Impact of the COVID-19 pandemic on drug-related issues and pharmacist interventions in geriatric acute care units

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Abstract

To assess and compare the activity of pharmaceutical analysis on drug management in a geriatric acute care unit prior to and during the COVID-19 pandemic. This was a single-centre, observational, retrospective, and comparative cohort study. All Pharmacist Interventions (PIs) carried out in the unit between 27 January 2020 and 30 April 2020 were distinguished according to whether they were conducted prior to or during the first wave of COVID-19. The main outcome measure was the rate of PIs per patient and per line of treatment analysed. Other data collected were the drug class managed by the PI, the Drug Related Problems (DRP) identified, the nature of the advice given, and the acceptance rate by geriatricians A total of 355 stays were analysed, with PIs generated for 21.7% of the stays prior to COVID-19, and for 53.4% of the stays during the first wave (p=1.029 E-9). Among the 4,402 lines of treatments analysed, 54 PIs were carried out for prescriptions prior to COVID-19, and 177 during the first wave (p=0.002). DRPs were mostly related to anti-infectious drugs during the pandemic (20.3%, p=0.038), and laxatives prior to the pandemic (13.0%, p=0.023). The clinical impact of the PIs was mainly moderate (43.7%). The acceptance rate was 59.3%. A greater amount of DRPs were detected and more therapeutic advice was proposed during the first wave of COVID-19, with a focus on drugs used for the management of COVID-19 rather than geriatric routine treatments. The needs for clinical pharmacists were strengthened during the pandemic.

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KEY POINTS:

During the COVID-19 a less typical form of medical care was expected for the infected patients, especially for older inpatients.

Clinical pharmacists may help the geriatricians in drug management as the value of working with them has been demonstrated.

A greater amount of drug-related issues were detected during the first wave of the pandemic.

The pharmacists'advice focused on drugs used for the management of COVID-19 rather than geriatric routine treatments. The needs for clinical pharmacists were strengthened during the pandemic.

Abstract

Aims :

To assess and compare the activity of pharmaceutical analysis on drug management in a geriatric acute care unit prior to and during the COVID-19 pandemic.

Methods :

This was a single-centre, observational, retrospective, and comparative cohort study. All Pharmacist Interventions (PIs) carried out in the unit between 27 January 2020 and 30 April 2020 were distinguished according to whether they were conducted prior to or during the first wave of COVID-19.

The main outcome measure was the rate of PIs per patient and per line of treatment analysed. Other data collected were the drug class managed by the PI, the Drug Related Problems (DRP) identified, the nature of the advice given, and the acceptance rate by geriatricians.

Results:

A total of 355 stays were analysed, with PIs generated for 21.7% of the stays prior to COVID-19, and for 53.4% of the stays during the first wave (p=1.029 E-9). Among the 4,402 lines of treatments analysed, 54 PIs were carried out for prescriptions prior to COVID-19, and 177 during the first wave (p=0.002). DRPs were mostly related to anti-infectious drugs during the pandemic (20.3%, p=0.038), and laxatives prior to the pandemic (13.0%, p=0.023). The clinical impact of the PIs was mainly moderate (43.7%). The acceptance rate was 59.3%.

Conclusion:

A greater amount of DRPs were detected and more therapeutic advice was proposed during the first wave of COVID-19, with a focus on drugs used for the management of COVID-19 rather than geriatric routine treatments. The needs for clinical pharmacists were strengthened during the pandemic.

INTRODUCTION

In December 2019, a new coronavirus, now identified as SARS-COV-2, was discovered in Wuhan, China, in cases of acute respiratory illness [1]. Since then it has spread worldwide and the World Health Organization (WHO) officially declared the disease caused by this virus (COVID-19) as a pandemic. During the "first wave" of infections, the virus caused 3,175,207 infections and 224,172 deaths worldwide; in France it resulted in 128,121 infections and 24,342 deaths [2].

Older people are at a higher risk of severe illness (respiratory distress, cardiovascular accident) due to their advanced age and comorbidities [3-5]. In France as of May 18, 2020, 75% of those who have died of COVID-19 are over 75 years of age [6].

