Review

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Roles and impacts of pharmacy technicians: a literature review

Rôles et impacts des techniciens en pharmacie : une revue de littérature

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Abstract. *Background.* Pharmacists have relied on the contribution of assistant pharmacist for several decades. Pharmacist can no longer work without the pharmacy technicians to efficiently and safely practice pharmacy. *Aim.* The aim of this study was to conduct a comprehensive literature review to examine the roles and the impacts of pharmacy technicians. *Methods.* Literature search in PubMed (January 1996-March 21th, 2018). Were included articles in French and English presenting pharmacy technician roles (e.g. defined activities supporting pharmacist and the drug use circuit in retail of hospital pharmacy practice) and their impacts. Were excluded articles about interviews, guidelines, practice models, curriculum and continuing education of pharmacy technicians. Each pharmacy technician activity was identified and collected. Each impact associated to a pharmacy technician activity was coded according to nine types of outcomes. *Results.* Sixty-eight studies were included. Fifty-four percent (37/68) of included studies had an observational design. A total of 62 positive outcomes associated to pharmacy technicians' activities were reported in a total of 33 articles included. Activities associated to a positive impact were, in decreasing order, related to medication errors and discrepancies (n=20), workload management (n=12), costs, adverse drug reactions (n=3), morbidity (n=2), patient compliance and healthcare workers satisfaction (n=1) or others (n=20). No published studies were associated to negative outcomes. A total of 85 descriptive indicators associated to pharmacy technicians' activities were identified in a total of 57 articles included. *Conclusion.* This literature review highlights the contribution of technical staff in supporting the practice of pharmacy. Pharmacy technicians contribute to a variety of activities and several studies show a favorable impact of their activity.

Key words: pharmacy technicians, roles, impact, practice, literature review

Résumé. *Contexte.* Les pharmaciens ont compté sur la contribution de préparateurs en pharmacie depuis plusieurs décennies. Un pharmacien ne peut plus travailler sans le soutien des préparateurs en pharmacie pour pratiquer la pharmacie de manière efficace et en toute sécurité. *Objectif.* Le but de cette étude était de mener une recherche documentaire exhaustive afin d'examiner les rôles et les impacts des préparateurs en pharmacie. *Méthodes.* Recherche documentaire sur PubMed (de janvier 1996 au 21 mars 2018). Des articles en français et en anglais présentant les rôles des préparateurs en pharmacie (p. ex. activités définies soutenant le pharmacien et le circuit du médicament en pharmacie de ville et en pharmacie hospitalière) ainsi que leurs impacts ont été inclus. Sont exclus les articles portant sur les sondages, les lignes directrices, les modèles de pratique, les programmes d'études et de formation continue des préparateurs en pharmacie. Chaque activité de préparateur en pharmacie a été identifiée et collectée. Chaque impact associé à une activité de préparateur en pharmacie a été codé selon neuf types de résultats. *Résultats.* Soixante-huit études ont été incluses. Cinquante-quatre pour cent (37/68) des

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études étaient de type observationnel. Un total de 62 marqueurs positifs associés aux activités des préparateurs en pharmacie a été rapporté dans 33 articles inclus. Les activités associées à un impact positif étaient, par ordre décroissant, liées aux erreurs et divergences de médication (n = 20), à la gestion de la charge de travail (n = 12), aux coûts, aux réactions indésirables aux médicaments (n = 3), à la morbidité (n = 2), à l'observance des patients et à la satisfaction du personnel soignant (n = 1) ou d'autres marqueurs (n = 20). Aucune étude publiée n'a été associée à des résultats négatifs. Un total de 85 indicateurs descriptifs associés aux activités des préparateurs en pharmacie a été identifié dans 57 articles inclus. *Conclusion.* Cette revue de littérature met en évidence la contribution du personnel technique à la pratique de la pharmacie. Les préparateurs en pharmacie contribuent à diverses activités et plusieurs études montrent un impact favorable de leur activité.

Mots clés : préparateurs en pharmacie, rôles, impact, pratique, revue de la littérature

Pharmacists have relied on the contribution of assistant pharmacists for several decades.

