Pharmacists’ strategies to detect, resolve, and prevent DRPs in CKD patients

Ni Made Susilawati1, Eli Halimah1, Siti Saidah2

1 Department of Pharmacology and Clinical Pharmacy, Faculty of Pharmacy, Padjadjaran University, Sumedang, Indonesia
2 Pharmacy Instalation, Dr. Hasan Sadikin General Hospital, Bandung, Indonesia

Corresponding author: Eli Halimah (eli.halimah@unpad.ac.id)

Received 26 February 2021 • Accepted 26 April 2021 • Published 23 August 2021

Citation: Susilawati NM, Halimah E, Saidah S (2021) Pharmacists’ strategies to detect, resolve, and prevent DRPs in CKD patients. Pharmacia 68(3): 619–626. https://doi.org/10.3897/pharmacia.68.e65136

Abstract
Pharmacists have undergone obstacles in the process of detecting, resolving, and preventing CKD patients’ DRPs. Thus, optimal strategies were needed. A total of 19 articles were included based on the article searching process. Based on the articles, it can be concluded: The strategies of detecting DRPs in CKD patients were carried out through medication reconciliation and medication review. The outcomes of these strategies were the number of DRPs/patients and types of DRPs detected. Strategies to resolve and prevent DRPs in CKD patients were conducted through interprofessional collaboration, education, and counselling. The outcome of these strategies was a change in the patients’ DRPs status. Optimization of detection, resolution, and prevention strategies were performed by improving pharmacists’ professional hard and soft-skills as well as modifying the pharmaceutical care delivery model. A decrease in the number of DRPs/patients and a change in DRPs status were reported as the outcomes of optimizing this process.

Keywords
Chronic Kidney Disease, Drug-Related Problems, Pharmaceutical Care, Pharmacist

Introduction

Background
Chronic Kidney Disease (CKD) is one of the deadliest diseases globally, ranked 17th in 1990 and 12th in 2017. Its global prevalence has increased by 29.3% from 1990 to 2017 (Bikbov et al. 2020). CKD patients with various comorbid diseases can experience polypharmacy. This condition can trigger the emergence of Drug-Related Problems (DRPs) (Hassan et al. 2009). One study showed that patients with polypharmacy, patients with ≥ five comorbid types, and patients with CKD stage 5 had a risk of developing DRPs of 4.695; 3.616; 3.941 times than those without polypharmacy and those with < 5 comorbid types and CKD below stage 5 (Garedow et al. 2019). Several studies have reported that DRPs prevalence in CKD patients reached 93% (Belaiche et al. 2012; Holm et al. 2015; Garedow et al. 2019). The mean number of DRPs/patients ranged from 5.31 to 10 (AbuRuz et al. 2013; Rammadiani et al. 2016). Drug interactions, indications without drugs, medication non-adherence, drug use without indications, and overdoses were reported to be the most DRPs in CKD patients (Chia et al. 2017; Njeri et al. 2018).

Based on these problems, DRPs management in CKD patients carried out by pharmacists is crucial. It has been proven to give some advantages, namely a better quality of life for patients, a shorter average Length of Stay (LOS), mortality prevention, and health cost reduction (Cardone et al. 2010). However, pharmacists have undergone obstacles in the process of detecting, resolving, and preventing DRPs in CKD patients (Mongaret et al. 2020). Therefore, this literature review aims to give insights to the pharmacists’ optimal strategies for detecting, resolving, and preventing DRPs in CKD patients.
Method

The method used in this literature review article was through articles search on three databases with specific keywords for each database. It is shown as follows:

- Google Scholar: (“Pharmaceutical Care” OR “Pharmacist”) AND (“Chronic Kidney Disease” OR “Kidney Failure” OR “End Stage Renal Disease”) AND (“Drug-Related Problem” OR “Medication-Related Problem” OR “Drug-Therapy Problem”).

- PubMed: (((pharmaceutical care [MeSH Terms]) OR (clinical pharmacist [MeSH Terms])) AND (((chronic kidney failure [MeSH Terms]) OR (chronic renal insufficiency [MeSH Terms])) OR (disease, end stage renal [MeSH Terms])) OR (Chronic Kidney Disease))) AND ((((Drug-Related Problems) OR (Medication-Related Problems)) OR (Drug-Therapy Problems)) OR (Pharmaceutical Care Issues)).