To cope with this pandemic several COVID-specific units have been set up in our University Hospital in Angers, France. Since March 19th, the geriatric acute care unit, for patients over 75 years, has been separated into two wards: one for positive or suspect patients (17 beds) and one for "non-COVID" patients (20 beds).

This unit benefits from a continued pharmaceutical presence. A major task for the clinical pharmacy team is the analysis of the patients' prescriptions within this unit. Pharmacists can highlight the problematics of inappropriate prescriptions and provide therapeutic advice. These Pharmacist Interventions (PIs) prevent a risk of medicinal error and encourage optimal prescriptions, especially for frail elderly inpatients who are at higher risk of iatrogenic event due to their natural vulnerability and their polypharmacy [7,8].

The value of working with clinical pharmacists for the prevention of drug-related iatrogenic events and the optimisation of therapeutics, especially in a geriatric unit, has been demonstrated in several previous studies [9-12].

During this state of health emergency linked to the emergence of the COVID-19 pandemic, an unusual and less typical form of medical care was expected for the infected patients with the use of specific protocols or drugs uncommon in geriatric standard practice. Therefore the pharmaceutical analysis of prescriptions by the clinical pharmacists in this unit may be a valuable support for the medical team.

With this work we wanted to assess the activity of pharmaceutical analysis in the geriatric acute care unit during the first wave of COVID-19 pandemic and its potential impact on drug management. To do so, we chose to compare the PIs carried out by the clinical pharmacy team during the analysis of the patients' prescriptions in this period with PIs carried out prior to the pandemic, over the same time-scale.

The main objective was to compare the number of PIs between the two periods.

The secondary objectives were (i) to compare the drug class managed by the PIs, (ii) to compare Drug Related Problems (DRP) identified and the pharmacists' therapeutic advice given, (iii) to compare the clinical impact of our PIs and (iiii) to compare the acceptance rate of our PIs by the geriatricians.

METHODS

All inpatients whose medical prescription was analysed by clinical pharmacists (1 senior pharmacist or 1 resident) in the geriatric acute care unit between January 27 and April 30, 2020 were included in this single-centre, observational, retrospective and comparative cohort study. The characteristics of those patients collected for the study were the following: demographical measures (age and gender), autonomy score (AGGIR scale - Autonomy Gerontology Iso-Resources Groups), length of stay and in-unit mortality. Those data were retrieved by consulting the hospital medical records.

All PIs carried out by the clinical pharmacy team during the patients' prescriptions analysis were gathered. They were distinguished according to whether they were conducted prior to COVID-19 (between January 27 and March 18) or during the first wave of COVID-19 (between March 19 and April 30).

The endpoints to answer our main objective were the rate of PIs per patient and per line of treatment analysed. To answer our secondary objectives we collected the following data: drug class managed by the PI, DRP identified and nature of advice given. The PIs data were collected for the study via Business Object© (v12.1.0, SAP Walldorf, Germany).

The study was conducted in accordance with the ethical standards set forth in the Helsinki Declaration (1983). The Angers ethical committee approved the study protocol under number 2020/140. The study protocol was declared to the National Commission for Information Technology and civil Liberties (CNIL) under number ar20-0058v1.

Computerized medication orders and pharmaceutical analysis were allowed with three interfaced software packages (v8.2.6, Maincare, Cestas, France): Crossway® and Horizon Expert Order® for the medical prescription and M-Pharmacie® for the pharmaceutical analysis.

The prescriptions were analysed on working days (Monday to Friday) by the senior clinical pharmacist or their resident according to the standards set out by the French Society of Clinical Pharmacy (SFPC) [13] based on the patient's medical records, test results, medication records and with the Hospital's therapeutic booklet taken into account.

The tools used for analysing were: i) the French drug compendium (Vidal Hoptimal® database), ii) the kidney adapted prescription guide website (GPR®) which provides dosing adjustments according to renal clearance, iii) the screening tool to detect potentially inappropriate prescribing in persons aged 65 or older (Laroche list [14] and STOPP/START list [15]) and iiii) the Geriatric Dosage Handbook 14th Edition (Semla T., Beizer J., Higbee M.). The latest internal clinical guidelines for COVID-19 were used during the pandemic.

