

# Lower Diagnostic Costs Associated with Early Deployment of Capsule Endoscopy in Non-Hematemesis Gastrointestinal Bleeding: a Cost-Utilization Analysis

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## Research article

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# Abstract

**Introduction:** Often, the diagnostic workup of patients presenting with non-hematemesis gastrointestinal bleeding (NHGIB) is inconclusive. Consequently, the diagnostic evaluation may incur unnecessary health care costs and diagnostic times. The use of a cost decision-analytical model of the current diagnostic management strategy applied to patients presenting with NHGIB may reveal alternative strategies for the evaluation of NHGIB.

**Methods:** Cost decision-analytical model that retrospectively follows the diagnostic course of 231 consecutive patients presenting with NHGIB to the emergency department (ED) of a tertiary medical center. We measured the effect (cost and relative times) of selecting a specific procedure, plus the effect of pursuing secondary procedures after non-diagnostic primary procedures.

**Results:** A primary VCE had a diagnostic rate of 68% vs. 45% and 48% for a primary EGD and COLO, respectively. Combining the diagnostic rates for each primary procedure with the cost of performing subsequent procedures (after non-diagnostic primary procedures), demonstrates the primary use of VCE (n=9) results in a total cost of \$12,146 vs. \$12,746 and \$13,162 for a primary EGD (n=47) and COLO (n=33), respectively. Similarly, the use of VCE as a primary diagnostic procedure in NHGIB patients admitted to the floor would take 74 unit hours to reach a diagnosis compared to 104 and 131 for EGD and COLO, respectively.

**Conclusion:** Our model suggests initial use of VCE for the diagnosis of acute NHGIB, may reduce time to diagnosis and management costs.

## Highlights:

1. Current diagnostic methodology used for NHGIB patients often leads to inconclusive findings while incurring high costs.
2. The current cost decision-analytical model suggests early deployment of VCE may be more cost-effective than current standard of care in the management of NHGIB.
3. The model allows health care administrators to assess the effects of manipulating certain variables in order to provide the most cost effective care in the management of NHGIB.

## Introduction:

In the United States, annual estimates indicate in patients presenting with acute gastrointestinal bleeding (GIB), 246,000 were found to have an upper GI source, 130,000 were found to have a lower GI source, and 165,000 were unspecified or indeterminate (1). Costs associated with upper GIB (UGIB) alone have been estimated to exceed \$2.5 billion annually (2), with lower GIB not far behind.

Given the extent of disease burden and the need for efficient health care, clinicians have attempted to categorize GIB into upper GIB and lower GIB to optimize the first diagnostic test used. If the bleed is originating from the upper GI tract, esophagogastroduodenoscopy (EGD) can be used to diagnose and treat the lesions, whereas bleeding from the lower GI tract and small bowel can be diagnosed via colonoscopy (COLO) and video capsule endoscopy (VCE), respectively. While patients presenting with hematemesis likely suggests an UGI source on its own, clinical factors such as age, sex, color of the material passed per rectum (melena, or hematochezia,), hemodynamic instability, and the ratio of blood urea nitrogen (BUN) to creatinine are used to help predict whether a non-hematemesis GIB (NHGIB) patient has an UGI or LGI source and assess the severity of the bleed (3-11). However, these clinical features alone are non diagnostic (12-14), and may lead to inefficient utilization of resources, and promote unnecessary hospital admissions. Specifically, melena has traditionally been associated with an UGI source, prompting most gastroenterologists to perform an EGD as the first diagnostic procedure (7-12). However, given the changing epidemiology of GIB, including decreasing incidence of peptic ulcer bleeding and increase in aspirin use, melena can be associated with bleeding anywhere from oropharynx to the right colon (15-17). Consequently, we have noticed a significant portion of patients presenting with NHGIB undergo non diagnostic EGDs and COLOs (12,18, 35), leading to inefficient evaluations and potentially augmented overall costs.

Studies have evaluated cost effective management strategies in patients with GIB and have used decision tree analysis to determine the most efficient diagnostic methods. However, these studies focus on patients with presumed UGIB or on a very select patient population (26,33-34). To date, there has been no study using a decision tree to detail the monetary and time cost associated with each diagnostic decision made in all patients presenting with NHGIB. We created a cost decision-analytical model by retrospectively following the diagnostic course of patients presenting to the ED with NHGIB. Our primary goal was to evaluate and compare the relative diagnostic costs and times associated with using EGD, COLO, and VCE as primary diagnostic tools in patients presenting with NHGIB with the hopes of identifying a potentially more cost-efficient diagnostic modality.