- Science Direct: (“Pharmaceutical Care” OR “Pharmacist”) AND (“Chronic Kidney Disease” OR “Kidney Failure” OR “End Stage Renal Disease”) AND (“Drug-Related Problem” OR “Medication-Related Problem” OR “Drug-Therapy Problem” OR “Pharmaceutical Care Issues”).

The article selection process used inclusion and exclusion criteria. The inclusion criteria included research articles that discussed about pharmaceutical care activities in CKD patients with DRPs as one of the study outcomes.

Results and discussion

The term pharmaceutical care according to the Pharmaceutical Care Network Europe (PCNE) in 2013, is “The pharmacist’s contribution to the care of individuals in order to optimize medicines use and improve health outcomes” (Allemann et al. 2014). Based on the definition, the process of detecting, resolving, and preventing DRPs in CKD patients by pharmacist is a part of pharmaceutical care. Tables 1, 2 summarises 19 selected studies regarding the pharmaceutical care for CKD patients with DRPs as one of the study outcomes.

The total number of articles selected from three databases was 847 articles

The article exclusions were due to the following reasons:

1. Issued under the 2010-2020 period (149 articles)
2. Non research articles (review articles, encyclopedias, book chapters, case reports, correspondence, editorials, practice guidelines, conference abstracts, etc.) (99 articles from PubMed and Science Direct)

Screening articles by title and abstract (599 articles)

The article exclusions were due to the following reasons:

1. Non research articles (review articles, encyclopedias, book chapters, case reports, correspondence, editorials, practice guidelines, conference abstracts, etc.) (332 articles from Google Scholar)
2. Article duplication (32 articles)
3. Not written in English (14 articles)
4. Not in CKD patients (151 articles)

Screening articles by full text (70 research articles)

The article exclusions were due to the following reasons:

1. Not in CKD patients (6 articles)
2. Not relevant to pharmaceutical care activities with DRPs as one of the study outcomes (45 articles)

The total number of articles selected was 19 research articles

Figure 1. Article Selection Scheme.
Table 1. Summary of Four Studies on Pharmaceutical Care for CKD Patients (Experimental Study).

| References              | Participants (Mean Age (year)) | Pharmaceutical care activities* | Study outcomes |
|-------------------------|--------------------------------|---------------------------------|----------------|
| (AbuRuz et al. 2013)    | 130 CKD patients (56.3±17.8)   |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: 1.8 DRPs/patient | Mean of DRPs: 5.33±2.61 DRPs/patient | Acceptance recommendation: A total of 690 recommendations were given, 86.6% were accepted, 69.2% were accepted and implemented, 2.3% were corrected by physicians | DRPs status: 17% DRPs resolved and 37.4% DRPs prevented |
| (El Borolossy et al. 2014) | 726 Dialysis patients (64±15) |                                 |                |
|                         |                                 | Haemodialysis patients          |                |
|                         |                                 | CG: 23 patients (11.5±0.6)      |                |
|                         |                                 | IG: 25 patients (10.8±0.64)     |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: 0.329 DRPs/patient | Mean of DRPs: (Not Reported) | Three types of interventions were accepted by patients 100%, 98%, and 96%, respectively | Physicians accepted three types of recommendations 100%, 95%, and 100%, respectively |
| (Lalonde et al. 2017)   | 130 CKD patients (71.9±12.0)   |                                 |                |
|                         |                                 | CKD without dialysis patients   |                |
|                         |                                 | IG: 304 patients (17.5±12.5)    |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: (Not Reported) | (Not Reported) | (Not Reported) | The decreased DRPs/patient in both groups: 2.16±2.10 to 1.60±1.79 for IG and 1.70±2.02 to 1.62±1.79 for CG. The difference in the decline between the two groups was 0.32 (95% CI: -0.63 to 0.61) |
| (Monterroza and Bolivar 2017) | 47 CKD patients (Not Reported) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: (Not Reported) | (Not Reported) | (Not Reported) | There were 35 recommendation accepted from a total of 41 recommendation |

