executed home visits and data collection. Finally, the use of the D.O.C.U.M.E.N.T. classification resulted in an overview of DRPs that can be compared to other studies.

A few limitations need to be considered. First, the prospective follow-up study design lacked a control group, which limits the ability to distinguish between the effects of individual intervention components. However, the illustrative *DRP-examples* (*Box 1*) indicate the necessity of collaboration across settings: during hospitalization a *DRP* can be identified but might not be addressed, whereas the community pharmacist needs the in-hospital information to resolve a specific *DRP*. Second, the HomeCoMe-program only included patients from two hospital wards (neurology and pulmonology) that might limit the generalizability. However, although several patient characteristics varied, the overall number of DRPs and *DRP-types* were similar between both wards. This illustrates the flexibility and comprehensiveness of the HomeCoMe-program to distinguish between these two “types” of patients (pulmonology: patients with a chronic, but unstable, illness and neurology: newly diagnosed patients) suggesting that patients from other wards might be expected to experience the same DRPs. Finally, although it used specific elements, the home visit protocol was not designed as a full clinical medication review. This might result in an underestimation of DRPs.

5. Conclusions

Collaboration between hospital and community pharmacists from hospital admission to readmission to primary care is crucial to establish continuity of care. A post-discharge community pharmacist home visit is a valuable addition to in-hospital transitional care to identify and solve drug-related problems. This improves the quality of care and patient safety after care transitions.

6. Declarations of Interests

None.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.sapharm.2018.05.001>.

Appendix I. Modification to the D.O.C.U.M.E.N.T.-Classification for Drug-Related Problems

The following modifications have been applied to the D.O.C.U.M.E.N.T. system used by Kwint and colleagues.

Other Dose Problem: dose frequency suboptimal

When to use When the total dose of a medication is suitable, but the frequency is inappropriate.

Example Patient takes omeprazole 20 mg two times daily.

Other Dose Problem: dose regimen suboptimal

When to use When the duration of use of the product is inappropriate – either it is too short or too long.

When the total dose of a medication is suitable, but the regimen is inappropriate. Also covers when the current regimen is unnecessarily impractical.

Example Simvastatin is ordered as 40 mg in the morning
Perindopril is ordered as 2 tablets of 4 mg once a day when a tablet of 8 mg also exists.

Taking too little: forgetful

When to use When the patient (unintentionally) uses, or is at risk of using, too little of a medication as a result of forgetfulness.

Example The patient forgets sometimes to take his nightly atorvastatin medication because he often works night shifts

Taking too little: lack of supplies

When to use When the patient uses too little of a medication as a result of lack of supplies.

Example The patient has different stocks of medication in house due to constant shortage

Taking too little: lack of self-reliance

When to use When the patient uses too little of a medication as a result of dependence on another individual for administration of medication.

Example The patient is due to start therapy with acenocoumarol but is reliant on the anticoagulant clinic for assessment of regimen.

Taking too little: unawareness of illness

When to use When the patient (intentionally) uses too little of medication as a result of unawareness of severity of his/her disease. This also covers when the patient intentionally changes the prescribed dosage regimen.

Example The patient taking metformin only when required rather than regularly.
The patient does not take his furosemide tablets when he has visitors over.

Taking too much: forgetful

When to use When the patient (unintentionally) uses too much of a medication as a result of forgetfulness.

Example Patient believes they have forgotten a medication and takes a second dose on the same day.

Taking too much: unawareness of illness

When to use When the patient intentionally uses too much of medication as a result of unawareness of severity of his or her disease. This also covers when the patient intentionally changes the prescribed dosage regimen.

Example The patient uses a paracetamol regimen of 5 times a day 1000 mg.
The patient thinks salbutamol should be used every day as a preventive method.

Difficulty using dosage form: regimen

When to use When the patient has a physical or general problem with the regimen of the dosage form as it is intended to be used.

Example The patient has difficulty with taking two inhalations of Spiriva four times a day.

Difficulty using dosage form: handling outer packaging

When to use When the patient has a physical or general problem with the handling of the outer packaging of the dosage form as it is intended to be used.

Example The patient has difficulty with opening of the carton box.

