

# Managing the risk of shortages and medication errors with curares during the COVID-19 pandemic: a hospital pharmacy experience

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Received 16 November 2020

Revised 9 March 2021

Accepted 16 March 2021

EAHP Statement 5: Patient Safety and Quality Assurance.

## ABSTRACT

**Background** Coronavirus disease 2019 (COVID-19) has spread rapidly around the world. Like many clinical teams, hospital pharmacies have widely contributed in preventing and containing the COVID-19 pandemic. Pharmacies were thus involved in the management of overuse of specific drugs, medication shortages and risk of medication errors.

**Objectives** To assess the use of curares during the COVID-19 crisis and to highlight the lessons to be learnt from this overuse.

**Methods** The use of curares (Atracurium, Cisatracurium and Rocuronium) was compared with the usual use levels in our hospital. Supply issues have been identified and investigated. The risk of medication errors was clearly established and considered.

**Results** Despite an increased demand, our hospital has not experienced any disruption in the supply of curare medications. But the risk of curare shortages has led to the registration of new pharmaceutical forms and dosages never used before. We also observed necessary switches between different curares. All of this has contributed to an increased risk of medication errors.

**Conclusions** During the COVID-19 pandemic, the pharmaceutical management of curare medications has been particularly critical. The risk of medication errors and unsafe medication practices was high. This analysis must lead to a high level of vigilance in the next few months.

unprecedented level of use. These drugs required the implementation of measures to limit the risk of shortages and medication errors in which the pharmacy of the American Hospital of Paris (AHP) was closely involved.

## BACKGROUND

The AHP is a 172-bed general hospital that usually provides eight intensive care beds. In accordance with international experience and the recommendations of the French Ministry of Health,<sup>6</sup> the AHP prepared to hospitalise COVID-19 patients. Thus, the AHP implemented 16 additional intensive care beds specifically dedicated to patients suffering from the coronavirus. At the same time, an operational crisis cell was set up, met 7 days a week and managed the increase in capacity of the AHP. The pharmacy has been entirely involved in the tasks of the crisis cell. The first patient infected by coronavirus was admitted at the AHP on 28 February 2020. The main role of the pharmacy was to ensure the supply, dispensing and good use of medications with the maximum degree of safety. During the pandemic, drugs may have been in late delivery and short supply due to interruptions in logistics and production disruptions for various reasons. Feedback from international experience<sup>7-9</sup> as well as national recommendations<sup>6</sup> made it possible to anticipate the supply of specific drugs (antibiotics, sedatives, curares, etc) as far as possible.

## METHODS

During the COVID-19 crisis, a drug shortage surveillance and an early warning mechanism were established in connection with the crisis cell. The pharmacy made a list of COVID-19 therapeutic drugs to be checked on a daily basis. Three curare drugs (atracurium, cisatracurium and rocuronium) were carefully monitored because these were essential medications for treating the most serious patients. Moreover, there were already supply difficulties in France even before the onset of the COVID-19 crisis. Any situation corresponding to a supply issue was also identified and investigated. In addition, the risk of medication errors was clearly established and required appropriate measures to reduce it.

## RESULTS

For more than 2 months and despite a significant decrease in surgical activities, the use of curare medications reached extremely high levels particularly in the intensive care unit (ICU) (figure 1). Even