## **Methods:**

We created a cost decision-analytical model (Precision Tree Software, Version 7.5, Palisade Corp) that was designed to retrospectively follow the diagnostic hospital course of 231 consecutive patients presenting with NHGIB to a tertiary care center emergency department (ED). Those patients presenting to the ED with guaiac + stools and symptomatic anemia, hematochezia/anemia, or melena were included in the NHGIB group. Patients were excluded if they had hematemesis. The decision tree was designed to mimic the most simplistic diagnostic algorithms used by most clinicians in the ED, starting with disposition of patients to sequence of diagnostic tests used. We used actual calculated diagnostic probabilities, diagnostic times, and procedure/hospital costs to complete the model. A definitive diagnosis was accepted only if the source of active bleeding or lesions that could be the origin of the bleeding, were identified by a gastroenterologist using standard diagnostic tools. Time to diagnosis was determined by identifying documented time of admission to ED and documented time on the diagnostic

procedure note. Given the retrospective nature of the study, it was assumed the clinician used traditional methods to decide patients disposition (discharge, floor, or ICU) and which primary diagnostic modality to employ (i.e., hemodynamic instability, BUN:Cr, color of blood passed through rectum, hemoglobin level). The data was collected by three observers and subsequently reconciled by all three observers in a standardized fashion. Data was stored in an encrypted computer file that was password protected and only accessible to the three data collectors.

### Model Scenarios

For patients presenting with NHGIB, the clinician could decide first to admit the patient to the intensive care unit (ICU), hospital floor, or discharge from the ED. Once in the ICU or the hospital floor, the clinician could either decide to or not to perform a procedure (seen as decision nodes on the decision tree) and if so, choose between an EGD, COLO, or VCE. We chose to separate the groups into ICU and floor subgroups, to observe intergroup cost variability amongst all three procedures given the substantially greater cost in ICU admissions compared to floor admissions. Patients were followed till discharge from the hospital.

If an EGD was the first diagnostic procedure chosen and a source of bleed was identified, than the decision tree ended and no further procedures were required for diagnostic purposes. If, however, the primary EGD was negative, the clinician had the option to perform a VCE, COLO, or no further procedure. Similar decisions were possible when COLO was the first procedure. If VCE was the first procedure chosen and the source of the bleed was identified, either a small bowel enteroscopy (SBE), EGD or COLO was performed for further clarification of the bleed. If however, the VCE was negative, no further procedure was performed and it was assumed the bleeding had stopped.

### Probabilities

Diagnostic probabilities were calculated by determining the rate of finding the source of bleed for each specific procedure within each specific decision tree arm (seen as part of chance nodes on the decision tree). A specific procedure was considered diagnostic if the gastroenterologist procedure note indicated the lesion found was the source of bleed.

### Costs/Times to diagnosis

Cost for each specific procedure was based on CPT codes and included both Medicare rates for facility and group fee. Diagnostic COLO w/wo brush/wash (CPT code 45378) cost \$1,093, diagnostic EGD w/wo brush/wash (CPT code 43235) cost \$930, VCE (CPT code 91110) cost \$1190, and diagnostic SBE w/wo brush (CPT code 44360) cost \$1,151. ICU and hospital floor admission costs were determined using Medicare data for diagnosis related groups (DRG) for a standard patient admitted for GIB to the ICU (\$32,746) and floor (\$10,160). Costs for therapeutic interventions were not included since we were investigating primarily the costs associated with admissions and diagnosis. Calculations of total cost incurred by each procedure were based on admission cost, procedure cost, and the cost of pursuing

secondary and tertiary procedures after non-diagnostic primary procedures. An increase in non-diagnostic tests will in essence increase total incurred costs and times.

Times to diagnosis were calculated based on time from ER admission to relevant diagnostic procedure. Unit hours were used as surrogates for costs in order to compare the relative times to diagnosis of each diagnostic procedure and *not actual times*.

### Sensitivity Analysis

We used one-way sensitivity analysis, to observe the effects of altering the variables on the decision tree. More specifically, we altered cost of certain procedures and hours to diagnosis to measure the change in total costs and total unit hours, respectively.

## **Results:**

### Disposition of Patients Presenting to the ER

Out of 231 patients presenting with NHGIB, 22 were discharged, 80 were admitted to the ICU, and 129 were admitted to the hospital floor. Of those patients admitted to the floor, 73% underwent a procedure and 27% did not, of which all were discharged home without a definitive diagnosis. Of those in the ICU, 84% underwent procedures and 16% did not, of which 77% were discharged and 23% passed away (**Fig 1**).

### Overall Probabilities for Floor Patients

In the floor group, 50% (n=47) patients underwent a primary EGD as the first diagnostic tool, 35% (n=33) underwent a primary COLO, 10% (n=9) underwent a primary VCE, and 5% underwent various other primary diagnostic procedures (**Fig 2**).

**Table 1** shows overall culprit bleeding lesions for those patients who were admitted to the floor and underwent diagnostic procedures. Of the primary EGDs, only 45% were diagnostic for a bleeding lesion and had no need for a further procedure (**Fig 3**). Of the 55% non-diagnostic primary EGDs, 31% (n=8) had a secondary VCE, 42% (n=11) had a secondary COLO, and 27% had no further diagnostic procedures and were discharged home. Only 18% of these secondary COLOs were diagnostic, whereas, 50% of the secondary VCEs were diagnostic. Out of the non-diagnostic secondary COLOs, 2 patients underwent a tertiary diagnostic VCE and a bleeding lesion was found in both these patients. All patients with a positive VCE underwent a subsequent small bowel enteroscopy (SBE) for further diagnostic clarification (**Fig 3**).