PIs can be carried out by treatment lines. A treatment line corresponds to the prescription of a new drug (original prescription or addition during hospitalisation), a discontinuation or suspension of a drug or a dosage adjustment.

The standardisation of the PIs was proposed by the SFPC [16]. Their tool for the documentation of PIs includes the identification of the drug related problem and the therapeutic advice given. The detailed categories are presented in Appendix 1.

A PI is notified in both the analysis software and the prescription software. PIs are discussed orally with the medical team and considered as accepted if they lead to a change in the prescription. The acceptance rate of our PIs was assessed in this study.

The clinical impact of a PI was evaluated with the Clinical, Economic and Organizational (CLEO) tool v3 [17] after a consultation between the senior pharmacist and a geriatrician from the unit. This consultation was made retroactively while analysing the data and the assessment of the problem wasn't patient-specific. The clinical impact scale ranges from -1C (harmful) to 4C (vital). The different scores are presented in Appendix 2.

All statistics were performed using SAS(c) (v9.4, SAS Institute Inc., Cary, NC, USA). The Chi-squared test or Fisher test were used for assessing differences in proportions and the Student test or the Mann–Whitney–Wilcoxon test were used to compare the distribution of ranks between the groups. P-values<0.05 were considered significant.

RESULTS

Between January 27 and April 30, 2020, 355 stays were analysed by the clinical pharmacists team, 166 (46.8%) prior to COVID-19 and 189 (53.2%) during the first wave of COVID-19 (mean+-SD age 88.0+-5.7y; 59.4% female; AGGIR score 3.2+-1.2); mean number of line of treatment validated 12.4+-7.8; mean length of stay 10.2+-6.7 days; death rate 10.4%).

There were no significant differences in the demographical measures of the population. During COVID-19 the mean length of stay was shorter ($p<0.05$) and the mean number of line of treatment per patient was larger ($p<0.05$). Characteristics of the stays analysed by the clinical pharmacists are detailed in Table 1.

The pharmacists analysed and validated 4,402 line of treatment (1,436 before the COVID and 2,966 during the pandemic). Among them 231 PIs were carried out (5.2%): 54 for prescriptions prior to the COVID-19 (23.4%) and 177 during the COVID-19 (76.6%). There were significantly more PIs per line of treatment validated during the pandemic ($p=0.002$).

Prior to COVID-19, PIs were generated for 21.7% (n=36) of the stays; the rate of PIs per stay analysed was 0.33. During the first wave of COVID-19, PIs were generated for 53.4% (n=101) of the stays; the rate of PIs

per stay analysed was 0.94. There were significantly more PIs per patient during the pandemic (p=1.029 E-9).

The distribution of the PIs according to the therapeutic classes is detailed in Table 2.

Prior to COVID-19, the therapeutic classes with most PIs were laxatives (n=7; 13.0%), proton pump inhibitor (n=6; 11.1%) and acetaminophen (n=6; 11.1%). There were significantly more PIs on laxatives during this period (p=0.023).

During the COVID pandemic, most PIs were put forwards for anti-infectious drugs (n=36; 20.3%), acetaminophen (n=31; 17.5%) and anticoagulant drugs (n=17; 9.6%). There were significantly more PIs on anti-infectious drug during the pandemic (p=0.038).

The distribution of the highlighted issues within the prescriptions and the pharmacists' therapeutic advice is detailed in Table 3.

The most frequently identified problem in the whole data collection was a drug supratherapeutic dosage (n=62, 26.8%) which was followed by a non-conformity to the guidelines or a contraindication (n=54, 23.4%) and the prescription of a drug without an indication (n=48, 20.8%).

Prior to the pandemic, there were significantly more PIs for a drug without an indication (p=0.013) and for a subtherapeutic dosage (p=0.019). During COVID-19, there were significantly more PIs for an improper administration (p=0.021).

For both periods combined 72 PIs (31.2%) were proposed for discontinuing a drug, 57 (24.7%) for adjusting the dosage of a drug and 41 (17.7%) for switching a drug.

Thirty-two PIs (59.3%) were accepted by the medical staff prior to COVID-19.