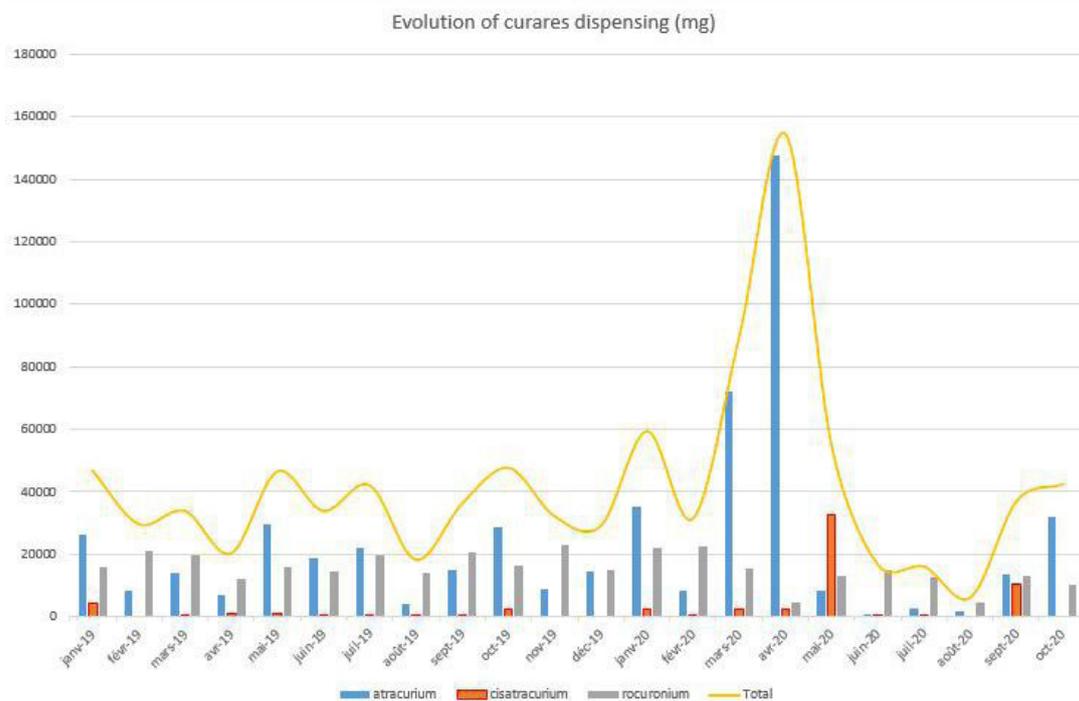
## INTRODUCTION

Following its onset in December 2019 in China, a novel coronavirus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), causing COVID-19 (coronavirus disease 2019), has spread widely in many countries.<sup>1</sup> The WHO declared COVID-19 a pandemic on 11 March 2020.<sup>2</sup> France reported the first cases of SARS-CoV-2 infection on 24 January 2020.<sup>3</sup> France was one of the most affected European countries and now reports more than 80 000 coronavirus-related deaths. France has been able to enhance its capacity to care for serious patients within a few weeks by providing more beds in intensive care units. However, to achieve this result, France, like other countries, had to face many difficulties in providing the required resources such as ventilators, intravenous infusion pumps, staff and personal protective equipment.<sup>4 5</sup> Because of very high demand, the procurement of several drugs has been very difficult too. Curares represent a therapeutic class that was particularly at risk during the COVID-19 crisis because of the



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**To cite:** Bohand X, Jordan D, Dubois F. *Eur J Hosp Pharm* Epub ahead of print: [please include Day Month Year]. doi:10.1136/ejhp-2020-002605



**Figure 1** Dispensing of curare medications (mg) at the American Hospital of Paris, from January 2019 to October 2020.

if atracurium and rocuronium were the two main curares used at the AHP, the serious difficulties in the availability of atracurium led physicians to switch their atracurium orders to cisatracurium orders. It explains the peak of cisatracurium observed in May 2020. Faced with the increasing difficulties of hospitals to obtain curare from companies, on 25 April 2020 the French government decided to set up a national platform with the aim to manage drug shortages of five priority drugs: atracurium, cisatracurium, rocuronium, midazolam and propofol. From this date, no French hospital was authorised to purchase these drugs from suppliers. It was a national requisition of the stock of these five major drugs. The French government took entire responsibility for purchasing all stocks from the companies and ensuring a weekly distribution within the hospitals.<sup>10</sup> During the COVID-19 crisis, the AHP did not suffer any major issues with propofol and midazolam. That is why this report focused only on curare medications. However, this led the pharmacy to receive a lot of different pharmaceutical forms (vials, bottles, etc) and in dosages never used before. Thus, the only atracurium formulation used at the AHP before the COVID-19 crisis occurrence was Tracrium 50 mg/5 mL. By contrast, the pharmacy had to manage six different dosage forms during the COVID-19 crisis period.

## DISCUSSION

Drug shortages in developed countries have been a serious public health problem for several years. They occur for a variety of reasons and may have far-reaching implications for healthcare providers and their patients.<sup>11 12</sup> The COVID-19 crisis amplified this problem and led to particularly stressful situations, especially in hospital pharmacies and ICUs. Indeed, unlike prior drug shortages caused mainly by supply-side issues, this one is principally a problem of very high demand.<sup>13 14</sup> The experience reported at the AHP highlighted the incredible impact of COVID-19 on the overuse of curare medications needed to care for patients. To satisfy physicians' expectations, the pharmacy of the AHP succeeded in supplying curare medications throughout

the COVID-19 crisis, until the French government provided the national management of curare medications. Obviously, this situation has created the opportunity for several medication errors, delayed or suboptimal therapy, and adverse drug events. The use of unfamiliar formulations of curare medications may result in dose calculation errors, in administration errors, in improper dilution, or in drug errors caused by look-alike/sound-alike confusion. Moreover, unexpected changes in prescribing order can be a source of medication errors. This was the case, for example, in May 2020 when the temporary disruption with atracurium led physicians to change their choice of therapeutic to cisatracurium. In order to avoid the occurrence of medication errors, the pharmacy implemented several measures in collaboration with healthcare teams. First, communication at all levels was essential. Thus, a daily-targeted communication on drugs availability was established between the pharmaceutical and ICU teams. The head of the pharmacy reported daily to the crisis cell on shortages issues. The pharmacy created a poster with photos of the different curare formulations available at the central pharmacy. A daily inventory of available stock of curare medications at the pharmacy and in the ICU was implemented. The curare formulations usually used at the AHP had a specific storage to make sure they were used in priority and not confused with the other formulations. An over-labelling of non-usual curare formulations with a specific sticker 'Pay attention to the dosage' was implemented in each box. Additionally, it is important to highlight that the risk of medication error was also increased by the high level of stress, fatigue and fear, even though the health and safety of the staff was a priority.<sup>15</sup>

## CONCLUSION

For several years, drug shortages have become a global concern, forcing health authorities to explore and implement strategies to prevent and mitigate them. However, the COVID-19 pandemic has created a new type of drug shortage—one caused by increased demand, particularly for curare medications. At the

AHP, drug shortages led to a major risk of medication errors with essential drugs such as curares. As a result of the great collaboration between the pharmacy and ICU teams, the AHP has not experienced any disruption in the supply of curare medications. For the time being, the fear of a COVID-19 resurgence and the ongoing supply shortages must require a high level of vigilance during the next few months.

**Contributors** XB conceived of the presented idea. XB, DJ and FD developed the theory and performed the computations. XB encouraged DJ and FD to investigate drug shortages and medication errors risk. XB supervised the findings of this work.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient consent for publication** Not required.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** No data are available.

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