Difficulty using dosage form: preparation for use

When to use When the patient has a physical or general problem with the preparation for use of the dosage form as it is intended to be used.

Example The patient has difficulty splitting the tablet to adjust the dose of lisinopril.

Difficulty using dosage form: actual drug taking

When to use When the patient has a physical or general problem with the actual drug taking of the dosage form as it is intended to be used.

Example The patient does not want to take CalciChew tablets due to its unpleasant taste

Difficulty using dosage form: handling immediate packaging

When to use When the patient has a physical or general problem with the handling of the immediate packaging of the dosage form as it is intended to be used.

Example The patient has difficulty removing medication from blister or pressing the inhaler.

Other compliance problem: expected effect

When to use When the patient is aware of the way to take the drug, is physically able to take the drug, and understands its purpose, but does not wish to take the drug due to the patients' expected effect of the drug.

Example The patient does not want to continue treatment of hydrochlorothiazide; the patient does not see the need for it.

Other compliance problem: lack of effect

When to use When the patient is aware of the way to take the drug, is physically able to take the drug, and understands its purpose, but does not wish to take the drug due to the lack of effect of the medication.

Example The patient has intentionally stopped treatment of tramadol due to the lack of analgesic effect.

Other compliance problem: concern

When to use When the patient is aware of the way to take the drug, is physically able to take the drug, and understands its purpose, but does not wish to take the drug due to a specific concern of the patient towards the medication.

Example Patient unwilling to use mirtazapine after reading the package insert.

Confusion about therapy: duration

When to use When the patient does not understand the duration of therapy, but they still take the medication as directed (i.e. correct dose and time).

Example The patient does not understand the chronic use clopidogrel.

Confusion about therapy: regimen

When to use When the patient does not understand the regimen of the medications, but they still take the medication(s) as directed (i.e. correct dose and time).

Example The patient has difficulty understanding how to organize his medication in the daily routine

Confusion about therapy: indication

When to use When the patient does not understand the indication of the drugs, but they still take the medication(s) as directed (i.e. correct dose and time).

Example The patient does not understand why omeprazole is necessary when taking diclofenac.

Confusion about therapy: shelf life

When to use When the patient does not understand the shelf life of the medications, but they still take the medication(s) as directed (i.e. correct dose and time).

Example The patient is unaware of the use by date after first use of Spiriva.

Confusion about therapy: side effect

When to use When the patient is unaware of a certain side effect, but they still take the medication as directed (i.e. correct dose and time).

Example Patient is unaware of possible diarrhoea when using antibiotics.

Confusion about therapy: drug use

When to use When the patient is unaware/does not understand the correct use of a drug, but they still take the medication as directed (i.e. correct dose and time).

Example The patient did not know that Ascal Cardio should be dissolved before administrating.

Appendix II. Modifications to the D.O.C.U.M.E.N.T.-Classification for recommendations for Drug-Related Problems

The following modifications have been applied to the recommendations from the D.O.C.U.M.E.N.T. system used by Kwint and colleagues.

Drug change (addition/cessation)

When to use Pharmacist recommends to add or stop a specific drug due to alterations in the prescribed regimen, e.g. due to unclear indication or duplication.

Example The patient has stopped using NSAIDs, and the patient does not have any indication for the use of PPI's, so you suggest the cessation of treatment with pantoprazole.

Drug brand change

When to use Pharmacist recommends to switched to another brand due to the claimed difference in effectiveness or side effects between generic and brand name version, packaging etc.

Example The patient has difficulty getting the drug out of the blister packaging, so you suggest the switch to another brand that packages the drug in containers.

Other therapy change recommendation

When to use Pharmacist recommends another therapy change.

Example The patient was taking protein nutritional drink but this has disrupted the glucose balance of the patient. In consultation with the hospital dietician, you suggest the patient to switch over to a special nutritional drink made for diabetics.

Refer the prescriber

When to use Pharmacist refers patient to the prescriber (i.e. general practitioner) and/or the treating physician of the disease in question.

Example The patient wants to stop taking Oxis turbuhaler due to improvement of her condition. You advise the patient to consult the lung specialist

Other referral required

Pharmacist refers to another health care provider.

