# Supplemental Digital content 2

# Methods

## Subjects

In this prospective observational study, 215 consecutive adult patients with indication for ambulatory pH-impedance monitoring for evaluation of reflux symptoms between December 2019 and March 2021 were included. Patients with a history of esophageal surgery, gastric surgery or other esophageal disorders (such as achalasia and esophageal atresia) were excluded. In the analysis only data from patients with nocturnal acid reflux, defined as esophageal acid exposure time of 0.5% or higher during supine position, were used. The study protocol was submitted to the local institutional review board. Formal evaluation was waived according to Dutch law (reference number W19\_469#19.542). Informed consent was obtained from all patients to use their (medical) data for scientific research purposes.

## Study Protocol

All patients underwent stationary oesophageal high-resolution manometry (HRM) and 24-hour pH impedance recording with simultaneous monitoring of sleeping position using a sleep position measurement and training device. The use of gastric acid-inhibitory drugs and drugs that might influence gastrointestinal motility was discontinued 7 days before the study. HRM was performed according to standardized protocol and evaluated using Chicago Classification 3.0 (1, 2). HRM was performed after a 4-hour fasting period and discontinuation of medication that could affect esophageal peristalsis or lower esophageal sphincter pressure. After the HRM, a combined pH-impedance catheter (Laborie, Enschede, the Netherlands) was placed transnasally based on the manometric findings. The catheter contains six impedance sites located at 2–4 cm (Z6), 4–6 cm (Z5), 6–8 cm (Z4), 8–10 cm (Z3), 14–16 cm (Z2), and 16–18 cm (Z1) proximal to the LES, as well as an antimony pH electrode located 5 cm above the LES. The antimony pH electrode was pre-calibrated at 37°C (using buffers of pH 7.01 and pH 4). Impedance and pH data was stored on a digital data logger (Ohmega, Laborie, Enschede, the Netherlands) using a sampling frequency of 50 Hz for impedance and 1 Hz for pH.

## Sleep position measurement

Sleep position was monitored by a sleep position measurement and training device (Side Sleep Technologies B.V., Amsterdam, the Netherlands) used in measurement-only mode. The device is a small (40 mm x 40 mm x 7 mm), lightweight (3 g) wearable with 3-axis accelerometer. The device registers the sleep position of patient at 10-second intervals. It categorizes sleep position as one of 5 categories: supine (‘’back’’), right, left, prone (‘’belly’’) and upright. Patients were instructed to place the device mid-sternal with an adhesive sticker and turn on the device when going to bed. Patients were asked to fill in questions regarding sleep position preference and reflux complaints.

## Data analysis

Data from the sleep position device was downloaded via Bluetooth on a mobile app provided by the manufacturer. The sleep position data was loaded into the pH-impedance analyses software (Laborie, Enschede, the Netherlands) using a dedicated executive program. The time used for the sleep position device and the pH-Impedance analysis software was retrieved from the digital clock from the Windows computer; which leads to a maximum synchronisation difference of 5 seconds between sleep position and pH-impedance signals.

## Nocturnal reflux definition and sleep position analysis

The nocturnal reflux definitions are displayed in table 1 (3). Nocturnal reflux detection was started when the sleep position device was turned on and a recumbent position was measured (supine, left, right or prone position). For each episode, the composition of the reflux (liquid or mixed liquid- gas), the type of reflux (acid or weakly acidic), proximal extent and position (left, right, supine, prone) were manually assessed by two investigators (J.M.S & M.D.) independently. A third investigator was consulted if consensus was not reached (A.J.B). The position “upright” was not included in this calculation as it was not defined as a sleep position. All reflux events were assigned to the sleep position that was present at the moment the pH dropped below 4. When a patient changed position while the pH was < 4, the reflux event was assigned to the sleep position during which the reflux event started. When a change in sleep position was accompanied by a 50% drop in impedance or a drop of > 1 pH unit even when already below 4, this was counted as a new reflux event. A reflux event that was preceded or followed by a change in sleeping position with a time window of 20 seconds (10 seconds before and 10 seconds after the start of the reflux event) was defined as a Position Change (PC) reflux. This takes into account the 0.1 Hz sampling rate of the sleep position registration device. Artefacts and meal periods were excluded from the analysis.

## Statistical Analysis

Descriptive statistics are presented as percentage for categorical data, mean with standard deviation (SD) or median with p25 – p75 for continuous variables. Friedman test and Wilcoxon signed rank test was used for comparison between sleep positions and acid exposure time. To analyze the relationship between acid clearance time and sleep positions, we were interested in the median acid clearance time/ per reflux episode/per body position (unrelated data). Therefore, the Kruskal-Wallis and Dunn’s test was used for comparison between sleep positions and acid clearance time. Bonferroni correction was not applied. A p value < 0.05 was considered statistically significant. SPSS statistics (version 24; SPSS, Chicago, Illinois, USA) was used for statistical analysis.

**References**

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