Table 2. Summary of 15 Studies on Pharmaceutical Care for CKD Patients (Observational Study).

| References              | Participants (Mean Age (year)) | Pharmaceutical care activities* | Study outcomes |
|-------------------------|--------------------------------|---------------------------------|----------------|
| (Belache et al. 2012)   | 67 CKD patients (70)           |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: 93% | Mean of DRPs: 2 DRPs/patient | Acceptance recommendation: Nephrologist accepted 82.6% of total 143 recommendations | DRPs status: (Not Reported) |
| (Joel et al. 2013)      | 37 Haemodialysis Patients (Not Reported) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: 51.35% | Mean of DRPs: 2.03 DRPs/patient | Acceptance recommendation: A total of 39 recommendations, 23.07% were accepted and the therapy was changed, 48.72% was accepted but the therapy was not changed, and 28.05%, neither the recommendation was accepted nor prescriber changed the therapy | (Not Reported) |
| (Holm et al. 2013)      | 59 CKD without dialysis patients (78.7±10.2) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: 62% | Mean of DRPs: 1.8 DRPs/patient | Acceptance recommendation: Recommendations accepted by physicians were 95.7% of 69 recommendations | (Not Reported) |
| (Pourrat et al. 2015)   | 177 CKD without dialysis patients (78.1) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: (Not Reported) | (Not Reported) | Recommendations accepted by general practitioners were 33.3% of 18 recommendations | 33.3% DRPs resolved |
| (Patricia and Foote 2016) | 59 Haemodialysis Patients (Not Reported) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: 0.5±0.8 DRPs/patient | Acceptance recommendation: Recommendations accepted by the prescriber and nurse were 27% of 64 recommendations | (Not Reported) |
| (Ramadanani et al. 2016) | 105 CKD patients (Not Reported) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: 10 DRPs/patient | (Not Reported) | (Not Reported) |
| (Chia et al. 2017)      | Haemodialysis Patients.         |                                 |                |
|                         | UC: 190 patients (60±10.8)     |                                 |                |
|                         | CC: 134 patients (62±11.4)     |                                 |                |
|                         |                                 | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: (Not Reported) | (Not Reported) | (Not Reported) |
| (Njeri et al. 2018)     | 60 CKD without dialysis patients (54.2±16.8) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: 4.5±1.4 DRPs/patient | (Not Reported) | (Not Reported) |
| (Drosztičková et al. 2019) | 1850 CKD patients (Not Reported) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: 0.65 DRPs/patient | Physicians accepted 92.79% of 1192 recommendations | (Not Reported) |
| (Garedow et al. 2019)   | 105 CKD patients (45.8±17.7)   |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: 78.6% | 1.94±0.873 DRPs/patient | A total of 218 recommendations, 81.6% were accepted | 79.8% DRPs resolved |
| (Manley et al. 2020)    | 726 Dialysis patients (64±15)  |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: (Not Reported) | (Not Reported) | (Not Reported) |
| (Mongaret et al. 2020)  | 442 CKD without dialysis patients (81.5±6.6) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: 22.4% | (Community pharmacist) dan 41.6% (Expert pharmacist) | (Not Reported) | The physicians accepted the community pharmacist recommendations were 52.5% of 99 recommendations | (Not Reported) |
| (Roya et al. 2020)      | 200 CKD patients (57.95±20.33) |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: 3.61 DRPs/patient | (Not Reported) | (Not Reported) |
| (Sarashti et al. 2020)  | 833 CKD patients (53.7±12.76)  |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: 29.41% | 1.02 DRPs/patient | Recommendations accepted and applied by nephrologist were 97.6% of 259 recommendations | (Not Reported) |
| (Slieter et al. 2020)   | 125 CKD patients (72±12)       |                                 |                |
|                         |                                | Yes                              | Yes            | Yes            | Yes            | Prevalence of DRPs: (Not Reported) | Mean of DRPs: (Not Reported) | (Not Reported) | (Not Reported) |

