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# Compliance with Gastric-Emptying Scintigraphy Guidelines:

# A Report from the Intersocietal Accreditation Commission Database

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**Brief Title:** Gastric-Emptying Guideline Compliance

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**Abstract**

Many variables can influence the results of the gastric emptying scintigraphy (GES). A lack of methodologic standardization may cause variability, limit comparisons, and decrease the credibility of the test. To address this, in 2009, the SNMMI published Procedure Guideline for Adult Solid-Meal Gastric-Emptying Study 3.0 which describes a standardized, validated GES protocol. Laboratories must closely follow the consensus protocol to provide valid and standardized results and improve patient care.

The Intersocietal Accreditation Commission (IAC) evaluates compliance with guidelines as part of the accreditation process. The rate of compliance with the GES guideline at a national level has not been assessed. The aim of this study was to quantify the compliance to the standardized protocol in a large cohort of laboratories from different institutions and practice settings across the United States.

**Methods:** The IAC Nuclear/PET database was used to extract GES protocols from all laboratories applying for accreditation from 2013-2015. Each protocol was assessed for compliance with the methods described in the SNMMI GES procedure guidelines. Fourteen binary variables were assessed: patient preparation (4), meal content (5), acquisition (2) and processing (3).

**Results:** Protocols from 127 labs demonstrated that patient preparation was the least compliant category of variables. Instructions for blood glucose monitoring and withholding of medications were problematic. Overall, 69.3% of protocols were not compliant with the content or preparation of the consensus meal. 47.3% used whole eggs instead of egg whites. Additional ingredients not recommended in the guidelines were also frequently used. Only 3.1% of laboratories were fully compliant with all 14 variables. Over half of all laboratories were compliant with ≤5 variables.

**Conclusion:** Almost eight years after the publication of the SNMMI GES guidelines, there is low protocol adherence among laboratories applying for IAC Nuclear/PET accreditation. This substantial degree of guideline noncompliance is concerning. The variability in GES protocols may have a significant effect on patient management, as results may be inaccurate. Consistent use of the standardized GES protocol permits interpretation of results in a standard manner allowing inter-laboratory comparisons and fosters acceptance of the test validity by referring clinicians.

**Key Words:** gastric-emptying scintigraphy, guidelines, accreditation, protocols, standardization

**Abbreviations**:

| | |
|---|---|
| ABNM | American Board of Nuclear Medicine |
| ANOVA | Analysis of variation |
| GES | Gastric emptying scintigraphy |
| GNM | General nuclear medicine |
| IAC | Intersocietal Accreditation Commission |
| SNMMI | Society of Nuclear Medicine and Molecular Imaging |
| VA | Veterans Administration |

## Introduction

Gastric-emptying scintigraphy (GES) is considered the reference standard test to measure gastric motility in patients with symptoms suggesting altered gastric emptying. Many variables can influence the results of the test such as patient factors (e.g. test preparation, blood glucose level), meal composition and amount, acquisition parameters (e.g. camera position, duration of measurement), and method of analysis. *(1,2)* A lack of methodologic standardization may cause variability in results and reporting of GES, limit comparisons between institutions, and decrease confidence and credibility of the test. *(1,3)* To address this, members of the American Neurogastroenterology and Motility Society and the Society of Nuclear Medicine and Molecular Imaging (SNMMI) published a consensus statement in 2008. *(1)* The key points of these recommendations were published by SNMMI in 2009 as *Procedure Guideline for Adult Solid-Meal Gastric-Emptying Study 3.0* which describes a standardized, validated GES protocol to guide nuclear medicine practitioners in performing and interpreting GES studies in a reproducible manner. *(4)* Laboratories must closely follow the consensus protocol to provide valid and standardized results and improve patient care.

Accreditation is often viewed as a gatekeeper of quality. The Intersocietal Accreditation Commission (IAC) determines quality by evaluating laboratory staff qualifications, imaging protocols, image quality, and reporting. A laboratory must be in compliance with the *Intersocietal Accreditation Commission Standards and Guidelines for Nuclear/PET Accreditation* to be accredited. *(5)* Specifically, the standards require that facility written protocols and procedure performance must follow accepted practices such as those published in professional society guidelines.

The rate of compliance with the GES guideline at a national level has not been assessed. The aim of this study was to quantify the compliance to the standardized protocol in a large cohort of laboratories from different institutions and practice settings across the United States.

**Materials and Methods**

The IAC database, consisting of facility demographic, staff qualification, protocol, case study and report information, was used to extract GES protocols from all laboratories applying for general nuclear medicine (GNM) accreditation from January 1, 2013, to December 31, 2015. Approval from an Institutional Review Board was not required as no patient data nor facility private/identifiable information was collected, and the results were reported in aggregate.