Initially without any special training, the assistant pharmacists became pharmacy technicians completing various types of pre-university curriculum and trainings. With the evolution of the normative framework, the commercialization of new, varied and complex drug therapies, the evolution of the drug circuit in hospitals, the centralization of sterile and non-sterile preparations of non-hazardous and hazardous drugs, the pharmacist can no longer work without the pharmacy technicians to efficiently and safely practice pharmacy.

In some countries, the recognition of the contribution of pharmacy technicians has led to the creation of professional titles, the development of an external certification process, the provision of liability insurance and the growing delegation of pharmacy technical tasks. In France, hospital pharmacy technicians are designed as "préparateurs" and they are "authorized to assist the pharmacist responsible for the management of the pharmacy for internal use and the pharmacists who assist him, as regards the management, supply, delivery and preparation of medicines, products and objects mentioned in article L. 4211-1 as well as sterile medical devices. They perform their duties under the responsibility and effective control of a pharmacist" [1]. Like in many countries, national healthcare network is being reorganized and the roles of several stakeholders are reviewed to optimize practices [2]. What could be the best use of pharmacy technicians within our respective healthcare system?

To answer that question, we should consider a growing body of evidence about the roles and the impacts of pharmacy technicians.

The objective of this study was to conduct a comprehensive literature review to examine the roles and the impacts of pharmacy technicians.

Methods

Data sources and searches

Literature review. The research team conducted a comprehensive literature search in PubMed (January 1996- March 21th, 2018) using the following search strategy: « pharmacy technician [All Fields] OR pharmacy technicians [All Fields] AND ("1996/01/01"[PDAT]:"2018/03/21"[PDAT]) ». Articles referenced in included articles were also considered following a manual search.

Study selection

Were included articles presenting pharmacy technician roles (e.g. defined activities supporting pharmacist and the drug use circuit in retail of hospital pharmacy practice) and their impacts. Articles published in English or French were considered. Articles were selected independently by one research assistant (CR) and one pharmacist (AG) on the basis of their title and their abstract. Divergences were resolved by consensus with the contribution of the other pharmacist (JFB).

Were excluded articles about interviews, guidelines, practice models, curriculum and continuing education of pharmacy technicians. Were also excluded editorials, letter to the editors, surveys, blogs, posters.

Data extraction

Included studies were reviewed according to a structured grid for data extraction, including the following elements: first author, year of publication, study design, study variables, main results, study limits, number of pharmacy technicians, and comments. Each pharmacy technician activity was identified and collected. Each impact associated to a pharmacy technician activity was coded according to the following nine types of outcomes suggested in the literature: costs, adverse drug reactions, medication errors and discrepancies, morbidity, mortality, patient compliance, healthcare workers satisfaction, workload management and others [3-5].

Data synthesis and analysis

Data were analysed according to the type of outcomes and the nature of the pharmacy technician activities performed. A qualitative summary of evidences has been discussed. Only descriptive statistics were performed.

Results

As displayed in *figure 1*, 68 articles were included in this literature review [6-73].

Sixty-eight percent (46/68) of the included studies come from the United States, compared to 12% (8/68) from the United Kingdom, 9% (6/68) from Canada, 4% (3/68) from Australia, 3% (2/68) from the Netherlands and Denmark and 1% (1/68) from New-Zealand. Twenty-six percent (18/68) of the included studies were published in the American Journal of Health-System Pharmacy (AJHP), compared to 16% (11/68) from Hospital Pharmacy, followed by 9% (6/68) in The Canadian Journal of Hospital Pharmacy **(**CJHP). A half (49%) of included studies was published in 24 other different journals. Seventy two percent (49/68) of included studied had an observational design, 19.1% (13/68) a pre-post design while 8.8% (6/68) were randomised studies. A total of 245 technicians were included on 51 studies and for 17 studies we don't have the information.

The *figure 2* illustrates the key pharmacy technicians' roles and their relative importance through the number of articles included.