During the pandemic our PIs acceptance rate was 60.5% (n=107; p=0.875). Table 4 describes the correspondence between therapeutic advice given by the pharmacists and changes of prescriptions by the geriatricians.

The clinical impact of the PIs is detailed in Table 5.

One hundred and one PIs (43.7%) had a moderate clinical impact, 76 (32.9%) a minor impact and 40 (17.3%) a major impact. There was no significant difference between the two groups.

DISCUSSION

The present study on pharmaceutical analysis in a geriatric care unit at a teaching hospital reports that clinical pharmacists detected a higher number of DRPs within prescriptions during the first wave of the COVID-19 pandemic than beforehand. Associated therapeutic advice focused on the use of drugs specific to the management of COVID-19 infected patients rather than geriatric routine treatments. The needs for clinical pharmacists were strengthened during the pandemic. With the persistence of hospitalizations for COVID-19, this work may be used to improve practices and provide better adapted PIs to support patient care.

To date, several articles on the roles of pharmacists during the COVID-19 pandemic have been published [18,19]. These articles emphasize the importance of pharmacists in managing stocks of health products but also their support role for the medical staff in the proper use of these treatments. This optimization of therapeutics is part of the routine job for clinical pharmacists, but has increased due to the health context [20]. Previous reports on PIs during this pandemic focused specifically on the management of COVID+ patients, whether via pharmaceutical teleconsultations in a tertiary care centre [21] or in hospitalised patients in a community teaching hospital [22,23]. We provide here, to the best of our knowledge, the first review of pharmaceutical analysis activity in a population of frail, elderly inpatients - regardless of their COVID status, and the first comparative review of the pharmaceutical analysis practices prior to and during the first wave of this pandemic.

The main result of our study is that, during the COVID-19 pandemic, pharmacists released significantly more PIs per stay, per patient and also per line of treatment than prior to the pandemic.

During the first wave of COVID-19, 6.0% of PIs were performed out of the total number of treatment lines analysed, 53.4% of hospital inpatients' prescriptions were subject to a PI and the total number of PIs per patient was 0.94. This rate is higher than those presented by two other studies in French geriatric acute care units [24,25] and whose results were similar to ours prior to the pandemic. On the other hand, the works of Collins et al. [22] and Perez et al. [23] have shown higher rates of PIs than ours, up to 8 PIs per patient. These higher figures might be explained by the greater number of staff in the clinical pharmacy team; nevertheless these studies suggest that the medical management of COVID+ patients is particularly at risk of medication errors.

This can be explained in different ways. Firstly, the mean length of stay for patients was shorter during the COVID-19 pandemic than beforehand. We therefore analysed more first-prescriptions that were more at risk of DRPs. Indeed, previous works have shown that approximately 50% of prescriptions on admission in a hospital unit include a DRP [26,27]. Secondly, the number of treatment lines per patient is higher among those hospitalized during the first wave and thus increases their risk of exposure to an iatrogenic event and potential DRP identified by the pharmacists. Thirdly, during the pandemic there were significantly more PIs on anti-infectious drugs than before. Their high prescription rate in the pandemic context is likely explained by the recommendation of their probabilistic prescription for suspicious or infected COVID-19 patients. These drugs are frequently cited as a cause of DRPs, due to their prescription in acute illness and their specificities of use in elderly patients (dosage adjustment, biological monitoring) which reinforced the pharmacists' vigilance during the analysis [28,29].

Our results showed a significant difference in the types of the PIs achieved over the two periods.

During the first-wave of the pandemic there was a focus on drugs that are part of the medical management protocol of COVID+ patients: the drugs with the higher number of PIs were anti-infectious ones (20.3%), acetaminophen (17.5%) and anticoagulant ones (9.6%).

The DRPs found in anti-infectious drug prescriptions were mostly an improper administration (e.g. an injectable form prescribed when the oral route is possible, a prescription with no duration of treatment) or a supratherapeutic dosage.