Of the primary COLOs, only 48% were diagnostic and had no need for a further diagnostic procedure (**Fig 4**). Of the 52% patients undergoing non-diagnostic primary COLOs, 1 patient had a non-diagnostic secondary EGD, 1 patient had a non-diagnostic secondary VCE, and the rest had no further diagnostic procedures and were discharged home without a true diagnosis.

Of the primary VCEs, 67% were diagnostic and underwent a subsequent therapeutic procedure (EGD, COLO, or SBE) **(Fig5)**. 33% of the primary non diagnostic VCEs did not undergo a further inpatient diagnostic procedure and were deemed safe for discharge.

### Overall Costs for Floor Patients

Combining the diagnostic rates and probabilities for each primary procedure with the cost of performing subsequent procedures (after non-diagnostic primary procedures), demonstrates the use of VCE, as a primary diagnostic procedure (n=9), results in a total cost of \$12,146 vs. \$12,746 and \$13,161 for a primary EGD (n=47) and COLO (n=33), respectively. The cost incurred by a primary diagnostic VCE also includes the subsequent diagnostic procedures (EGD, COLO, SBE) required for further clarification of the bleeding lesion **(Fig 2)**.

### Overall times for Floor Patients

We substituted unit hours in place of dollar values to assess the overall costs in times associated with each decision. Combining the diagnostic rates and probabilities for each primary procedure with the time to each subsequent procedure (after non-diagnostic primary procedures), demonstrates the use of VCE, as a primary diagnostic procedure (n=9), results in relative faster times to diagnosis at 74 unit hours compared to 104 and 131 unit hours for EGDs and COLOs, respectively, in patients admitted to the floor. Of note it took on average 29, 38, and 37-unit hours to obtain a primary EGD, COLO, and VCE respectively **(Fig 6)**.

### Overall Probabilities for ICU Patients

In the ICU group, 70% (n=47) patients underwent a primary EGD as the first diagnostic tool, 12% (n=8) underwent a primary COLO, 7.5% (n=5) underwent a primary VCE, and 10.5% (n=7) underwent various other primary diagnostic procedures **(Supp Fig 1)**.

**Supp Fig 2, 3, and 4** demonstrates the overall probabilities of choosing EGD, COLO, and VCE, as the primary procedure in ICU patients, respectively. Of the 45% non-diagnostic primary EGDs, 14% (n=3) had a secondary VCE, 57% (n=12) had a secondary COLO, and 29% (n=6) had no further diagnostic procedures. None of these secondary COLOs were diagnostic, whereas, 100% of the secondary VCEs were diagnostic and underwent a subsequent SBE.

### Overall Costs and Times for ICU Patients

**(Supp Fig 1 and 5)** demonstrate the relative monetary costs and time cost for ICU patients after combining the diagnostic rates and probabilities for each primary procedure with the time to each subsequent procedure (after non-diagnostic primary procedures). The use of VCE, as a primary diagnostic procedure (n=5), results in a total cost of \$35,487 vs. \$34,729 and \$34,136 for a primary EGD (n=47) and COLO (n=8), respectively. The cost incurred by a primary diagnostic VCE also includes the subsequent diagnostic procedure (EGD, COLO, SBE).

## Sensitivity analysis

A one way sensitivity analysis was performed on the hospital floor group to note changes to overall costs and unit hours if variables such as cost and diagnostic probabilities were varied. If the probabilities of finding a bleeding lesion with a primary COLO (48%) and primary VCE (67%) remained constant, the diagnostic probability of EGD would have to increase to roughly 70% from 45% to incur fewer costs than a primary VCE. In a similar fashion, the probability of finding a bleeding lesion for COLOs would have to increase to roughly 80% from 48% to incur fewer costs than a primary VCE (**Supp Fig 9 and 10**).

Given there are extra costs associated with a positive VCE, most of which require a subsequent therapeutic procedure, we calculated the theoretical effect of increasing the diagnostic probability of a primary VCE to 100%. Even with the substantially increased diagnostic yield of VCE, leading to an increase in subsequent diagnostic procedures, the cost incurred of a primary VCE would still be less than that incurred by a primary diagnostic EGD (\$12,445 vs \$12,746) (**Fig 7**).

In the same token, the diagnostic probability of a primary EGD and COLO would need to reach approximately 70% and 85%, respectively, to have faster times to diagnosis than VCE for patients admitted to the floor (**Supp Fig 6,7**). Even if the primary diagnostic yield of VCE was to reach 100%, the cost in unit hours would only increase to 85-unit hours from 74-unit hours (**Supp Fig 8**), still less than a primary diagnostic EGD (104).

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## **Discussion:**

Decision tree models are advantageous when attempting to describe the overall effect of complex decision making, which otherwise would be difficult to describe in the traditional sense. It also allows clinicians to quickly gauge the theoretical impact of altering certain decisions without having to trial those decisions in real time. Thus, it allows health care administrators to implement the most efficient system for the evaluation of complex medical problems.