Tables 1-3 show the profile of outcome and descriptive indicators associated to pharmacy technicians' activities, as they were worded by their authors in the included studies. A total of 62 positive outcomes associated to pharmacy technicians' activities were reported in a total of 33 articles included. Activities associated to a positive impact were, in decreasing order, related to medication errors and discrepancies (n=20), workload management (n=12), costs, adverse drug reactions (n=3), morbidity (n=2), patient compliance and healthcare workers satisfaction (n=1) or others (n=20). A total of 32 neutral outcomes associated to pharmacy technicians' activities were identified in a total of 20 articles included. Activities associated to a neutral impact were, in decreasing order, related to medication errors and discrepancies (n=13), workload management (n=5), costs, morbidity (n=2), adverse drug reactions (n=1) and others (n=9). No published studies were associated to negative outcomes. A total of 85 descriptive indicators associated to pharmacy technicians' activities were identified in a total of 57 articles included. Indicators were, in decreasing order, related to workload management (n=15), medication errors and discrepancies (n=14), costs (n=8), healthcare workers satisfaction (n=3), adverse drug reactions (n=2), morbidity (n=1) and others (n=42).

Discussion

There is relatively little data on the roles and impacts of technical staff in the indexed literature. There could be

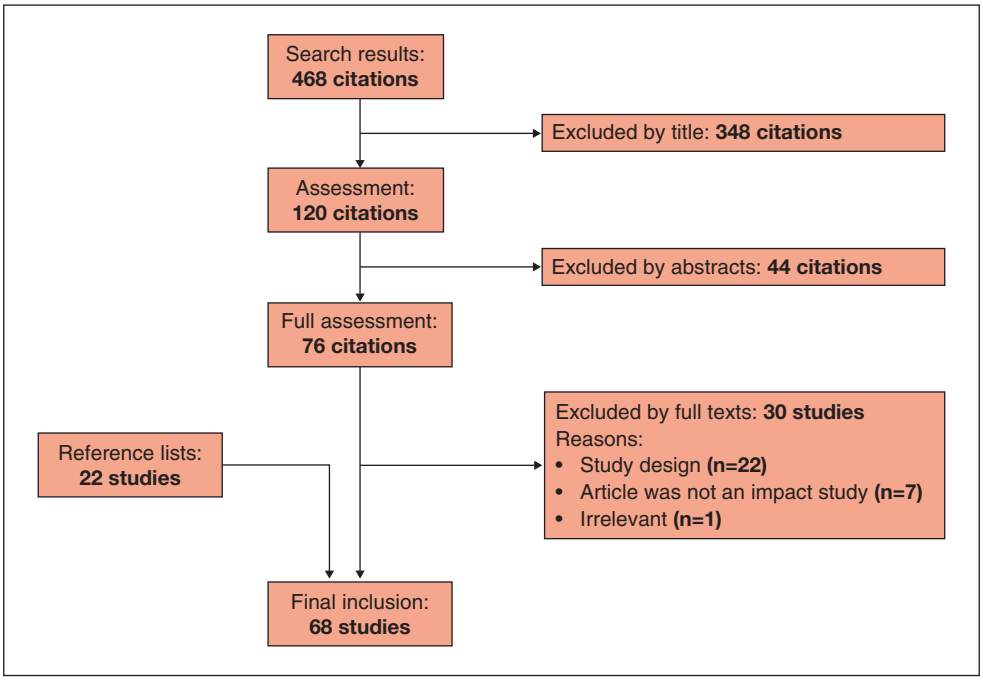

Figure 1. Literature review inclusion/exclusion flow chart.

