



# Colonoscopy Outcomes by Duration of NPO Status Prior to Colonoscopy with Moderate or Deep Sedation

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## PREFACE

Quality Enhancement Research Initiative's (QUERI) Evidence-based Synthesis Program (ESP) was established to provide timely and accurate syntheses of targeted healthcare topics of particular importance to Veterans Affairs (VA) clinicians, managers and policymakers as they work to improve the health and healthcare of Veterans. The ESP disseminates these reports throughout the VA, and some evidence syntheses inform the clinical guidelines of large professional organizations.

QUERI provides funding for four ESP Centers and each Center has an active university affiliation. The ESP Centers generate evidence syntheses on important clinical practice topics, and these reports help:

- develop clinical policies informed by evidence;
- guide the implementation of effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- set the direction for future research to address gaps in clinical knowledge.

In 2009, the ESP Coordinating Center was created to expand the capacity of HSR&D Central Office and the four ESP sites by developing and maintaining program processes. In addition, the Center established a Steering Committee comprised of QUERI field-based investigators, VA Patient Care Services, Office of Quality and Performance, and Veterans Integrated Service Networks (VISN) Clinical Management Officers. The Steering Committee provides program oversight, guides strategic planning, coordinates dissemination activities, and develops collaborations with VA leadership to identify new ESP topics of importance to Veterans and the VA healthcare system.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP Coordinating Center Program Manager, at [Nicole.Floyd@va.gov](mailto:Nicole.Floyd@va.gov).

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## EXECUTIVE SUMMARY

### INTRODUCTION

Fourteen million colonoscopies are performed annually in the United States for screening, diagnosis, surveillance, and treatment of numerous colonic conditions. Colonoscopies require bowel preparation for cleansing to sufficiently visualize the colon lining, identify and treat suspected lesions, and maximize quality and safety. To optimize colon lining visualization, patients are advised to divide the bowel preparation regimen over two sessions (known as “split-dose preparation”): 1) the evening prior to the colonoscopy (PM dose) and 2) the morning of the colonoscopy (AM dose), the latter taken ideally within 2-6 hours of the planned procedure. In addition, some level of sedation (typically moderate or deep) is used in almost all colonoscopies to facilitate patient comfort and procedure quality.

There is significant variation among anesthesia providers as to the acceptable timing of NPO (“nothing by mouth”), including how many hours prior to the planned procedure the last bowel preparation dose can be taken, in order to minimize anesthesia risk (primarily pulmonary aspiration requiring hospitalization). Practice guidelines from the American Society of Anesthesiologists suggest a minimum fasting period of 2 hours for clear liquids and 6 hours for a light meal (*ie*, toast and clear liquids). The guideline authors note that published clinical evidence is insufficient to clearly define a relationship between NPO status and risk of emesis/reflux or aspiration.

There is a need to balance optimal colonic preparation, patient convenience, and scheduling efficiency (typically a shorter NPO window status) with anesthesia safety concerns for an elective procedure (typically a longer NPO status). In addition, performing procedures with moderate or deep sedation requires development of and adherence to local and/or national policy measures that cross multiple procedures and physician specialties. These policies include recommendations regarding NPO status.

The purpose of this report was to review the evidence on the relationship between timing of NPO and 1) the incidence of aspiration and other anesthesia-related harms during elective colonoscopy and 2) colonoscopy rescheduling. We also reviewed the evidence on the benefits and harms of variable timing of NPO status on colonoscopy outcomes including colonoscopy quality measures, resource use, and patient satisfaction. The review may be used to guide policy within the VA. We addressed the following key questions:

**Key Question 1.** Does the incidence of aspiration and other anesthesia-related harms for colonoscopy vary by NPO status or bowel prep timing (*eg*, > 6 hours, 2-6 hours, < 4 hours, and < 2 hours)? Does the incidence of anesthesia-related harms by NPO status vary by: a) patient characteristics (age, race, sex, obesity, comorbidities) or b) sedation (moderate, deep)?

**Key Question 2.** What is the effect of variable timing of bowel prep and NPO status on the quality of the bowel preparation, diagnostic yield, and colonoscopy procedural quality indicators (*eg*, completion rates, adenoma detection rate, total procedure time, cecal intubation time and withdrawal time)?

**Key Question 3.** What is the effect of NPO status prior to colonoscopy on resource use (*eg*, costs, unused procedure slots, delays in rescheduling, delays in diagnosis, increased volume of procedures, scheduler and nursing time associated with cancelled or delayed procedures)?

**Key Question 4.** What is the effect of bowel preparation and NPO status prior to colonoscopy on patient adherence to bowel preparation, colonoscopy, and/or rescheduled colonoscopy, and satisfaction with bowel preparation and/or colonoscopy?