There were no significant differences in the number of DRPs in the prescription of acetaminophen and anticoagulants drugs. Acetaminophen is the most frequently prescribed molecule during hospitalisation in France [30] and particular attention is paid to its correct prescription in geriatric care (respecting the maximum dosage for older adults and according to the patients' weight, adapted route of administration or verification of the absence of double prescription lines). Anticoagulants are a class of drugs that are particularly at risk of serious adverse effects in older adults [31]; the pharmaceutical team therefore focused attention on their prescription as they require reinforced vigilance in their use (duration of treatment, route of administration, adapted dosage, biological monitoring).

Before the COVID-19 pandemic, the drugs with the highest number of PIs were laxatives (13.0%), acetaminophen and proton pump inhibitors (11.1%). These therapeutic classes are frequently found in prescriptions for older adults, and correspond to standard geriatric care. We noted significantly more DRPs for a prescription without an indication and advice on drug discontinuation. This is consistent with the specificities of routine geriatric care where particular attention is paid to the reassessment of inappropriate prescriptions (i.e., overuse, misuse, underuse). The purpose is to encourage deprescribing whenever possible in order to limit avoidable iatrogenic risks, the prevalence of which is particularly high in this population [32,33].

This difference in practices adopted during the pandemic, and significantly highlighted, can be explained by the notion of emergency in the management of COVID+ patients on their admission to the unit. Indeed, PIs on inappropriate administration or dosage adjustments are more in line with those expected for acute care

management as this was the case during the first wave of the pandemic; whereas PIs on laxatives or drugs without an indication are more appropriate for routine management, when the patient stays long enough on the ward to benefit from geriatric therapeutic optimisation.

Our PIs during the pandemic were similar to the advice for therapeutic optimisation during COVID-19 proposed by the work of Burgess et al. [20] and found in the reviews by Surapat et al. [21], Collins et al. [22] and Perez et al. [23]. Basically, we proposed dosage adjustments to use the optimal dose for each patient, we insisted on the optimisation of the administration of drug modalities and advised on deprescription to ease the treatment regimens for those patients, but we note, however, a lower proportion of PIs on treatment monitoring in our results.

Concerning the clinical impact of our PIs, no significant difference was found between the two periods of analysis. Only 3 studies proposing an evaluation of the impact of PIs using the CLEO scale were found in the literature [34-36]. The CLEO scale being a French scale and of recent implementation, is currently little used.

Other scales have been used in previous works (Hatoum, Pippins) and these tools have demonstrated that PIs in geriatrics most often have a clinical impact considered as "significant" [25,37,38]. This is similar to our results. As the pharmaceutical team works in partnership with the medical team, PIs have little major or even vital clinical impact for patients.

The acceptance rate of our PIs is similar for both analysis periods, with an average value of 60.2%. This result is lower than those found in the literature, ranging from 63.3% to 92.0%. The main hypothesis to explain this lower acceptance rate is the lack of systematic oral communication of the PI. Indeed, it has been proven that PIs have a better chance of being accepted if they are discussed with the medical team [39]. We did not distinguish the mode of transmission of our PIs to the prescribers in our data collection. Studies that have shown an acceptance rate of computer-transmitted-only PIs in their results have similar results to ours [25]. Following the awareness of the need for oral transmission, proposals to improve our communication were discussed with the medical team but were not always successful in the health context of the pandemic which reduced the contact between pharmacists and the healthcare team. While PIs focusing on compliance with good prescribing practices, in accordance with protocols or based on biological elements, may be considered relevant, some advice for therapeutic optimisation may have been less appropriate for prescribers during the pandemic.

This study had some limitations. Contrary to other works, we decided to compare the PIs carried out over two distinct periods of time rather than between COVID+ and COVID- patients. This may have caused a bias in our analysis practices. As the clinical pharmacy team has only been working in the unit since November 2019, its efficiency in analysing prescriptions was not optimal at the beginning of the data collection. As the gain in experience through contact with the medical team and the performance of clinical pharmacy activities is acquired over time, it is logical to highlight an improvement in the pharmacists' practices in this activity during the 2nd period of data collection.

Also, due to the difficulties in determining the proportion of COVID+ patients in our population, the results of our work are more a reflection on general geriatric management during this pandemic than specific geriatric management for COVID+ patients.

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DECLARATIONS

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No sources of funding were used to assist in the preparation of this article.