When to
use

Example The pharmacist refers the patient to a dietician.

Education session: indication

When to
use When the patient does not understand the indication of the drugs.

Example The patient has all his medication in a multidrug dispensing system but does not understand what the medications are prescribed for.

Education session: identification

When to
use When the patient cannot identify the medication.

Example The patient thinks that Kestine and ebastine are two different medications with different indications

Education session: duration

When to
use When the patient does not understand the duration of the therapy with the medication in question.

Example The patient is continuously taking xylometazoline for longer than is recommended and the patient does not know the maximum duration of the medication.

Education session: drug use

When to
use When the patient is unaware/does not understand the correct use of a drug

Example The patient did not know that Ascal Cardio should be dissolved before administering

Counselling session: regimen

When to
use When the patient does not understand the regimen of the medications.

Example The patient takes Bonefos and CalciChew at the same time which can result in a lower efficacy of Bonefos, so the pharmacist advises the patient to take them separately.

Counselling session: adherence

When to
use All situations where a problem arises because of the way in which the patient takes the medication in any way other than prescribed.

Example The patient has stopped taking Movicolon even though he is still taking oxycodone for the pain. The pharmacist advises the patient to restart treatment with Movicolon.

The patient is reluctant to start new medications, so the pharmacist explains the necessity.

Counselling session: address concerns

When to
use When the patient has a reasonable understanding of their condition and the medication use, but has specific concerns regarding their condition or medication.

Example The patient is not taking Movicolon because of the side effects the patient has experienced in the past. The pharmacist advises the patient to switch to lactulose that has helped the patient in the past.

Counselling session: address side effects

When to
use When the patient is unaware of the side effects, wants to discuss the side effects of the medication in question or is experiencing a side effect.

Example The patient is concerned about the possible side effects of pravastatin.

Counselling session: disease management

When to
use When the primary purpose is to inform the patient of critical aspects of the management or prevention of a disease or condition. Also covers when explanation is needed about a fundamental aspect of a condition they have.

Example The patient experiences instability when standing, so the pharmacist suggests improving his fitness level by exercising more frequently.

Instruction session: inhalation

When to
use When the patient has a technical or informative problem with the use of an inhalation device.

Example The patient uses Pulmicort twice daily and is complaining of hoarseness which indicates possible incorrect use.

Instruction session: eye drops

When to
use When the patient has a technical or informative problem with the use of eye drops.

Example The patient is not informed on the correct use of artificial tears

Instruction session: other

When to
use When the patient has a technical or informative problem with the use of another administration device, monitoring device or administration aid.

Example The patient is using an unfit multidrug dispensing system so the pharmacist suggests the switch to the weekly baxter system, and explains this to the patient

Written summary of medication/-regimen

When to
use When the patient requests a written summary of their medication or regimen. Also covers when the pharmacist thinks this will help the patient understand their therapy better.

Example The patient is confused about the medications he is taking

Commence dose administration aid

When to
use When the patient is using an expired dose administration aid or is given a dose administration for the first time.

Example The patient has difficulty splitting lisinopril tablets so you give the patient a tablet splitter

Commence multidrug dispensing system

When to use When the patient is eligible for a multidrug dispensing system.

Example The patient has difficulty keeping track of her medications due to the number of medications in use and the complexity of her regimen

Commence repeat prescription system

When to use When the patient is eligible for a repeat prescription service, where the chronic medications are automatically requested from the community pharmacist every three months.

Example The patient has difficulty with the changing of the outer packaging of the medications due to the preferential policy

Other written information

When to use The pharmacist provides any other written information.

Example The patient asks which medication has an interaction with grapefruit juice. The pharmacist explains this and provides written information with further explanations

Spare medication collection

When to use If the spare medication is not relevant to the current therapy and is thus collected by the pharmacist.

Example The patient has old batches of medication in his home.

