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Using a worldwide in-app survey to explore sugammadex usage patterns: a prospective observational study

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Editor—Via encapsulation, sugammadex can rapidly and completely reverse even profound neuromuscular block induced by rocuronium or vecuronium, which is not possible to achieve with cholinesterase inhibitors.^{1–4} Although approved for use in Europe in 2008⁵ and available for several years elsewhere,⁶ the United States Food and Drug Administration (US FDA) delayed approval due to concerns regarding potential hypersensitivity reactions and effects on coagulation tests,⁷ which were ultimately satisfied.^{8–10} We are interested in better understanding global experience with sugammadex and the impact, if any, of pharmacoeconomics on post-marketing policies. The present data were analysed from an ongoing, Institutional Review Board (IRB)-approved (Emory University, Atlanta, GA, USA, IRB# 00082571) study of a globally utilized anaesthesia calculator app for the Android platform ('Anesthesiologist')^{11–12} fitted with a module capable of collecting survey data and app analytics.¹³ We used this tool to deploy a survey assessing global patterns of clinical practice and experience with sugammadex.

Of 11 863 anaesthesia provider respondents in 183 countries, 5510 (46%) reported sugammadex was available and relevant to their practice and were thus asked additional questions. Due to respondent fatigue,^{14–15} not all questions were completed by all respondents. A majority of these providers (72%, Table 1, Q2, 'Sometimes/Rarely/Never') reported selective usage of sugammadex. Most (56%, Table 1, Q3) had some form of extrinsic restriction on sugammadex access, primarily due to cost (69% of

n=1808, Table 1, Q3, those reporting any restriction) with far fewer reporting restrictions due to policies (26%) or problems with drug availability (22%). Even in the absence of policies restricting use, respondents self-limited administration of sugammadex, primarily due to cost concerns (40%, Table 1, Q4). Fewer self-limited due to limited drug supply (24%), and very few were concerned about adverse events (7.8%). These trends held true among respondents reporting free, unrestricted access to sugammadex (Table 1, Q4, subset).

Given the advantages of sugammadex over traditional reversal agents and tolerability in a wide range of disease states,⁶ we expected stronger adoption of sugammadex. Our findings suggest that cost concerns are the primary driver of limitations in use. It was surprising that institutional policies restricting sugammadex were not common. Even in the relative absence of policies restricting sugammadex use, about two-thirds of anaesthesia providers reported self-imposed limitations on sugammadex administration (66.5%, Table 1, Q4). This is likewise unexpected as physician knowledge and awareness of medication costs are generally poor,^{16–17} and drug costs generally do not impact individual anaesthesia providers directly. Anaesthesia providers appear to be making care decisions with economic concerns of their hospitals and patients in mind. However, the pharmacoeconomics of sugammadex are likely complex as higher drug costs may be offset by decreased operating room recovery times, faster discharge to the ward and fewer complications related to residual neuromuscular block.^{18–21} Providers

Table 1 Responses to pharmacoeconomic survey questions

| | n | % |
|---|--------|------|
| 1. Cost knowledge (select all that apply): | n=4640 | |
| I know the hospital cost of sugammadex | 2361 | 50.9 |
| I know the patient's cost of sugammadex | 872 | 18.8 |
| Acquisition/patient costs not applicable | 773 | 16.7 |
| Don't know cost/don't know applicability of cost | 852 | 18.4 |
| 2. How often do you use sugammadex for reversal? | n=4163 | |
| Always/mostly | 1158 | 27.8 |
| Sometimes | 1423 | 34.2 |
| Rarely/never | 1582 | 38.0 |
| 3. Restricted vs unrestricted access to sugammadex (select all that apply) | n=3212 | |
| Free, unrestricted access | 1404 | 43.7 |
| Restricted access (policies, costs or availability) | 1808 | 56.3 |
| Due to policies (vs any restriction) | 477 | 26.4 |
| Due to medication cost (vs any restriction) | 1246 | 68.9 |
| Due to medication availability (vs any restriction) | 396 | 21.9 |
| 4. I limit my use of sugammadex due to (select all that apply): | n=3851 | |
| Any reason | 2564 | 66.5 |
| Cost or cost benefit concerns | 1549 | 40.2 |
| Limited medication supply | 937 | 24.3 |
| Concerns about adverse events | 302 | 7.8 |
| Unsure how to use the medication | 114 | 3.0 |
| 4 (subset). I limit my use of sugammadex due to (select all that apply, those with free access): | n=1404 | |
| Any reason | 975 | 69.4 |
| Cost or cost benefit concerns | 512 | 36.5 |
| Limited medication supply | 428 | 30.5 |
| Concerns about adverse events | 142 | 10.1 |
| Unsure how to use the medication | 39 | 2.8 |

may not be fully considering these and other means of indirect cost savings.

Budgetary silos typically constrain the way in which hospital pharmacy and therapeutics committees conceptualize cost and cost savings as they often emphasize acquisition costs with little regard for potential indirect savings. Such an approach is ill advised as these direct cost considerations must be balanced against possible advantages from a quality and value perspective that are afforded by the use of sugammadex. Further assessment of global and regional variability in the impact of pharmacoeconomics on sugammadex practice patterns may yield further insight into the relatively low prevalence of reported institutional policies. Variations in national or regional healthcare delivery systems and administration may influence the way in which costs are conceptualized, thus influencing clinical approaches to reversal of neuromuscular block and the utilization of sugammadex.

Authors' contributions

Met criteria for authorship under ICMJE criteria: all authors. Designed data-collection tools, monitored data collection for the whole trial, wrote the statistical analysis plan, cleaned and

analysed the data, and drafted and revised the letter. He is corresponding author: V.N.O.-S.

Designed data-collection tools, contributed to the statistical analysis plan and revised the letter: F.A.W.

Contributed to the statistical analysis plan and revised the letter: C.S.J.

Contributed to the analysis and interpretation of the data and revised the letter: G.C.L.

Declaration of interest

All authors declare: no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work. The Anesthesiologist app was initially released in 2011 by V.N.O.-S. with advertising in the free version and a paid companion app to remove the ads. The app intellectual property was transferred to Emory University in 2015 and advertisements were subsequently removed, and the companion app to remove ads made freely available for legacy users not updating to the ad-free version. Following review by the Emory University Research Conflict of

Interest Committee, V.N.O-S. has been released from any conflict of interest management plan or oversight.

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Availability of critical care services in Taiwan under National Health Insurance

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Editor—Since the implementation of Taiwan's National Health Insurance (NHI) programme in 1995, use of health-care services

has significantly increased.¹ This is also true for the use of mechanical ventilation and extracorporeal membrane