Pharmaceutical care activities*: (1) Medication Reconciliation, (2) Medication Review, (3) Interprofessional Collaboration, (4) Education, (5) Counselling. CKD: Chronic Kidney Disease. DRPs: Drug-Related Problems. UC: Usual Care. CC: Collaborative Care.
Pharmacists’ strategies in detecting DRPs in CKD patients

Medication reconciliation and medication review are strategies used by pharmacists to detect DRPs. The purpose of medication reconciliation is to detect medication discrepancies in order to get early prevention. In this way, the pharmacists will have a complete and accurate reconciled medication list (National Institute for Health and Care Excellence 2015). Later, the reconciled medication list can be used in a medication review to detect DRPs. Based on the medication review defined by PCNE, this activity’s scope begins with DRPs evaluation based on the data to the intervention planning. Meanwhile, the follow-up activities of DRPs found both the actual and the potential ones are not the scope of this activity (Griesse-Mammen et al. 2018). Therefore, medication reconciliation and medication review are pharmacists’ strategies in detecting DRPs.

DRPs classification system used as an instrument for evaluating DRPs is essential in medication reviews (Da Costa et al. 2019). Ten of nineteen studies showed the DRPs classification types they used; the Hepler and Strand, Norwegian, Societe Francaise de Pharmacie Clinique (SPFC), and PCNE (Belaiche et al. 2012; Joel et al. 2013; Holm et al. 2015; Ramadaniati et al. 2016; Chia et al. 2017; Njeri et al. 2018; Dvořáčková et al. 2019; Mongaret et al. 2020; Roy et al. 2020; Savitha et al. 2020). However, the reasons for choosing the DRPs classifications were not explained in these studies. The other studies applied a modified DRPs classification according to the study needs, and the rest did not explain the type of DRPs classification used (AbuRuz et al. 2013; El Borolossy et al. 2014; Pourrat et al. 2015; Patricia and Foote 2016; Lalone et al. 2017; Monterroza and Bolivar 2017; Garedow et al. 2019; Manley et al. 2020; Sluiter et al. 2020).

The results of DRPs evaluation are presented in Tables 1 to 2 for the number DRPs/patient, and Tables 3 to 6 present the types of DRPs. Studies presented in Table 1 dan 2 report DRPs prevalence up to 93% and the number of DRPs up to 10 DRPs/patients. The high prevalence and number of DRPs indicate that pharmacists need efforts to optimize strategies in detecting, resolving, and preventing DRP in CKD patients. Further, the discussion of the optimization strategies in detecting, resolving, and preventing DRP in CKD patients will discussed on other section of discussion in this review. In addition, based on Tables 3 to 6, the types of DRPs detected were problems of drug selection, dosage, and medication non-adherence. These problems are the highest types of DRPs among other DRPs classifications in Tables 3 to 6. The symptoms of CKD patients are often unrecognized until advanced stages. Thus, drug selection and dosage problems are the main challenges in CKD patients (Holm et al. 2015). The dosage selection in CKD patients is crucial because inappropriate dosage selection in CKD patients leads to ineffective treatment or toxicity (Hassan et al. 2009). Further, medication non-adherence problem is caused by several factors, including inadequate knowledge about CKD, health beliefs, expensive medical costs, the complexity of drugs received, adverse effects, and psychological factors such as stress and depression (Chironda and Bhengu 2016). In addition, several drug classes based on the Anatomical Classification System caused the most DRPs in CKD patients from the study of: Alimentary Tract and Metabolism (Antidiabetic drugs) (Holm et al. 2015; Pourrat et al. 2015; Mongaret et al. 2020), Cardiovascular System (Belaiche et al. 2012; AbuRuz et al. 2013; Garedow et al. 2019), and Antinfectives for systemic use (Holm et al. 2015; Dvořáčková et al. 2019).

Based on this discussion, the outcomes of the pharmacists’ strategies in detecting DRPs in CKD patients were the number of DRPs/patients and types of DRPs detected. After that, the pharmacists used the DRPs findings to make intervention plans as a form of the follow-up to the DRPs’ findings (Da Costa et al. 2019). This process is the end of the pharmacists’ strategies in detecting DRPs in CKD patients.

