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Impact of adding therapeutic recommendations to risk assessments from a prediction model for postoperative nausea and vomiting†

T. H. Kappen[1]*, Y. Vergouwe[2,3], L. van Wolfswinkel[1], C. J. Kalkman[1], K. G. M. Moons[1,2] and W. A. van Klei[1]

[1] Division of Anaesthesiology, Intensive Care and Emergency Medicine, University Medical Center Utrecht, PO Box 85500, Mail stop F.06.149, Utrecht, 3508 GA, The Netherlands
[2] Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, PO Box 85500, Mail stop STR.6.131, Utrecht, 3508 GA, The Netherlands
[3] Department of Public Health, Erasmus Medical Center, PO Box 1738, Rotterdam, 3000 DR, The Netherlands

* Corresponding author. E-mail: t.kappen@umcutrecht.nl

Editor's key points

- Risk model-guided changes in clinician decision-making should not only document a change in practice but also better patient outcomes.
- PONV prediction models have, at best, modest predictive utility for individual patients.
- It is unclear whether a risk-modified strategy of PONV prophylaxis can meaningfully reduce rates of PONV.
- The overall cost and net effect of universal PONV prophylaxis on patient comfort after surgery deserves further study.

Background. In a large cluster-randomized trial on the impact of a prediction model, presenting the calculated risk of postoperative nausea and vomiting (PONV) on-screen (assistive approach) increased the administration of risk-dependent PONV prophylaxis by anaesthetists. This change in therapeutic decision-making did not improve the patient outcome; that is, the incidence of PONV. The present study aimed to quantify the effects of adding a specific therapeutic recommendation to the predicted risk (directive approach) on PONV prophylaxis decision-making and the incidence of PONV.

Methods. A prospective before–after study was conducted in 1483 elective surgical inpatients. The before-period included care-as-usual and the after-period included the directive risk-based (intervention) strategy. Risk-dependent effects on the administered number of prophylactic antiemetics and incidence of PONV were analysed by mixed-effects regression analysis.

Results. During the intervention period anaesthetists administered 0.5 [95% confidence intervals (CIs): 0.4–0.6] more antiemetics for patients identified as being at greater risk of PONV. This directive approach led to a reduction in PONV [odds ratio (OR): 0.60, 95% CI: 0.43–0.83], with an even greater reduction in PONV in high-risk patients (OR: 0.45, 95% CI: 0.28–0.72).

Conclusions. Anaesthetists administered more prophylactic antiemetics when a directive approach was used for risk-tailored intervention compared with care-as-usual. In contrast to the previously studied assistive approach, the increase in PONV prophylaxis now resulted in a lower PONV incidence, particularly in high-risk patients. When one aims for a truly 'PONV-free hospital', a more liberal use of prophylactic antiemetics must be accepted and lower-risk thresholds should be set for the actionable recommendations.

Keywords: antiemetics; decision support techniques; drug therapy, computer-assisted; postoperative nausea and vomiting; postoperative nausea and vomiting/prevention and control; prognosis

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Current guidelines on prevention of postoperative nausea and vomiting (PONV) recommend using risk-dependent strategies, where administration of antiemetic prophylaxis is based on individual risk using a prediction model.[1 2] Although several prediction models have been developed,[3–6] their effect on clinical practice is small, mainly because of poor implementation.[7 8] These disappointing results of risk-dependent PONV prophylaxis have fostered ongoing debate as to whether or not to shift to routine PONV prophylaxis in all patients, irrespective of their predicted risk.[9–11] Before switching to such a new, as yet unproven, strategy of administering multiple antiemetics to every patient, the impact of risk-dependent strategies for PONV should be critically evaluated.[12–15] However, comparative studies assessing the actual impact of risk-dependent prophylaxis on the incidence of PONV are rare.[16]

We have previously shown that assisting anaesthetists by only presenting the patient's calculated risk of PONV on-screen in an anaesthesia information management system, but without

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further therapeutic directives per predicted risk, increased the number of prophylactic antiemetics administered by anaesthetists.[17] However, this change in physician decision-making did not decrease the incidence of PONV. We hypothesized that a greater impact could be achieved when being more directive by simply adding actionable recommendations according to the calculated risks.[12–14 18–20]

The present before–after study aimed to quantify the effects of combining a specific therapeutic recommendation with the patient's predicted risk on both the incidence of PONV and the actual administration of risk-dependent PONV prophylaxis.