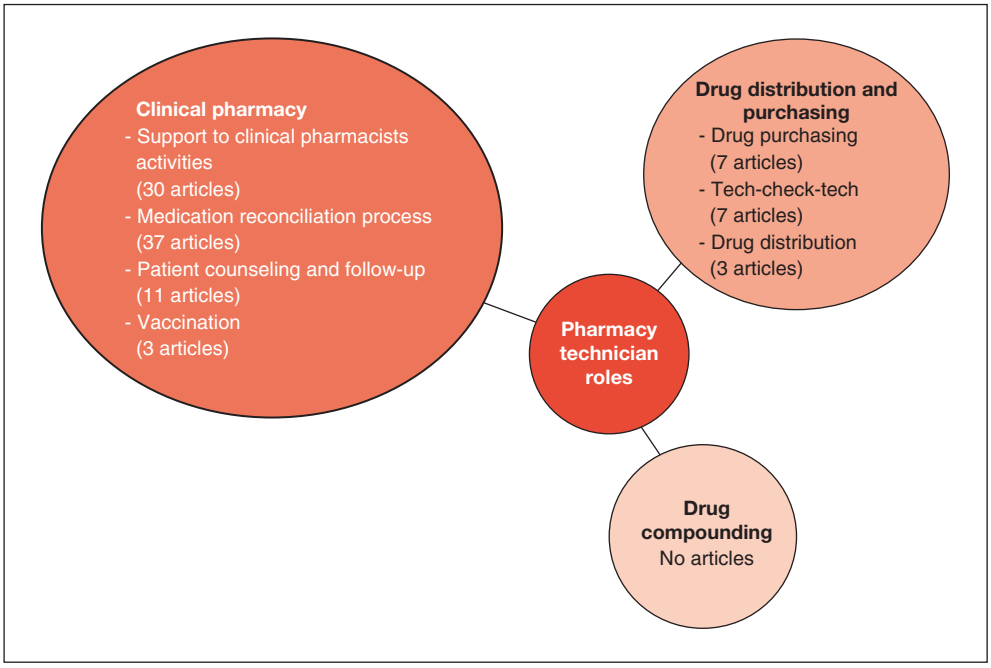

Figure 2. Pharmacy technicians' roles and number of articles included.

more data published in non-indexed pharmacy or other professional journals. Given their training, the pharmacy technicians are not trained to write scientific articles, evaluate their practice and engage in a knowledge transfer approach. Pharmacy technicians should partner with pharmacists to better document their activities and their impacts in the scientific literature.

This literature review, covering the last twenty years (e.g. 1996-2016), highlights a total of 36 articles on the roles and impacts of pharmacy technicians. While the literature of the eighties has focused more on the delegation to pharmacy technicians of dispensing tasks including tech-check-tech [74-77], our review highlights more advanced roles of pharmacy technicians to support the clinical work of pharmacists. However, four articles still described more traditional roles of pharmacy technicians [20, 27, 34, 41]. The majority of included articles were published in North America (e.g. USA, Canada). This may suggest a more advanced practice of pharmacy technicians that are more solicited to support technical tasks of clinical pharmacists.

For example, pharmacy technicians' activities were associated to positive outcomes in 33 articles evaluating the safe provision of patient care (e.g. percentage of patients with accurate medication history, number of defects in order forms). Their activities were also associated indirectly to the reduction of morbidity (e.g. number of readmissions, number of visits to the emergency department), better patient adherence to drug therapy, healthcare workers' satisfaction (e.g. nurses 'and pharmacists' satisfaction), a better workload management (e.g. reduction of time spent for pharmacists on non-clinical activities). However, pharmacy technicians' activities were not associated to a change of outcomes in 20 articles (e.g. neutral effect and no difference with pharmacists/nurses/physicians) and we found no paper associated to negative outcomes. Two recent systematic reviews focused on the roles of pharmacy technicians. Gernant *et al*. published a systematic review of the use of pharmacy technicians in elements of medication therapy management delivery [78]. Matingly *et al*. published also a systematic review of advanced roles of pharmacy technicians [79]. Both studies highlight more indirect than direct benefits of pharmacy technicians' contribution.

The drug circuit, especially in healthcare organizations, continues to evolve and the pharmacy assumes a more and more complete support of all the stages of the circuit, taking into account the contribution of the technical staff but also the introduction of new technologies (e.g. robots, smart devices). This process optimization allows for new roles for technical staff in support of the pharmacist's professional activities, as our literature review shows.

In the 2013-2014 Hospital pharmacy in Canada Report, MacNair has surveyed the proportion of respondents where pharmacy technicians performed tasks that directly support pharmacists in carrying out their clinical activities [80]. Such tasks included the ability to serve as the initial pharmacy liaison for solving drug distribution problems

Table 1. Profile of outcome and descriptive indicators associated to pharmacy technicians' activities with positive impacts.