Pharmacists’ strategies in resolving and preventing DRPs in CKD patients

Follow-up plans to resolve and prevent DRPs in CKD patients are aimed at three levels: prescribers, drugs, and patients based on SPFC.

**Table 3.** Studies Results regarding Types of DRPs in CKD Patients based on Hepler and Strand.

| No | DRPs Types | Joel et al. 2013 (N) | Chia et al. 2017 (N) | Njeri et al. 2018 (N) | Total (N) |
|----|------------|---------------------|---------------------|-----------------------|-----------|
| 1  | Non-adherence | 7                   | 219                 | 42                    | 268       |
| 2  | Unintended indication | 1                   | 62                  | 49                    | 113       |
| 3  | Drug use without indication | 1                   | 78                  | 25                    | 104       |
| 4  | Over dosage | 9                   | 66                  | 592                   | 278       |
| 5  | Adverse drug reaction | 4                   | 29                  | 24                    | 57        |
| 6  | Drug interactions | 10                  | 6                   | 59                    | 75        |
| 7  | Improper drug selection | 3                   | 19                  | 33                    | 55        |
| 8  | Sub-therapeutic dosage | 3                   | 10                  | 19                    | 52        |

**Table 4.** Studies Results regarding Types of DRPs in CKD Patients based on Norwegian.

| No | DRPs Types | Holm et al. 2015 (N) |
|----|------------|---------------------|
| 1  | Incorrect dose | 40                  |
| 2  | Inappropriate drug | 36                  |
| 3  | Other | 8                   |
| 4  | Interaction | 4                   |

**Table 5.** Studies Results regarding Types of DRPs in CKD Patients based on SPFC.

| No | DRPs Types | Belaiche et al. 2012 (N) | Mongaret et al. 2020 | Total (N) |
|----|------------|--------------------------|----------------------|-----------|
| 1  | Over dosage | 12                      | 75                   | 333       |
| 2  | Sub-therapeutic dosage | 27                  |                      |           |
| 3  | Non conformity to guidelines/contraindication | 17                   | 26                   | 26        |
| 4  | Unintended indication | 43                   |                      | 43        |
| 5  | Drug monitoring | 6                     | 14                   | 20        |
| 6  | Improper administration | 10                   | 6                    | 16        |
| 7  | Drug use without indication | 11                   | 3                    | 14        |
| 8  | Adverse drug reaction | 14                   |                      | 14        |

*CP: Community Pharmacists; EP: Expert Pharmacists.*
patients (Pharmaceutical Care Network Europe Foundation 2017). The pharmacists’ activity to resolve and prevent DRPs at the prescriptions and drug levels are an interprofessional collaboration. In this stage, the pharmacists could discuss with the prescribers about recommendations to the findings of both actual and potential DRPs. Based on this literature review, the most DRPs in CKD patients were drug selection problem, dose selection problem and medication non-adherence. An example of pharmacist plan to the DRPs’ findings is to provide a recommendation of the used antihypertensive Fixed Dosed Combination (FDC) for CKD patients with hypertension which could prevent patients from polypharmacy. In addition, antihypertensive FDC is more cost-effective compared to free combination therapy, thereby save medical costs. Polypharmacy and expensive medication cost were risk factors of CKD patients’ non-adherence. Therefore, the use of antihypertensive FDC could resolve and prevent DRPs in CKD patients with hypertension (Akazawa and Fukuoka 2013; Chironda and Bhengu 2016; Kawalec et al. 2018; Wang et al. 2020). Later, the pharmacists’ recommendations on the findings can be considered by the prescribers in determining the patient’s treatment therapy. After that, the acceptance of the recommendations will be the basis of the pharmacists to intervene at the drug level during the dispensing process. The pharmacists may undertake drug-level interventions with the consent of the prescribers obtained through interprofessional collaboration, education, and counselling activities (Belaïche et al. 2012; AbuRuz et al. 2013; Joel et al. 2013; El Borolossy et al. 2014; Holm et al. 2015; Pourrat et al. 2015; Patricia and Foote 2016; Chia et al. 2017; Monterroza and Bolivar 2017; Dvořáčková et al. 2019; Garedow et al. 2019; Mongaret et al. 2020; Savitha et al. 2020; Sluiter et al. 2020). Tables 1, 2 shows that the percentage of pharmacists’ recommendation acceptance for the DRPs findings in CKD patients is 25% to 100%. Several considerations by the nephrologists to decline the given recommendation have been reported in one study. Some reasons for this occasion are the drug was prescribed by another prescriber, there was no valid indication to discontinue or start taking the drug, the patient did not want to change his medication, the patient was not compliant, and the nephrologist wanted to see patients progress until the results of laboratory tests proved it (Sluiter et al. 2020).