## METHODS

### Data Sources and Searches

We searched MEDLINE (OVID) for articles published from 1990 through October 2014. Our search was designed to identify studies of any design. We limited the search to studies involving human subjects published in the English language. Search terms included the following Medical Subject Headings (MeSH): Colonoscopy, Cathartics, Polyethylene Glycols, Phosphates, and Respiratory Aspiration of Gastric Contents. We also searched reference lists of guidelines, existing reviews, and included studies and we received reference suggestions from stakeholders, Technical Expert Panel (TEP) members, and peer reviewers.

### Study Selection

Abstracts of citations identified from the literature search were assessed for relevance by an investigator. Full text reports of studies identified as potentially eligible (or indeterminate, *eg*, title only) were obtained for further review by 2 independent investigators. We included studies of any design that reported outcomes following bowel preparation if at least one preparation was completed within 8 hours of the colonoscopy procedure. Only studies of adults, undergoing colonoscopy with moderate or deep sedation, and reporting outcome during colonoscopy or recovery from colonoscopy were included. We also included population-based studies of adverse events during colonoscopy.

### Data Abstraction and Risk of Bias Assessment

From studies of different preparation-to-procedure or NPO intervals, study characteristics (inclusion/exclusion criteria and details about the preparation interventions or NPO status), patient characteristics, and outcomes data were abstracted onto tables by one investigator and verified by a second. Risk of bias (low, moderate, or high) was determined for each included study.

### Data Synthesis and Analysis

We described and qualitatively compared the patient characteristics, study characteristics, intervention timing, and findings of included studies. Due to variation in the preparation-to-procedure interval and/or NPO status across studies and different systems used to report outcomes, we summarized most outcomes narratively. Strength of evidence was assessed for primary and secondary outcomes.

## RESULTS

### Results of Literature Search

Our literature search yielded 1177 abstracts or titles. We excluded 1069 and performed a full text review of 108 articles, excluding 74 articles and including 34. A hand-search of reference lists of guidelines, existing reviews, and included studies yielded another 6 articles for a total of 40 included studies of different bowel preparation or NPO status intervals (28 randomized controlled trials [RCTs], 2 controlled clinical trials [CCTs], and 10 observational studies). Of the 28 RCTs, 10 were low risk of bias, 16 were moderate risk of bias, and 2 were high risk of bias. Of the 10 observational studies, 3 were low risk of bias, 6 were moderate risk of bias, and one was high risk of bias. Both CCTs were high risk of bias.

### Overview

An overview of outcomes reported is presented in Executive Summary Table 1. Our predefined primary and secondary outcomes were rarely reported. All but one study reported quality of the bowel preparation. Few or no studies reported other secondary or intermediate outcomes.

**Executive Summary Table 1. Summary of Outcomes Reported in Included Studies**

Category	Outcome (Number of Studies Reporting) <sup>a</sup>
Primary Outcomes	Aspiration (k=6)
	Rescheduled Colonoscopies (k=1)
Secondary Outcomes	Bowel Perforation (k=1)
	Other Adverse Events (k=7)
	Diagnostic Yield (k=3)
	Completion Rate (k=11)
	Adenoma Detection Rate (k=7)
	False Negative Colonoscopy
Intermediate Outcomes	Hospitalizations
	Costs
	Quality of Bowel Preparation (k=39)
	Total Procedure Time (k=3)
	Cecal Intubation Time (k=4)
	Withdrawal Time (k=5)
	Patient Adherence (k=11) <sup>b</sup>
	Patient Satisfaction (k=11) <sup>b</sup>
	Unused Procedure Slots
	Delays, Rescheduling
	Delays, Diagnosis
	Increased Volume, Procedures
	Scheduler/Nurse Time
	Volume of Gastric Contents (k=2)
	pH of Gastric Contents

<sup>a</sup>Total of 40 studies included in review

<sup>b</sup>Data on patient adherence and patient satisfaction extracted only from studies using same bowel preparation substance in the study groups (k=21)

## Summary of Results for Key Questions

**Key Question 1.** *Does the incidence of aspiration and other anesthesia-related harms for colonoscopy vary by NPO status or bowel prep timing (eg, > 6 hours, 2-6 hours, < 4 hours, and < 2 hours)? Does the incidence of anesthesia-related harms by NPO status vary by: a) patient characteristics (age, race, sex, obesity, comorbidities) or b) sedation (moderate, deep)?*

Five studies (3 RCTs and 2 observational studies, total n=2,318) of split-dose bowel preparation regimens (completed at least 2 hours before colonoscopy) compared to evening-before regimens reported either no aspiration events during colonoscopy or in the 30 days following colonoscopy, or no complications related to sedation. Two of the 5 studies also specified that liquids were allowed up to 3 hours prior to the procedure. One of the observational studies reported no difference in gastric volume.