The decision regarding which diagnostic test to employ in NHGIB patients can become quite complex and involve multiple factors. The goal for creating the current decision tree model was to describe the effect (diagnostic costs and relative times) of traditional diagnostic decisions made by clinicians for patients presenting to the ED with NHGIB. Our study is the first to use a decision tree to analyze the incurred diagnostic costs and relative times associated with using a primary diagnostic VCE, EGD, or COLO in patients presenting with NHGIB. We found VCE, when used as the primary diagnostic procedure in patients admitted to the hospital floor with NHGIB, lead to quicker diagnostic times and less incurred cost when compared to a primary diagnostic EGD or COLO.

In our model, we found the most common primary diagnostic procedure chosen by clinicians was EGD followed by COLO and VCE in both the floor group and ICU group. This aligns well with traditional diagnostic methodology as most patients presenting with NHGIB symptoms (melena, guaiac + stool with anemia), will undergo an EGD first, followed by a COLO if the EGD is non-diagnostic, and finally a VCE if both are non-diagnostic (7-12). However, for patients admitted to the floor, we found the diagnostic probability for a primary EGD and primary COLO was significantly lower than VCE. As a consequence, we noted increasing observed diagnostic costs in floor patients undergoing primary EGDs and COLOs as a significant portion of these patients underwent multiple subsequent non-diagnostic procedures. In contrast, VCE maintains a relatively higher diagnostic yield and consequently accumulates overall lower costs.

The low diagnostic yields of COLOs and EGDs correlate well anecdotally and are likely due to the changing epidemiology of GIB lesions. These findings were corroborated in our recent retrospective analysis demonstrating similar low diagnostic yields with significant variation in location of culprit lesions (35). Peptic ulcers, albeit still common, are becoming less prevalent and NHGIB symptoms such as melena, guaiac + stool with anemia, and hematochezia are less localizing (12,15-17). Hence, a primary EGD in NHGIB patients may miss a small bowel or right colonic lesion and by the time a COLO or VCE is performed the bleeding lesion has stopped. After all, given enough time most bleeding lesions will resolve spontaneously (29). The diagnostic lag time as well as the need for proper prep time, may also explain the low diagnostic yields of COLOs observed in our model when used as a primary or secondary diagnostic procedure for NHGIB patients admitted to the floor (18, 27-28).

In a similar fashion, our model demonstrated lower accumulated diagnostic times for floor patients undergoing a primary VCE versus an EGD or COLO. This, once again, is a direct consequence to the time accumulated completing secondary and tertiary diagnostic tests after a large number of non diagnostic primary EGDs and COLOs. More specifically, whereas a positive VCE lends itself to only one possible subsequent procedure (only done for further clarification and treatment of the lesion rather than an initial diagnosis), a non-diagnostic EGD or COLO allows for multiple options for diagnostic testing and the array of possibilities leads to an accumulation in time.

Interestingly, similar results were not seen in patients admitted to the ICU as EGDs and COLOs incurred slightly less costs and times than VCE. According to our model, the similarities in cost likely stems from

the increased diagnostic probabilities of all three procedures which seems to correlate well with quicker times to the first diagnostic procedure. Interestingly, the average time for a primary diagnostic VCE in the ICU group was 8 hours and all 5 of these patients obtained a diagnosis. This correlates well with previous studies showing the faster VCE is done from the time of index bleeding the higher the likelihood of finding the source of bleeding (31,32).

Sensitivity analysis done in our model suggests the cost utility of EGDs and COLOs would be equivalent to VCEs if the diagnostic probabilities were substantially increased (70% for EGD and 80% for COLO) for patients admitted to the floor. Although EGD has great diagnostic yields for true UGI bleeding lesions (30), our experience and results of our study indicate clinicians are having difficult times accurately predicting location of bleeding for patients presenting with NHGIB (12, 35). Moreover, given the inherent variability in bleeding lesions throughout the GI tract and an inability to visualize the GI tract past the duodenum, it seems unrealistic to achieve a diagnostic yield greater than the 70% required for EGDs to become diagnostically more cost efficient. Similarly, bowel prep time and lack of rapid visualization of the colon, would make it difficult to achieve a high diagnostic probability for COLOs, unless done urgently (18,27-28). VCE on the other hand has a high potential to rapidly detect location of bleeding throughout most of the GI tract. While VCE has traditionally been used primarily for suspected small bowel lesions and rarely as a primary diagnostic choice for patients presenting with GIB (19-21), pilot studies using VCE as a primary diagnostic tool for UGIB have demonstrated comparable results to EGD (22-25). More recently, we performed a randomized controlled trial comparing early VCE use to the traditional diagnostic methodology in the work up of NHGIB. We found VCE was able to determine the location of bleeding significantly faster and with better accuracy than EGD and COLO alone (36). It is then to no surprise that the diagnostic probability for VCE in NHGIB floor patients was substantially higher than EGDs or COLOs in our model, and consequently incurs less overall costs and times.