Additionally, low awareness and inadequate medication adherence were the main obstacles for health professionals in providing CKD management services (Sperati et al. 2019). Several studies showed that medication non-adherence was the most type of DRPs in CKD patients (Joel et al. 2013; Chia et al. 2017; Njeri et al. 2018). Therefore, the strategies to prevent and resolve DRPs in patients level are by education and counselling (American Society of Health-System Pharmacists 1997). Through patients education and counselling, it is important for pharmacist to provide the common adverse effect and the severe adverse effect information of the drug used to the patients. Adverse effect is one of the risk factor of CKD patients’ medication non-adherence. Therefore, CKD patients’ adequate understanding about adverse effect could resolve and prevent patients from the medication non-adherence problem as one types of DRPs (American Society of Health-System Pharmacists 1997; Chironda and Bhengu 2016). Providing education and counselling significantly increased CKD patients’ knowledge, medication adherence, attitude, and practice (Ghimirey et al. 2013; Aggarwal et al. 2018; Chandrasekhar et al. 2018). Increased knowledge through education and counselling leads patients to be more actively involved in the disease management process (American Society of Health-System Pharmacists 1997). Through this activity, medication reconciliation can also occur optimally because patients can provide complete medical history information.

The results of several studies revealed that a process of resolving and preventing of DRPs in CKD patients through interprofessional collaboration, education, and counselling successfully resolve and prevent DRPs in CKD patients. These findings were confirmed by the changed of patients DRPs’ status in 4 studies at Tables 1, 2. The meaning of DRPs status change is a transformation of the status from DRPs’ findings to the DRPs resolved and DRPs prevented after the process of resolving and preventing through interprofessional collaboration, education, and counselling (AbuRuz et al. 2013; Pourrat et al. 2015; Chia et al. 2017; Garedow et al. 2019). The changed of DRPs status in CKD patients was the outcome of pharmacists’ strategies in re-

| Based on Problems | PCNE V6.02 | PCNE V8.02 |
|-------------------|------------|------------|
| Appearance        | (N)        | (N)        |
| Treatment costs   | 107        | 114        |
| Treatment duration| 677        | 114        |
| Other             | 387        | 880        |
| Drug selection    | 214        | 228        |
| Drug use process  | 21         | 73         |
| Patient           | 2          | 25         |
| Adverse reactions | 18         | 160        |
| Treatment effectiveness | 1134 | 1718 |
| Total (N)         | 1382       | 221        |
| Treatment safety  | 578        | 7          |
| Others            | 12         | 2          |
| Drug use process  | 34         | 12         |

Table 6. Studies Results regarding Types of DRPs in CKD Patients based on PCNE.
solving and preventing DRPs in CKD patients. Based on this discussion section, it is known that the interprofessional collaboration, education, and counselling are strategies to resolve and prevent the DRPs of CKD patients with the outcome is the patients’ DRPs status change.

**Optimizing the process of detecting, resolving, and preventing DRPs in CKD patients**

Pharmacists have undergone in conducting a series of detecting, resolving, and preventing DRPs in CKD patients. A study reported that the number of DRPs assessed by expert pharmacists was 1.9 times higher than that of community pharmacists. The pharmacists’ ability to detect the DRPs on CKD patients depends on their experiences and trainings. Besides, this study also reported that 48% of community pharmacists experienced interprofessional communication difficulties. These issues become obstacles in the series of detecting, resolving, and preventing DRPs in CKD (Mongaret et al. 2020). Based on these problems, pharmacists need solutions to optimize the process of detecting, resolving, and preventing DRPs in CKD patients.