Appendix III. Number and type of DRPs identified during the HomeCoMe-program for 152 patients (extended)

DRP type, subtype and sub-subtype	Total = 745% (n)
D(rug selection)	11.7 (87)
Duplication	0.8 (6)
Drug interaction	1.3 (10)
Wrong drug	0.1 (1)
Wrong dosage form	0.3 (2)
Lack of indication or unclear indication	6.6 (49)
Lack of effectiveness	0.3 (2)
Contraindication/intolerance	1.6 (12)
Other drug selection problem	0.7 (5)
O(ver or underdose)	2.5 (19)
Dose too high	0.5 (4)
Dose too low	0.3 (2)
Other dose problem	1.7 (13)
Dose frequency suboptimal	0.3 (2)
Dose regimen suboptimal	1.5 (11)
C(ompliance)	16.3 (122)
Taking too little	8.2 (61)
Forgetful	3.5 (26)
Lack of supplies	0.8 (6)
Lack of self-reliance	0.1 (1)
Unawareness of illness	3.8 (28)
Taking too much	1.9 (15)
Forgetful	0.1 (1)
Lack of self-reliance	–
Unawareness of illness	1.9 (14)
Intentional drug misuse	0.3 (2)
Difficulty using dosage form	4.3 (32)
Regimen	1.7 (13)
Handling outer packaging	0.4 (3)
Preparation for use	0.7 (5)
Actual drug taking	0.9 (7)
Handling immediate packaging	0.5 (4)
Other compliance problem	1.6 (12)
Expected effect	0.3 (2)
Lack of effect	0.4 (3)
Concern	0.9 (7)
U(ntreated indications)	10.2 (76)
Condition not adequately treated	8.2 (61)
Preventive therapy required	1.9 (14)
Other untreated indication problem	0.1 (1)
M(onitoring)	3.3 (25)

Laboratory monitoring	2.9 (22)
Non-laboratory monitoring	0.3 (2)
Other monitoring problem	0.1 (1)
E(ducation or information)	36.1 (269)
Patient drug information request	7.2 (54)
Confusion about therapy	19.4 (145)
Duration	3.6 (27)
Regimen	2.7 (20)
Indication	11.0 (82)
Shelf life	0.1 (1)
Lack of expected effect	–
Side effect	1.9 (14)
Drug use	0.1 (1)
Demonstration of device needed	6.6 (49)
Disease management or advice	2.3 (17)
Other education or information problem	0.5 (4)
N(on-clinical)	10.9 (81)
T(oxicity or adverse reaction)	8.9 (66)
Dose related	0.8 (6)
Caused by drug interaction	0.1 (10)
Toxicity/adverse reaction evident	7.0 (52)
Risk of adverse effects with prolonged use	0.1 (1)
Possible drug treatment in response to adverse effect	0.1 (1)
Other toxicity/adverse effect problem	0.7 (5)

Appendix IV. Number and types of recommendations for solving the identified DRPs for 152 patients (extended)

Type of recommendations	Total = 928% (n)
Recommendations for drug change	26.0 (243)
Dose increase	1.7 (16)
Dose decrease	1.4 (13)
Drug change (initiation/cessation)	17.0 (158)
Drug formulation change	1.8 (17)
Drug brand change	0.5 (5)
Dose frequency/regimen change	3.3 (31)
Other therapy change recommendation	0.3 (3)
Referral	2.8 (26)
Refer to prescriber	2.0 (19)
Refer to hospital	0.1 (1)
Refer for medication review	–
Other referral required	0.7 (6)
Education and information	57.0 (528)
Education session	18.0 (168)
Indication	12.0 (115)
Identification	0.7 (6)
Duration	3.9 (36)
Drug use	1.2 (11)
Counseling session	27.0 (254)
Regimen	6.7 (62)
Adherence	4.1 (38)
Address concerns	7.2 (67)
Address side effects	7.5 (70)
Disease management	1.8 (17)
Instruction session	6.5 (61)
Inhalation	5.6 (52)
Eye drops	0.4 (4)
Other	0.5 (5)
Written summary of medication/-regimen	0.2 (2)
Commence system	4.5 (42)
Commence dose administration aid	0.3 (3)
Commence multidrug dispensing system	2.2 (20)
Commence repeat prescription service	2.0 (19)
Other written information	0.1 (10)

Monitoring	3.9 (36)
Laboratory test	3.1 (29)
Non-laboratory test	0.8 (7)
No recommendation necessary	5.0 (46)
Collection of spare medication	5.3 (49)

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