Studies with positive impacts measured			
Outcomes	**Number of papers**	**Number of outcomes**	**Description of outcomes studied**
Costs	3	3	Mean cost of error detection per dose [35] Reduction of the cost of preventable adverse drug events per patient [53] Mean cost of items supplied per patient per course [65]
Adverse drug reactions	2	3	Severity-weighted AMH error score per patient [50] Severity-weighted AMO error score per patient [50] Severity of medication discrepancies [69]
Medication errors and discrepancies	14	20	Percentage of patients with accurate medication histories [10] Number of medication errors [10, 57] Comparison of the categories of medication errors [10] Comparison of reconciliation of the medications on the list [15] Comparison of accuracy of the medications on the list [15] Number of unintentional discrepancies per patient than the national average [22] Proportion of patients with one or more medication discrepancy [26, 63] Number of defects per order forms [33] Number of defects per individual drug order [33] Accuracy rates in checking unit dose medication cassettes [34] Percentage of total dispensing errors missed by pharmacy technicians compared to pharmacists [48] Percentage of missed errors rated as being of minor significance compared to pharmacists [48] Rate of clinically significant errors per medication [49] Total error rate [49, 57, 61, 69] AMH errors per patient [50] AMH errors per patient, severe or life threatening only [50] AMO errors per patient [50] AMO errors per patient, severe or life threatening only [50] The proportion of medication orders with one or more unintentional medication discrepancies [63] Number of discharge prescription transcription errors compared to doctors [73]
Morbidity	2	2	Number of readmissions at 30 and/or 60 days [21, 60] Number of visits at emergency department at 30 and 60 days [21]
Mortality	0	0	/
Patient compliance	1	1	Number of targeted medication therapy management contacts [7]
Healthcare workers satisfaction	1	1	Nurses' and pharmacists' satisfaction [33]
Workload management	11	12	Time for completion of discharge medication reconciliation [13] Time used by nurses in dispensing medecines before and during the study [14] Average length of time for technicians and pharmacists for interviews to obtain a BPMH [22] Time taken to unpack ward stock orders [37] Time spent by pharmacist on non-clinical activities [40] Time required to complete chart review [45] Pre- and postintervention average patient wait time once adjusted [52] Mean total time required to process automated medication supply systems medications between pre- and post-implementation periods [54] Median times required to verify stat and routine medication orders in the computerized physician order entry system between pre- and post-implementation periods [54] Technicians years of AMH experience correlated with AMH time [56] Mean total time to perform order entry before and after [59] Mean time per patient spent resolving prescription issues [65]
Others outcomes	11	20	Number of outpatients comprehensive medication review contacts [7] Home visit completion rate within 72 hours of discharge [7]

Table 1
(*Continued*)

Studies with positive impacts measured			
Outcomes	**Number of papers**	**Number of outcomes**	**Description of outcomes studied**
			Telephone follow-up within 30 days of discharge [7] Participants attending medication therapy management support session [7] Completeness of best possible medication histories (BPMH) within 48 h after admission [9] Completeness of transfer reconciliation within 24h of the transfer [9] Documentation of the last administration date and time of high-risk anticoagulant and antiplatelet medications [10] Patients seen by pharmacist for pharmaceutical care after the introduction of a technician service [40] Number of items supplied (inpatient items and discharge prescriptions) [40] Number of urgent discharge prescriptions [40] Number of patients per month for whom a CMR was performed within 5 days of discharge before and after addition of the pharmacy technician [45] Immunization compliance rates for influenza vaccines [46] Number of patients with no errors [49] Number of medication histories performed [57] Level of patients' understanding of their chemotherapy support medication [65] Number of patients having chemotherapy delays [65] Number of patients having chemotherapy dose reductions [65] Median number of items of support medication supplied per patient per course [65] Mean number of medications identified by nursing on admission compared with identified by pharmacists [67] Risk of patients not receiving admission medication reconciliation [71]

AMH: admission medication histories, AMO: admission medication orders, BPMH: best possible medication history, LMWH: low molecular weight heparin, PT: pharmacy technician.