Improving the hard and soft skills of pharmacists’ professional is a way to optimize the process of detection, resolution, and prevention of DRPs in CKD patients. Professional hard-skills cover the knowledge of the disease and management of CKD therapy as well as social knowledge such as culture and economics understanding. Meanwhile, professional soft-skills cover the ability to communicate well and effectively, personal barriers management skills, and the ability to be assertive and empathetic (American Society of Health-System Pharmacists 1997; Da Costa et al. 2019). Thus, pharmacists training can be one way of the ways to increase the pharmacists’ professional hard-skills and soft-skills.

Lalonde et al. in 2017 conducted a study about pharmacists’ training impact on DRPs in CKD patients using the ProFil program. The ProFil is a program designed to assist pharmacists in carrying out therapeutic management to CKD patients, consisting of training and communication components. The ProFil program was given to pharmacists, who provided intervention to the intervention group patients, while the control group only received the usual care. The results showed that through the ProFil program application, the mean of DRPs/patients in the intervention group has decreased as presented in Table 1. Other results are the increased knowledge (difference of 4.5%; 95% CI, 1.6% -7.4%) and clinical competencies (difference of 7.4%; 95% CI, 3.5% -11.3%) occurred in pharmacists who attended this program (Lalonde et al. 2017). The decrease in the number of DRPs/patients was the outcome of the training intervention as form of optimization of the detection, resolution, and prevention process of DRPs in CKD patients.

Additionally, modification of the delivery model is an effort to optimize the detection, resolution, and prevention of DRPs in CKD patients. Consultation with a pharmacist before the patient consulted a nephrologist was discussed in two studies of CKD out-patient care. The counseling with pharmacist aims to explore patients’ understanding of CKD, comorbid diseases they have experienced, and the treatment during the consultation session. After that, the pharmacist will perform comprehensive medication reviews. Before the patient attends a consultation session with the nephrologist, a reconciled medication list and recommendations on DRPs findings are given to the nephrologist as consideration for determining patient therapy (Belaiche et al. 2012; Chia et al. 2017). This model can improve pharmacist services’ quality and efficiency because the patients’ DRPs can be handled on the same day visit. Through a modified delivery model, 83.3% of the DRPs in CKD patients were resolved. This is the outcome of optimizing the detection, resolution, and prevention process of DRPs in CKD patients through a modified pharmaceutical care delivery model, as reported in this study (Chia et al. 2017). According to each healthcare facility’s needs, using such modified delivery model is flexible.

The strategies of optimizing detection, resolution, and prevention of DRPs in CKD patients provide several benefits. It has positively impacted to patients and the health care system such as preventing CKD patients’ unplanned admissions and making the average of LOS shorter (Chia et al. 2017). Further, it has an economic advantage of saving $ 4 in medical costs through $ 1 spending on DRPs management of CKD patients (Manley and Carroll 2002).

**Conclusion**

Pharmacists’ roles in detecting, resolving, and preventing DRPs in CKD patients are part of pharmaceutical cares aiming to optimize patient therapy; therefore, the patients’ effectiveness and safety can be guaranteed. The process of detecting DRPs in CKD patients was carried out through medication reconciliation and medication review. The outcomes of this process are the of number DRPs/patients and types of DRPs can be detected. Further, the processes of resolving and preventing DRPs be done through interprofessional collaboration, education, and counselling for CKD patients or their families. The outcome of this process is the change of patients’ DRPs status. Pharmacists need to improve their professional hard and soft-skills; thus, the process can be optimized. Additionally, modification of the pharmaceutical care delivery model can also be applied as needed. The decrease in the number of DRPs/patient and the change of DRPs status were reported as the outcomes of this optimization process.

**Acknowledgement**

The authors especially thank the Faculty of Pharmacy Padjadjaran University and Pharmacy Installation of Dr. Hasan Sadikin General Hospital for support during the manuscript review and preparation.
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