Although VCE has the ability to determine the location of bleeding through most of the GI tract with one test, at times it may have difficulty clarifying the specific cause for bleeding. Thus, secondary diagnostic/therapeutic procedures are usually required for further clarification. Critics will suggest that this will add additional overall cost and may decrease VCE cost utility. However, our sensitivity analysis suggests that even if the diagnostic probability of VCE were to reach 100%, meaning a significant increase in subsequent procedures, the total incurred costs will still be at most equivalent to that of a primary EGD for patients admitted to the floor. The benefit of VCE seems to not only stem from its inherent ability to visualize most of the GI tract with one test but also from its ability to rapidly visualize most of the GI tract and detect intermittently bleeding vascular lesions, which was readily seen in our aforementioned RCT (36).

Only one previous study (Meltzer et al) has designed a decision tree to evaluate the cost effectiveness of VCE compared to other non-invasive diagnostic methods with similar results to ours, but it only looked at patients with acute UGIB and used inferred probabilities (26). Our study supplants Meltzers by using

observed probabilities and costs, rather than calculated assumptions, to depict how low diagnostic yields of a primary EGD and COLO can potentially increase overall cost and diagnostic times in the difficult to diagnose NHGIB patient admitted to the floor. In addition, the results of our study indicate that current diagnostic methodologies have room for improvement and exploiting VCEs rapid diagnostic capabilities may be a potential means to curtail unnecessary GIB associated health care costs. We suggest rapid deployment of VCE in the ED setting may increase overall diagnostic probabilities with more directed therapeutic modalities (EGD, COLO, SBE), not only leading to improved diagnostic times but also preventing unnecessary costly hospital admissions. Clearly, prospective studies using a similar decision tree analysis are required to confirm this hypothesis, but the preliminary results seem promising.

There are several limitations of the study beginning with the retrospective nature of the study. The decision tree model was designed to retrospectively follow and analyze the clinician's decision to perform certain procedures. Thus, assumptions were made that clinicians were using traditional modalities and clinical parameters to determine which procedures should be performed first. Given the inherent variability in clinical judgments and the ambiguity in these clinical parameters, assumptions made based off the decision tree analysis may be oversimplified. Moreover, costs calculated only depicted the cost associated with admitting a patient and their respective diagnostic course. Practically, there are significantly more cost incurred due to other modalities, including medications use, blood transfusions, imaging, therapeutic procedures, etc., that were not included. Thus, costs depicted in our model were not directed at showing actual monetary costs associated with clinical decisions but merely a relative comparison between the three main diagnostic procedures used to diagnose NHGIB. In extension, the total times to diagnosis cannot be interpreted as actual hours to diagnosis since the decision tree is designed to incorporate probabilities with unit measures and is generally additive. However, comparing the total unit hours accumulated between all three procedures allows for at least a relative depiction of which procedures may be quicker at obtaining a diagnosis with respect to each other.

In conclusion, our current decision tree model for NHGIB patients demonstrates a potential opportunity to curtail costs associated with managing patients presenting with NHGIB. In addition, it provides clinicians a means to measure effects of changing certain variables before implementation in real time. Our model, along with other recently published data, suggest early use of VCE may be a more cost-effective method to identify culprit gastrointestinal lesions in NHGIB patients. Further prospective studies are needed to corroborate these findings.

## **Abbreviations**

COLO- Colonoscopy

EGD- Esophagaogastroduodenoscopy

NHGIB- Non- Hematemesis Gastrointestinal Bleeding

VCE- Video Capsule Endoscopy

## Declarations

## Funding:

No funding was provided for this study

## Author Contributions:

**Salmaan Jawaid** - study concept and design, acquisition of data, analysis and interpretation of data, drafting of manuscript, and statistical analysis

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## Tables

**Table 1: Culprit Bleeding Lesions in Non-ICU NHGIB Patients Who Underwent Diagnostic Procedures**

Diagnosis (n=94)	N (%)
No diagnosis	35 (37.2)
Gastric ulcer	7 (7.4)
Duodenal ulcer	9 (9.6)
Jejunum/Cecal ulcer	3 (3.2)
Varices	2 (2.1)
Mallory-Weiss	0 (0)
Esophagitis/gastritis	3 (3.2)
Jejunum polyps	0 (0)
Small bowel angioectasia	7 (7.4)
Ischemic Colitis	8 (8.5)
Diverticulosis	9 (9.6)
Gastric angioectasia	4 (4.3)
Misc (postprocedure bleed, tumor, radiation enteritis)	5 (5.3)
Colonic angioectasia	2 (2.1)

## Figure 7

Figure 7 is not available with this version of the manuscript.