Methods

Design and participants

The present study was a prospective before–after cohort study, conducted at the Anaesthesiology Department of a Dutch university hospital (UMC Utrecht) in 2010. The study aimed to quantify the effects of a directive PONV prediction model approach (i.e. presenting predicted risks accompanied with non-obligatory, therapeutic recommendations) on both the incidence of PONV and the administration of antiemetic prophylaxis. Care-as-usual (see below) was studied during the before-period (January to March 2010), followed by an intervention period (April to May 2010), during which all physicians were provided with a recommendation on how many prophylactic antiemetics would be required to sufficiently lower their individual patients' PONV risks (see below).

According to Dutch law, research protocols that do not subject patients to a particular treatment or that require them to behave in a particular way, do not apply to the Medical Research Involving Human Subjects Act. As the decision support tools in our study protocol only provided evidence-based information to physicians, the institutional ethical review board waived the need for individual informed consent and approved the study protocol (Medical Ethics Review Board, UMC Utrecht, 11–553).

All adult patients undergoing general anaesthesia for elective, non-ambulatory surgery who had visited the outpatient preanaesthesia evaluation clinic were considered eligible for the study. Exclusion criteria were pregnancy, postoperative admission to the intensive care unit, overnight ventilation at the post-anaesthesia care unit, and inability to communicate in Dutch or English. All eligible patients from the time of study initiation were automatically included using the anaesthesia information management system.

The prediction model

The implemented prediction model was originally developed in a population of a different university hospital in the Netherlands and had already been externally validated.[21 22] The model was subsequently updated for implementation at the UMC, Utrecht.[23] The model consisted of seven predictor variables: age; gender; current smoking; type of surgery; inhalation anaesthesia (including nitrous oxide); ambulatory surgery; and history of motion sickness or PONV (Table 1).

Intervention

Care-as-usual group

During the care-as-usual period, anaesthetists were not exposed to any automated prognostic information by the prediction model. The prophylactic management of PONV was not standardized in any way, which was according to care-as-usual in our hospital. At that time, the existing, local protocol for administration of PONV prophylaxis only included a preferable order for antiemetic drugs, their dosage and timing of administration: (i) ondansetron 4 mg i.v., 30 min before emergence of anaesthesia; (ii) droperidol 1.25 mg i.v., 30 min before emergence of anaesthesia; (iii) dexamethasone 4 mg i.v., after induction of anaesthesia. Other prophylactic antiemetic drugs, such as NK-1 receptor antagonists, were not readily available in our hospital during the study period.

In the post-anaesthesia care unit and the ward the PONV protocol consisted of rescue-treatment with an antiemetic drug: either one of the above antiemetic drugs if not previously administered, or metoclopramide 20 mg i.v. There was no scheduled PONV prophylaxis prescribed for patients returning to the ward.

Intervention group

The prediction model was implemented as a directive decision support tool in the anaesthesia information management system (Vierkleurenpen®), a custom-made system written by one of the authors (L.v.W.). The model presented a patient's predicted PONV risk accompanied with advice on the number of prophylactic antiemetics to administer based on that individual's risk (i.e. a directive risk-based approach). The anaesthesia information management system automatically

Table 1 The implemented prediction model for PONV. Probability of PONV as estimated by the model = 1/{1 + exp [−(0.12 − 0.017 × age + 0.36 × female gender − 0.50 × current smoking + 0.60 × history of PONV or motion sickness + 0.48 × surgery with a high PONV risk + 0.35 × inhalation anaesthesia − 1.16 × outpatient surgery)]}. PONV, postoperative nausea and vomiting. *Definition of this predictor was 'abdominal or middle ear surgery'. †When compared with i.v. anaesthesia using propofol. ‡Although the prediction model included a predictor for outpatient surgery, only non-ambulatory patients were included in the present study. Therefore, for each patient included in the study, this predictor was automatically set to zero. §For the intercept, the column represents the baseline odds not the OR

Predictor	Updated model OR (95% CI)
Age (yr)	0.98 (0.98–0.99)
Female gender	1.44 (1.14–1.82)
Current smoking	0.61 (0.48–0.77)
History of PONV/motion sickness	1.82 (1.44–2.31)
Surgery with a high PONV risk*	1.62 (1.14–2.30)
Inhalation anaesthesia†	1.42 (1.12–1.79)
Outpatient surgery‡	0.31 (0.24–0.41)
Intercept§	1.13 (0.73–1.74)