Nine demographic variables were recorded including facility type (hospital vs. nonhospital practice setting), accreditation cycle (first time vs. reaccreditation), accreditation decision (accredited vs. delayed), GNM annual study volume (excluding nuclear cardiology and PET), number of physicians and technologists, American Board of Nuclear Medicine (ABNM) board certified medical director, any ABNM certified physicians on staff, and number of gamma cameras.

We assessed each GES protocol for compliance with the methods described in the SNMMI GES procedure guideline. *(4)* Fourteen binary variables considered the most important for the performance of GES were selected and grouped into four categories: patient preparation (4 variables), meal content (5), image acquisition (2), and processing (3) (TABLE 1). Meal content was further categorized into eight subgroups depending upon the ingredients used (TABLE 2). The total number of compliant variables per laboratory was calculated. Laboratories with an overall score of 14 were compliant with all designated variables in the standardized protocol. Conversely, laboratories with a score of 0 were compliant with none of the 14 designated variables in the standardized protocol.

Comparisons between the 14 compliance variables and the demographic variables were performed to ascertain any trends or associations. We also correlated the total number of compliant variables with the demographic variables.

Statistical Analysis: We analyzed the data using SPSS for Windows (version 22.0; Chicago, IL). The data were cleaned and examined for outliers, normality of distribution, and correlations. The frequency and percent compliance was reported for the 14 compliance variables, meal subgroup, and categorical demographic variables. Mean, median, and range were reported for the continuous demographic variables. The continuous demographic variables were also categorized by quartile. Comparisons between the compliance and demographic variables were calculated using Chi-square statistics for categorical variables and analysis of variation (ANOVA) for continuous measures. Pearson's correlation was used to determine trends related to the number of correct variables. For all tests, p-values <0.05 were considered significant.

**Results:**

A total of 183 laboratories applied for GNM accreditation from 2013 – 2015. Of those, 171 applied for gastrointestinal imaging accreditation with 127 laboratories submitting GES protocols. The remaining 44 laboratories did not provide GES protocols because they either do not perform GES or submitted other types of gastrointestinal imaging protocols (e.g., hepatobiliary imaging or liver scan) for evaluation.

Demographic Measures

Frequency distributions for the demographic variables are listed in TABLE 3. A majority of laboratories was hospital-based (63.0%). Laboratories performed a mean of 1709.4 ± 1805.2 (median 1201) GNM studies annually. Almost all of the laboratories (96.1%) had previously completed the accreditation process and had applied for reaccreditation. However, GNM accreditation was delayed for a majority of laboratories (59.8%) pending correction of issues.

Compliance with GES Guideline Variables

Laboratory compliance with the protocol variables grouped by category is shown in figure 1. These ranged from a high of 95.3% of laboratories compliant with the instruction to take nothing by mouth for at least 4 h prior to the study to a low of 12.6% laboratories compliant for blood glucose measurement and reporting. Taken overall, the variables adhered to the least were related to patient preparation. Other problematic variables in that section were instructions for withholding medications and for withholding medications for the correct length of time, 74.0% and 72.4% respectively. For a majority of the protocol variables (9/14), more than one-half of the laboratories were noncompliant (FIGURE 1).

Overall, 69.3% of laboratory protocols were not complaint with the consensus meal. Detailed evaluation of the composition of the meals showed that fewer than one-third (30.7%) of laboratories used the exact content of egg whites, white toast, jelly and water as recommended in the guidelines (TABLE 4). Variations of the egg white consensus meal, with partial or additional ingredients, were used in 4.8% of laboratories. A large number of laboratories (47.3%) used whole eggs instead of egg whites with either partial or additional ingredients. Of this group, whole eggs were the sole component of the meal for 16.3% of laboratories. Additional ingredients not recommended in the guidelines but part of the whole egg meal were used in 14.2% of laboratories and included juice, milk, butter or margarine, lettuce, tomato, and peaches.

Oatmeal alone or combined with additional ingredients was used in 11.8% of laboratories as the standard meal for all patients. Note, egg allergy was not given as a reason to substitute oatmeal for eggs. 4.7% percent of laboratories used highly unusual GES meals. These included a honey bun, corn flakes and milk, peanut butter sandwich, egg salad sandwich, egg burrito, or McDonalds' Egg McMuffin®. In addition, we found a variety of unusual meal preparation methods. For instance, several laboratories instructed the patient to bring scrambled eggs from home and added the tracer to the already cooked eggs. Numerous laboratories injected the technetium-99m-sulfur colloid ($^{99m}$Tc-SC) directly into the egg yolk.

Overall Variable Compliance

Only 3.1% of laboratories were fully compliant with all 14 variables (FIGURE 2), and conversely, 1.6% were not compliant with any of the variables. Over half of all laboratories were compliant with only five variables or fewer.