(82% of Canadian hospitals), to collect and collate information concerning the patient's pre-admission drug therapy (70%), to collect data for drug utilization review to support the drug use evaluation program (28%), to assist in collection of data for presentation to the Medication Safety Committee (27%), to create initial inpatient drug therapy documentation and discharge drug therapy plane at discharge (20%), to collect laboratory test results to support drug therapy evaluation/monitoring (20%), to assemble pamphlets and documentation to be given to the patient (19%), to collate information used in the preparation of drug formulary submissions (12%) and to calculate changes to parenteral nutrition therapy (7%). Our literature review provides a more limited scope of practice, focusing a lot on medication reconciliation. For instance, in France, the patient's medication management is a required organizational practice for the accreditation of healthcare organizations [81] and the medication reconciliation is required process. In Canada, a similar obligation is required with Accreditation Canada [82]. Our review of literature highlights the useful contribution of pharmacy technicians to patient's medication management, considering the limited number of pharmacists within healthcare organizations.

The new roles given to pharmacy technicians must require legislative changes in numerous countries. For instance in Canada, a transition of pharmacy technicians to regulated health professionals has been initiated in early 2010, in response to these new roles. In 2017, most provinces have already enacted new legislations that regulate pharmacy technicians as licensed members practicing in an independent defined scope of practice with title protection. Such process relies on national model standards of practice for Canadian pharmacy technicians and professional competencies for Canadian pharmacy technicians at entry to practice proposed by the National Association of Pharmacy Regulatory Authorities. The adopted standards specify the minimum standards of practice a pharmacy technician must meet and the standards apply to all practicing pharmacy technicians [83]. Moreover, the Pharmacy Examining Board of Canada (PEBC) has developed an evaluating examination and a qualifying examination for pharmacy technicians to support the certification of practicing pharmacy technicians [84]. In France, although a reflection is being made about the revised legislative framework applicable to pharmacy technicians, nothing has yet been decided yet.

Table 2. Profile of outcome and descriptive indicators associated to pharmacy technicians' activities with no impacts measured.

Studies with no impact measured			
Outcomes	**Number of papers**	**Number of outcomes**	**Description of outcomes studied**
Costs	2	2	Mean cost of error detection per dose [35] Comparison of the mean labor costs for pharmacists and technicians to obtain AMHs [56]
Adverse drug reactions	1	1	Severity ratings of the observed unjustified changes [11]
Medication errors and discrepancies	8	13	Accuracy of BPMH: proportion of patients with at least one BPMH discrepancy [9] Proportion of patients with at least one unintentional discrepancy for admission and transfer reconciliation [9] Total number of medication discrepancies from the verified home list [11] Number of medication discrepancies unjustified on admission from the home medication regimen [11] Frequency of medication errors [18] Number of unintentional discrepancies [22] Mean number of discrepancies between the first and second interviews [22] Mean weighted severity sum per patient for prescription medications and over-the-counter medications [22] Proportions of patients with one or more allergy discrepancy [26] Proportions of patients with one or more antithrombotic error [26] Accuracy rates in checking syringues (percentages of syringues correctly evaluated) [41] Percentage of missed errors rated as being of 'major' significance compared to pharmacists [48] Types of errors made for both prescription and OTC medications [49]
Morbidity	1	2	Length of stay [50] Readmission within 30 days [50]
Mortality	0	0	/
Patient compliance	0	0	/
Healthcare workers satisfaction	0	0	/
Workload management	5	5	Amount of pharmacist time saved reviewing cases through the use of technician support versus usual care [12] Pre- and postintervention average patient wait time [52] Comparison of the mean time pharmacists and technicians needed to obtain an AMH [56] Mean total time for order-entry checking before and after [59] Mean time to completing patients' medication histories by pharmacist [67]
Others outcomes	6	9	Completeness of BPMH within 24 h after admission [9] Completeness of admission reconciliation within 24h of admission [9] Documentation of patient allergies and reactions [10] Immunization compliance rates for pneumococcal vaccines [46] Number of patients completed the immunization process [46] Mean number of pharmacist reconciliation recommendations per patient [51] Total number of patients with drug interactions recorded [65] Number of patient prescriptions requiring intervention [65] Rates of discharge on bronchodilators and acid blockers [70]

AMH: admission medication histories, AMO: admission medication orders, BPMH: best possible medication history, LMWH: low molecular weight heparin, PT: pharmacy technician.