## Figures

**Figure 1: Disposition of Patients Presenting to the Emergency Department for NHGIB**

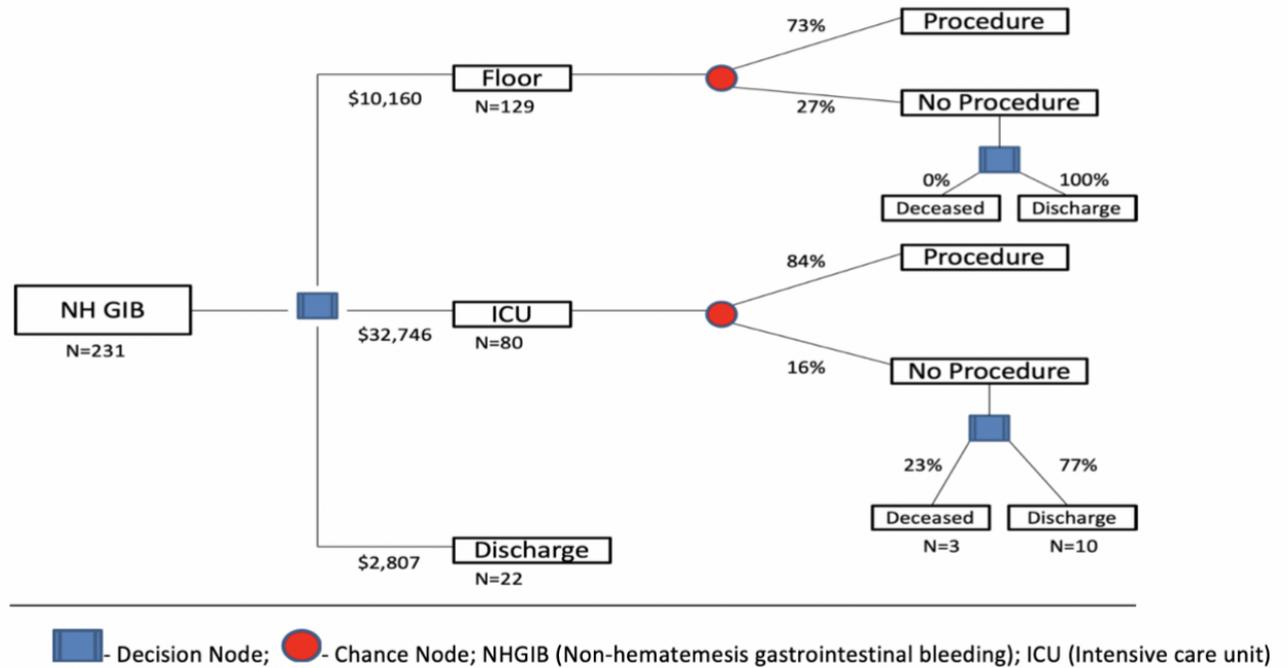
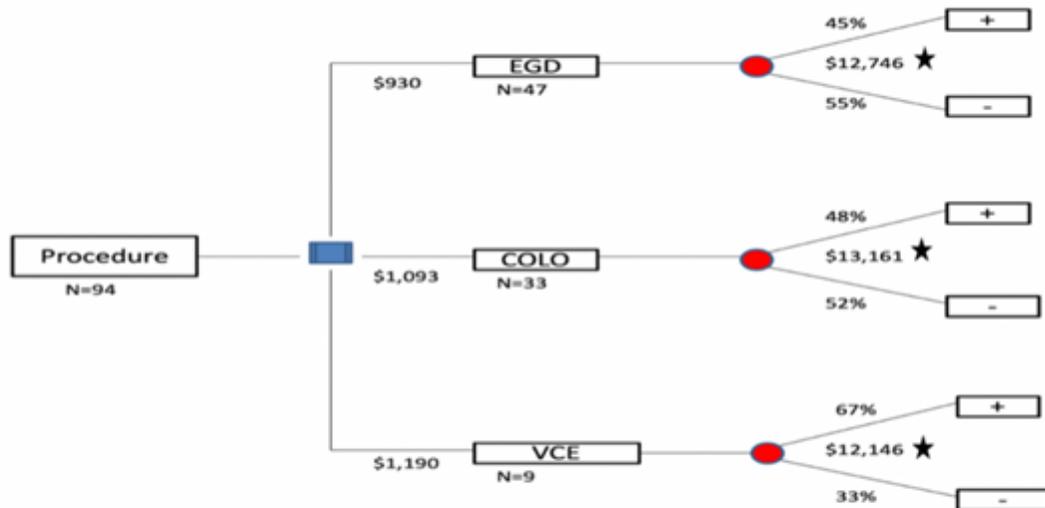


Figure 1

Disposition of Patients Presenting to the Emergency Department for Non-Hematemesis GIB

**Figure 2: Diagnostic Probabilities and Overall Incurred Costs of Primary Diagnostic Procedures Performed in NHGIB Patients Admitted to the Floor**