Conflict of interest and disclosures:

The authors report no conflict of interests with this article.

Availability of data and material

The data collected for the study is stored on a server with regulated access. They are available from the corresponding author upon reasonable request.

ETHICS APPROCAL

Ethical approval was waived by the local Ethics Committee of Angers ethical comittee in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.

AUTHORS CONTRIBUTION

- Chappe has full access to the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analyses.
- Study concept and design: Chappe, Annweiler and Spiesser-Robelet.
- Acquisition of data: Chappe, Corvaisier and Annweiler.
- Analysis and interpretation of data: Chappe, Corvaisier and Annweiler.
- Drafting of the manuscript: Chappe, Spiesser-Robelet, and Annweiler.
- Critical revision of the manuscript for important intellectual content: Corvaisier, Raimbault-Chupin, Brangier and Lagarce.
- Obtained funding: Not applicable.
- Statistical expertise : Annweiler.
- Administrative, technical, or material support: Annweiler.
- Study supervision: Annweiler and Spiesser-Robelet.

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Table 1 Characteristics of the stays analysed by the clinical pharmacists (n=355)

	Total cohort (n=355)	Population analysed	Population analysed	Population analysed	Population with a PI	Population with a PI	Population with a PI
		Prior to COVID-19 (n=166)	During COVID-19 (n=189)	*p-value*	Prior to COVID-19 (n=36)	During COVID-19 (n=101)	*p-value*
Demographical measures							
Age (mean±SD, years)	88.0±5.7	87.8±5.8	88.3±5.7	*0.346*	88.6±5.4	89.0±5.8	*0.726*
Female gender, n (%)	211 (59.4%)	100 (60.2%)	111 (58.7%)	*0.829*	20 (55.6%)	59 (58.4%)	*0.845*
AGGIR score		3.1±1.1	3.3±1.3	*0.26*	2.7±1.3	3.2±1.2	0.02
Hospitalization in geriatric acute care unit							
Length of stay (mean±SD, days)	10.2±6.7	11.9±7.0	8.6±6.0	<0.001	13.1±6.3	8.1±5.3	<0.001
In-unit mortality, n (%)	37 (10.4%)	12 (7.2%)	25 (13.2%)	*0.081*	6 (16.7%)	14 (13.9%)	*0.784*
Number of line of treatment validated							
Mean±SD	12.4±7.8	8.7±6.1	15.7±7.7	<0.001	*13.7±6.9*	*16.5±8.3*	*0.171*

Table 2 Distribution of PIs according to the therapeutic classes (n=231)

Therapeutic classes	**Pharmacist Interventions n (%)**	**Pharmacist Interventions n (%)**	**Pharmacist Interventions n (%)**
	Prior to COVID-19 (n=54)	During COVID-19 (n=177)	*p-value*
Acetaminophen	6 (11.1%) 5 (9.3%)	31 (17.5%)	*0.298*
Anticoagulants		17 (9.6%)	*1.000*
Anti-depressors	0	2 (1.1%)	*1.000*
Antidiabetics	1 (1.9%)	2 (1.1%)	*0.552*
Antiemetics	1 (1.9%)	0	*0.234*
Anti-histamine	0	1 (0.6%)	*1.000*
Anti-infectious	4 (7.4%)	36 (20.3%)	0.038
Anti inflammatories	2 (3.7%)	4 (2.3%)	*0.626*
Anti-parkinsonians	0	1 (0.6%)	*1.000*
Anti-platelets	3 (5.6%)	9 (5.1%)	*1.000*
Cardiologic drugs	0	6 (3.4%)	*0.340*
Experimental drugs	0	1 (0.6%)	*1.000*
Laxatives	7 (13.0%)	7 (4.0%)	0.023
Lipid lowering drugs	4 (7.4%)	6 (3.4%)	*0.249*
Ophthalmic drugs	2 (3.7%)	4 (2.3%)	*0.626*
Opioids	2 (3.7%)	11 (6.2%)	*0.738*
Proton pump inhibitor	6 (11.1%)	16 (9.0%)	*0.606*
Psycholeptics	3 (5.6%)	2 (1.1%)	*0.085*
Respiratory system drugs	0	2 (1.1%)	*1.000*
Supplements	5 (9.3%)	13 (7.3%)	*0.772*
Urological agents	3 (5.6%)	6 (3.4%)	*0.440*