The development of new clinical pharmacists' support activities should not be at the expense of technical missions (e.g. supply, storage and dispensing of medicines). Such literature review may be used within a country, a region or an organization, to revise the current division of responsibilities and tasks between pharmacists and pharmacy technicians. It also gives an overview of the potential indicators to evaluate the impact of pharmacy technicians.

Table 3. Profile of outcome and descriptive indicators associated to pharmacy technicians' activities with only descriptive results.

Studies with only descriptive results			
Outcomes	**Number of papers**	**Number of outcomes**	**Description of outcomes studied**
Costs	10	8	Cost saving by using technicians [19, 29, 64] Medication-related cost saving by pharmacy staff interventions [31] Efficiency and cost of error detection methods [35] Drug savings per year [36] Reduction amount of material wasted [38] Reduction number of medication vials left in the hospital by patients [38] Mean cost of items wasted [65] Cost savings [66, 72]
Adverse drug reactions	6	2	Severity of unintentional discrepancies [9, 17, 25, 28, 44] Number of adverse vaccination events [42]
Medication errors and discrepancies	35	14	Number of medication discrepancy/errors [8, 14, 18, 24, 25, 28, 32, 33, 35, 43, 44, 51, 59, 67, 69, 71] Therapeutic groups of drugs involved in medication discrepancies [8, 10, 25, 26, 57, 61] Medication discrepancy/errors types [9, 11, 14, 16, 18, 24-26, 28, 32, 44, 51, 57,, 60, 61, 63, 67, 69, 71] Identify patients requiring pharmacist intervention [12] Medication history accuracy rates [13, 21, 47, 57] Number of patient admissions with errors involving drug-drug interactions and renal dose adjustments [18] Accuracy rates for technicians in checking unit dose medication [20, 34, 64] Percentage of class II (moderate) and III (serious) errors [21] Classification of drug-related problems [25] Errors rated potentially clinically significant [35] Number of drug missed doses due to drug unavailability [37] Percent of omitted doses of vaccination [62] Effect of time after implementation on percentage of unintentional medication discrepancies [63] Types of discharge prescription transcription errors [73]
Morbidity	2	1	Percentage of INRs within the therapeutic range after the technician program began [29, 31]
Mortality	0	0	/
Patient compliance	0	0	/
Healthcare workers satisfaction	8	3	Pharmacists satisfaction [20, 29, 31, 36, 38, 39] Technicians satisfaction [29, 31, 36, 38, 39, 72] Nurses' satisfaction /opinion on technicians' additional duties [37, 38]
Workload management	24	15	Time to complete a medication history [8, 15, 17, 24, 25, 43, 60] Median time spent obtaining a formal medication history [11, 44] Time spent for pharmacists on checking medication doses for cart fill after « tech-check-teck » [20] Pharmacist time performing cognitive-based activities before and after using clinical pharmacy support technicians in care unit [23] Pharmacists' work hours before and after using clinical pharmacy support technicians in care unit [23] Pharmacists' time saved/freed up [23, 27, 38, 39, 58, 64] Time lapsed after admission before a medication history interview was conducted per day [30, 67] Time taken to order ward stock drugs without and with a ward based pharmacy technician service [37] Time per day spent by the technician counselling patients about their medication [40] Amount of time that the pharmacists spend on total patient-focused activities pre- and post-intervention [55] Amount of time that the pharmacists spend on dispensing activities pre- and post-intervention [55] Workflow interruptions [59] Pharmacy time saving [65] Mean number of minutes technicians spent reviewing each patient's chart and home medication [67] Mean time of a technician discharge prescription transcribing service [73]

Table 3
(*Continued*)