An additional RCT compared morning-only preparation to a split-dose regimen with both groups completing bowel preparation 4 hours before colonoscopy but allowed clear liquids up to 2.5 hours before. This study reported one aspiration event requiring 24 hour hospital observation in the morning-only group.

Although hospital- or population-based studies have reported on aspiration requiring hospitalization during colonoscopy, none documented NPO status of the patients at the time of the colonoscopy. One study reported a slightly higher incidence of aspiration requiring hospitalization (0.14% vs 0.10%) for Medicare patients having diagnostic colonoscopy with deep sedation versus moderate sedation. An Australian study of 23,508 outpatient colonoscopies reported one patient (0.004%) who had colonoscopy following general anesthesia had an aspiration event requiring hospitalization.

In an Italian study of 3,155 colonoscopies, there were 5 aspiration events requiring “some intervention by an anesthesiologist” (0.16%) but it was unclear what type of sedation the 5 patients received. Patients followed fasting guidelines of the study time period which allowed clear liquids at least 2 hours before the procedure and a light meal at least 6 hours before.

**Key Question 2.** *What is the effect of variable timing of bowel prep and NPO status on the quality of the bowel preparation, diagnostic yield, and colonoscopy procedural quality indicators (eg, completion rates, adenoma detection rate, total procedure time, cecal intubation time and withdrawal time)?*

Thirty-nine studies (28 RCTs, 2 CCTs, and 9 observational studies) reported on the effect of variable timing of bowel preparation on quality of the bowel preparation. Eleven of these studies (6 RCTs, 1 CCT, 4 observational) also reported the time prior to colonoscopy when water or other clear liquids were allowed, ranging from 4 hours until the time of the procedure. Although different rating scales were used to rate the quality of the bowel preparation, quality was consistently rated higher for NPO intervals of 6 hours or less compared to intervals of more than 8 hours. The difference was observed whether the minimum time was based on the completion of bowel preparation to procedure time (1 to 6 hours) or the time that liquids were allowed prior to the procedure (0 to 4 hours).

Pooled results from 5 RCTs (total n=1,795) found no difference in completion rate between shorter and longer NPO status (based on bowel preparation) groups. A retrospective observational study (n=5,175) reported a significantly higher completion rate (96% vs 94%, P = .008) in the shorter NPO group. One RCT reported no difference in adenoma detection rate based on NPO status while pooled results from 3 observational studies showed an improved detection rate with shorter NPO time. Diagnostic yield was reported in 3 RCTs with mixed findings for all polyps or lesions. One RCT reported no documented complications of bowel perforation on discharge from the endoscopy unit. No studies reported on false negative colonoscopies or hospitalizations.

**Key Question 3.** *What is the effect of NPO status prior to colonoscopy on resource use (eg, costs, unused procedure slots, delays in rescheduling, delays in diagnosis, increased volume of procedures, scheduler and nursing time associated with cancelled or delayed procedures)?*

One moderate risk of bias RCT (n=113) reported a significantly lower percentage of rescheduled colonoscopies (3%) in the split-dose group compared to 2 groups that completed preparation the evening before the colonoscopy (8% and 24%). However, preparation agents differed in the 3 study groups. No other resource use outcomes were reported.

**Key Question 4.** *What is the effect of bowel preparation and NPO status prior to colonoscopy on patient adherence to bowel preparation, colonoscopy, and/or rescheduled colonoscopy, and satisfaction with bowel preparation and/or colonoscopy?*

We extracted data on adherence and satisfaction from studies where the same bowel preparation substance (eg, polyethylene glycol) was used for all patients. Adherence to the bowel preparation regimen was typically higher with a split-dose regimen but several studies reported no difference between split-dose and same day (day before colonoscopy) regimens.

We extracted elements of satisfaction that would be impacted by different schedules for bowel preparation. Results were inconsistent for time lost from work or school and sleep disruption.