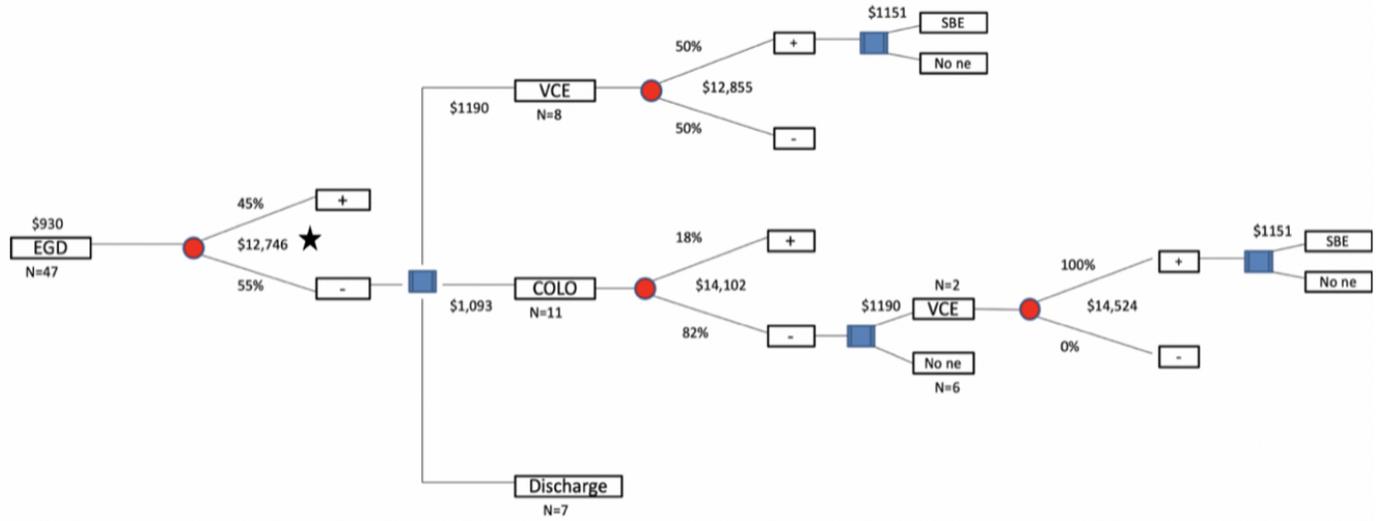


■ - Decision Node; ● - Chance Node; ★ - total incurred costs, EGD (esophagogastroduodenoscopy); COLO (Colonoscopy), VCE (Video capsule endoscopy)

## Figure 2

Diagnostic Probabilities and Overall Incurred Costs of Primary Diagnostic Procedures Performed in NHGIB Patients Admitted to the Floor

**Figure 3: Overall Costs and Decision Flow of Primary EGDs in NHGIB Patients Admitted to the Floor.**

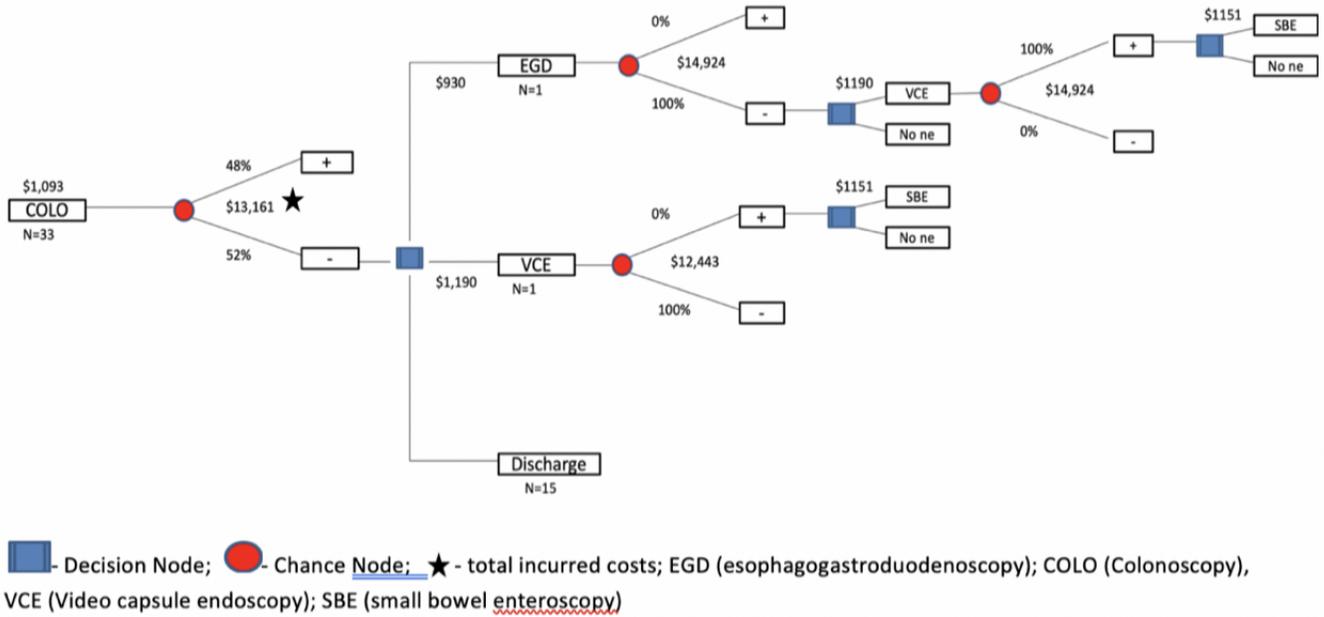


■ - Decision Node; ● - Chance Node; ★ - total incurred costs; EGD (esophagogastroduodenoscopy); COLO (Colonoscopy), VCE (Video capsule endoscopy); SBE (small bowel enteroscopy)