Table 3 Distribution of drug-related issues and therapeutic advice within the prescriptions (n=231)

	Pharmacist Interventions n (%)	**Pharmacist Interventions n (**
	Prior to COVID-19 (n=54)	During COVID-19 (n=177)
Drug-related issues		
Adverse drug reaction	0	1 (0.6%)
Drug monitoring	2 (3.7%)	2 (1.1%)
Drug without indication	18 (33.3%)	30 (16.9%)
Failure to receive a drug	0	1 (0.6%)
Improper administration	5 (9.3%)	42 (23.7%)
Non conformity to guidelines or contraindication	13 (24.1%)	41 (23.2%)
Subtherapeutic dosage	5 (9.3%)	3 (1.7%)
Supratherapeutic dosage	11 (20.4%)	51 (28.8%)
Untreated indication	0	6 (3.4%)
Therapeutic advice		
Addition of a new drug	2 (3.7%)	16 (9.0%)
Administration modalities optimisation	1 (1.9%)	27 (15.3%)
Change of administration route	2 (3.7%)	8 (4.5%)
Dose adjustment	13 (24.1%)	44 (24.9%)
Drug discontinuation	26 (48.1%)	46 (26.0%)
Drug monitoring	2 (3.7%)	3 (1.7%)
Drug switch	8 (14.8%)	33 (18.6%)

Table 4 Correspondence between therapeutic advice given by the pharmacists and changes of prescriptions by the geriatricians (n=139)

Therapeutic advice	Accepted (n)	Accepted (n)	Acceptance rate
	Prior to COVID-19 (n=32)	During COVID-19 (n=107)	Prior to COVID-19
Addition of a new drug	1	12	50.0%
Administration modalities optimisation	1	16	100.0%
Change of administration route	0	5	-
Dose adjustment	7	26	53.8%
Drug discontinuation	15	24	57.7%
Drug monitoring	2	2	100.0%
Drug switch	6	22	75.0%

Table 5 Clinical impact of the PIs issued assessed with the CLEO tool (n=231)

Clinical Impact	Pharmacist Interventions n (%)	Pharmacist Interventions n (%)	Pharmacist Interventions n (%)
	Prior to COVID-19 (n=54)	During COVID-19 (n=177)	*p-value*
Harmful	0	1 (0.6%)	*1*
Null	2 (3.7%)	11 (6.2%)	*0.738*
Minor	22 (40.7%)	54 (30.5%)	*0.186*
Moderate	22 (40.7%)	79 (44.6%)	*0.641*
Major	8 (14.8%)	32 (18.1%)	*0.684*
Lethal	0	0	-

APPENDICES

Appendix 1: Categories for documentation of PIs proposed by the SFPC[16]

DRUG RELATED ISSUES	Non conformity to guidelines or contra-indication Untreated indication Subtherapeutic dosage Supratherapeutic dosage Drug without indication Drug interaction Adverse drug reaction Improper administration Failure to receive drug Drug monitoring
PHARMACIST INTERVENTIONS	Addition of a new drug Drug discontinuation Drug switch Change of administration route Drug monitoring Administration modalities optimisation Dose adjustment

Appendix 2: The CLEO tool for the evaluation of the clinical impact of a PI proposed by the SFPC[19]

Score	**Impact**	**Definition**
-1C	Harmful	The PI can lead to adverse outcomes on clinical status, knowledge, satisfaction, patient adherence and
0C	Null	The PI can have no influence on the patient regarding the clinical status, knowledge, satisfaction, pati
1C	Minor	The PI can improve knowledge, satisfaction, medication adherence and/or quality of life OR the PI ca

Score	Impact	Definition
2C	Moderate	The PI can prevent harm that requires further monitoring/treatment, but does not lead to or do not e
3C	Major	The PI can prevent harm which causes or lengthens a hospital stay OR causes permanent disability or
4C	Lethal	The PI can prevent an accident that causes a potential intensive care admission or the death of the pa