## DISCUSSION

### Key Findings and Strength of Evidence

- Hospital- or population-based studies have reported that the risk of aspiration serious enough to require hospitalization during colonoscopy is very low (1 in 1000 or less). However, these studies have not documented NPO status and it is possible that the low rates are driven by more individuals having longer rather than shorter NPO status.
- In 3 RCTs and 2 observational studies (total n=2,318) comparing shorter NPO status to NPO status of at least 8 hours, no aspiration events were reported. Bowel preparation was completed at least 2 hours prior to colonoscopy in 2 studies and at least 3 hours prior to colonoscopy in one study. Another study allowed clear liquids up to 3 hours prior to colonoscopy and the remaining study only reported that bowel preparation was completed in the morning for an afternoon colonoscopy.
- One small RCT (n=113) reported a significantly lower percentage of rescheduled colonoscopies in the split-dose group compared to 2 groups that completed preparation the evening before the colonoscopy, although different preparation agents were used in the 3 groups. No studies reported on other resource use outcomes including unused procedure slots or increased volume of procedures by NPO status.
- Few studies assessing NPO status specified adverse events associated with colonoscopy as an outcome of interest and therefore adverse events may be underreported.
- Time from completion of colonic preparation to colonoscopy of 1 to 6 hours is associated with greater bowel preparation quality than time intervals of greater than 8 hours. Of 24 studies comparing split-dose versus non-split-dose preparation, 20 reported higher quality of bowel preparation with split-dose.
- Completion rate was not significantly different between NPO status groups in 5 RCTs; one large observational study reported a greater completion rate with shorter NPO status. Results were mixed for diagnostic yield and adenoma detection rate with no consistent findings based on NPO status. One study reported no documented complications of bowel perforation; no study reported on false negative colonoscopy.
- Among studies reporting adherence to the bowel preparation regimen, time lost from work, or sleep disruption, results were mixed with no clear benefit of split-dose regimens over same day regimens.
- Studies of NPO status typically excluded patients with serious comorbidities.
- For our co-primary outcomes, strength of evidence was low for aspiration and insufficient for rescheduled colonoscopies. For secondary outcomes, strength of evidence was moderate for completion rate based on pooled results from 5 RCTs, low for adenoma detection rate based on pooled results from 3 observational studies, and insufficient for diagnostic yield, bowel perforation, and false-negative colonoscopy.

## Applicability

Populations enrolled in eligible studies were broadly applicable to many individuals undergoing elective colonoscopy in the United States. Eligible studies typically included patients 45 to 65 years with approximately 50% of patients enrolled in studies done in the US. Nearly one-half patients were male and two-thirds of colonoscopies were performed for cancer screening. The largest study reporting on aspirations requiring hospitalization was completed in a US Medicare population. However, aspiration by NPO status was not provided in this study and few other studies were adequately designed to directly assess the role of NPO status on aspirations requiring hospitalizations or colonoscopy rescheduling.

## Research Gaps/Future Research

Future studies are needed that systematically assess duration of NPO status in relation to timing of colonoscopy and record serious adverse events, including aspiration requiring hospitalization. Such studies could include prospective registries or pooling currently collected adverse event outcomes across the Veterans Health Administration (VHA). Future studies are also needed to determine and understand variability in NPO duration policies and practices across VA (especially practices that appear not to adhere to national society guidance statement) and to implement interventions to reduce variation. There is also a need for larger studies comparing shorter durations of NPO prior to colonoscopy (such as 2 to 4 hours) to longer intervals of NPO prior to colonoscopy (such as  $\geq 6$  hours) that directly assess for colonoscopy effectiveness (such as detection rate of adenoma and neoplasia, completion rate) and safety outcomes. We also need studies evaluating the effect of variable duration of NPO status prior to colonoscopy on patient satisfaction, adherence to colonoscopy, and impact on endoscopy scheduling processes, including delays in timely receipt of colonoscopy. Finally, evidence-based multi-society consensus conference guidelines are needed that bring together patient representatives and members from anesthesia, gastroenterology, and general medicine. Important items include determining the “clinically important” balance between important outcomes to anesthesiologists, gastroenterologists and patients including aspiration rates due to NPO status, colonoscopy quality measures, resource use, and patient satisfaction and adherence.

## Conclusions

Aspiration incidence requiring hospitalization during colonoscopy with moderate or deep sedation is very low and on the order of magnitude commonly accepted for adverse effects of similar clinical importance due to other elective procedures. Participants in hospital- and population-based studies likely had wide ranges of timing from NPO to colonoscopy and many were likely longer than 2 to 4 hours. No study documenting NPO status found that shorter NPO status prior to colonoscopy increased aspiration risk. We did not find direct evidence of the effect of NPO status on colonoscopy rescheduling. Shorter time from completion of colonic preparation to colonoscopy is associated with greater bowel preparation quality than longer time intervals.

**ABBREVIATIONS TABLE**

ASA	American Society of Anesthesiologists
CCT	Controlled clinical trial
NPO	Nil per os (nothing by mouth)
RCT	Randomized, controlled trial
VA	Department of Veterans Affairs
VHA	Veterans Health Administration