## Figure 3

Overall Costs and Decision Flow of Primary EGDs in NHGIB Patients Admitted to the Floor

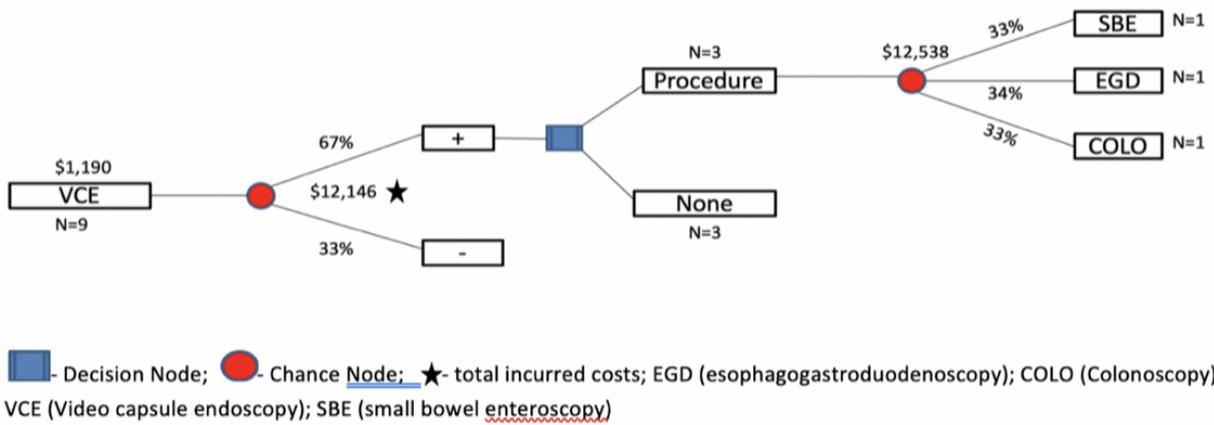
**Figure 4: Overall Costs and Decision Flow of Primary COLOs in NHGIB Patients Admitted to the Floor.**



**Figure 4**

Overall Costs and Decision Flow of Primary COLOs in NHGIB Patients Admitted to the Floor

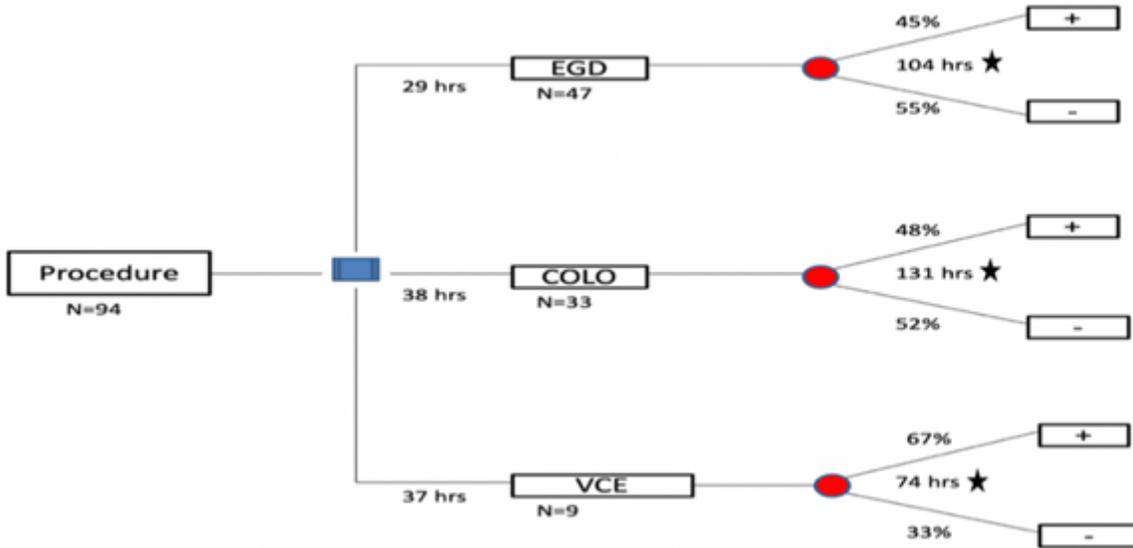
**Figure 5: Overall Costs and Decision Flow of Primary VCE in NHGIB Patients Admitted to the Floor.**



## Figure 5

Overall Costs and Decision Flow of Primary VCE in NHGIB Patients Admitted to the Floor

**Figure 6: Overall Incurred Diagnostic Times of Primary Diagnostic Procedures Performed in NHGIB Patients Admitted to the Floor**



## Figure 6

Overall Incurred Diagnostic Times of Primary Diagnostic Procedures Performed in NHGIB Patients Admitted to the Floor

## Supplementary Files

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