Studies with only descriptive results			
Outcomes	**Number of papers**	**Number of outcomes**	**Description of outcomes studied**
Others outcomes	33	42	Proportion of work that could be shifted to a clinical pharmacy technician [6] Appropriateness of anticoagulation clinic tasks for technicians [6] Information sources utilized to obtain medication histories [11] Medication history completeness rates [13, 67] Number of medication histories or/and medication reconciliation completed by technicians [13, 14, 16, 24, 43, 44, 71] Rate of provider compliance with discharge medication reconciliation [13] Number of clinical interventions made by a medication reconciliation pharmacist [18, 60] Number of patients visited by pharmacy technician [19] Prescription of rationalised medication regimens [19] Number of LMWH injections per month administered by the pharmacy technician [19] Duplication of visits: number of unplanned nursing needs arose during patient visits by pharmacy technician [19] Number of patients visited by pharmacy technician for the administration of medication [19] Number of self-care devices recommended to prescribing colleagues by pharmacy technician [19] Success index of medication reconciliation compared to the national average [22] Number of patient assessments completed per day by pharmacist after the pharmacist-technician combined approach [23, 36] Interruptions of pharmacist during patient care rounds before and after using clinical pharmacy support technicians in care unit [23] Numbers of doses validates per month by technicians after « tech-check-tech » program [27] Total number of drug recorded [28] Number of pharmacists appointments per week for direct patient care [29] Number of external team presentation and publications yearly [29] Number of clinical interventions recorded per discharged patient before and after introduction of ward technician support [30] Impact on clinical pharmacist activities [31, 64] Number of patient discharges that have not required dispensary involvement [32] Number of discharge prescriptions requiring final dispensing for a technician-led ward [32] Number of interventions performed for specific targeted initiatives requiring the technician to perform monitoring duties [36] Number of initiatives/new clinical services implemented [36, 39, 66, 68] Number of non-stock items ordered without and with a ward based pharmacy technician service [37] Number and type of patient counselling episodes performed by ward based pharmacy technician under supervision of a clinical pharmacist [37] Number of patients per month with technicians' monitoring services [39] Number of immunizations administered by technicians [42] Number of patient care interventions documented by pharmacist pre and post-implementation periods [54] Average number of clinical pharmacist-completed encounters [58] Number of clinical pharmacy consultations [58] Number of clinical pharmacy appointments completed [58] Average number of days to completed clinical pharmacy appointment [58] Number of clinical pharmacy consultations completed by centralized call center [58] Number of consultations completed by clinical pharmacy services [58] Number of interruptions per order entered [59] Vaccination rate [62] Number of interventions in therapy and patients evaluated [66] Number of patients visited within 24 hours of admission [72] Number of medication supplied on discharge [72]

AMH: admission medication histories, AMO: admission medication orders, BPMH: best possible medication history, LMWH: low molecular weight heparin, PT: pharmacy technician.

What this paper add?
This article provides a comprehensive literature review to examine the roles and the impacts of pharmacy technicians.
What is really known on this subject?
Pharmacy technicians are essential partners in the management of the drug use process.
What this study adds?
The majority of published studies (68%) comes from the United States.
The majority of published studies (54%) has an observational design.
Positive outcomes associated to pharmacy technicians' activities were reported in some articles.
Activities associated to a positive impact were, in decreasing order, related to medication errors and discrepancies, workload management, costs, adverse drug reactions, morbidity, patient compliance and healthcare workers satisfaction.
There are emerging roles for pharmacy technicians in support to clinical pharmacists.

Limitations

This literature review has limitations. Only one database was searched for studies considering time and available resources. Other databases could be considered for a broader search and review. Only studies involving pharmacy technicians were included. A literature scan of practice standards and guidelines about pharmacy technicians would provide a broader perspective of the roles and the impacts associated with their work. Quality of included studies was generally poor with bias, limited description of pharmacy technicians' activities and small sample size. Moreover, the absence of studies or data about certain aspects of practice models should not be seen as an absence of effect.

Conclusion

This literature review highlights the contribution of technical staff in supporting the practice of pharmacy. Pharmacy technicians contribute to a variety of activities and several studies show a favorable impact of their activity.

Conflict of interest : none of the authors has any conflict of interest to disclose.

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