Compliance Comparisons with Demographic Variables

We correlated the compliance variables with the laboratory demographic variables to search for trends. However, few significant differences were found by comparing with laboratory characteristics. Focusing specifically on compliance with the consensus meal, laboratories were more likely to use this when there were ABNM certified physicians on staff (p=0.005). However, there was no significant difference based on whether the medical director was ABNM certified (p=0.265). Significant positive correlations were found for meal compliance with the number of technologists (r=0.231, p=0.009) and annual volume of GNM studies (r=0.243, p=0.029). Meals were also more likely to be compliant with the consensus meal in larger laboratories with a greater number of technologists and a higher annual volume of studies annually.

## Discussion

Evidence-based procedure guidelines provide concise instructions on how to perform a diagnostic study, thus, ensuring protocol standardization. *(6)* The principal aim of practice guidelines is to improve the quality of patient care and outcomes. *(7)* Studies have shown that practice guidelines can improve the process of care and reduce variation in practice. *(8)* Guidelines improve consistency by making it more likely that patients receive the same care regardless of where and whom performs the test.

In 2009, SNMMI published *Procedure Guideline for Adult Solid-Meal Gastric-Emptying Study 3.0* with the aim of standardizing the performance of GES protocols and avoiding issues of unreliable test results, non-valid clinical interpretations and problematic variations between nuclear medicine sites. *(4)* This guideline reflected the consensus of several professional societies. *(1)* Data obtained from laboratories applying for IAC accreditation show that almost eight years after the publication of the guideline, there is a low rate of compliance with the consensus guideline GES protocol in our study group of 127 laboratories. A very small number of laboratory protocols (3.1%) were fully compliant with the guideline protocol components.

<u>GES Variability</u>

*Patient Preparation*

When a diagnostic protocol differs from the standard methodology, a variety of technical and physiologic sources of error and variation in the test results may be introduced. Our results demonstrated that 74.0% of laboratory protocols did not include instructions for withholding medications. In general, unless a treatment response is the purpose of the GES study, patients should withhold medications that alter gastric emptying for an appropriate period, often 48 – 72 hours, depending on the specific half-life. *(4)* While most medical and technical staff are aware of the potential confounding effects of prokinetic drugs e.g. metoclopramide on the measurement of gastric emptying, less consideration is given to drugs not specifically prescribed for their gastrointestinal action, e.g. opiates, erythromycin, atropine, theophylline, and benzodiazepines (Appendix A). It is particularly important for the protocol to list not only the classes of medication that may interfere with the test but also the various brand and generic names and the length of withholding. Nuclear medicine technologists are usually responsible for obtaining the patient medical history, including medications, and screening for contraindications or other factors that may affect the results of the test. Technologists are unlikely to be aware of the entire list of medications that can alter the rate of gastric emptying; therefore, a comprehensive list in the protocol is useful for easy reference. Improved education of all staff will lead to improved compliance and generate more accurate and reproducible results.

A majority of the protocols (87.4%) in our study did not contain any instructions for obtaining the patient's blood glucose level immediately prior to testing. (*9)* Ideally, the blood glucose level should be < 200 mg/dL. Hyperglycemia is an important cause of delayed gastric emptying. The blood glucose level should be recorded and included in the final report so that the effects of elevated blood glucose may be taken into consideration for the final interpretation.

*Meal Composition*

The results of this study demonstrate that the composition and preparation of the GES test meal is a major source of variability. Meal composition (caloric and fat content and meal volume) significantly affects the rate of gastric emptying. Solids, indigestible foods, and fats empty more slowly while liquids, highly digestible foods, proteins or carbohydrates empty more rapidly. *(10-13)* Divergence of the test meal from the standard precludes valid comparisons to published normal values and, thus, may factitiously alter the interpretation of normal versus delayed emptying. *(1)*

The GES guideline standardized meal consists of 0.5 – 1.0 mCi (18.5 – 37 mSv) $^{99m}$Tc-SC scrambled with 120 gm liquid egg white (Egg Beaters® or generic) plus two slices of white toast, 30 gm strawberry jelly, and 120 ml water. (*4)* In the current study, laboratory test meals with additional ingredients such as juice or butter, oatmeal or “other” non-standard composition would not be expected to have the same emptying rate or normal values as compared to the consensus meal. It cannot be emphasized more strongly that alternative meals have no validity for interpreting GES results unless specific normal databases for that particular meal have been developed by the individual laboratories.

*Meal Preparation*

The liquid egg whites must be cooked together with the sulfur colloid, thereby forming a bond with the protein component as it becomes denatured during heating; this property is exploited to trace true solid gastric emptying. Firm binding between the egg whites and the $^{99m}$Tc-SC produces a stable solid that keeps the labeled component from being absorbed or binding to the mucous membranes of either the stomach or small intestine. If the tracer separates from the protein, the test’s result will vary because the meal becomes a part-solid, part-liquid mixture. A common error seen in this study was that some laboratories simply added the tracer to an already prepared solid food (e.g., honey bun, peanut butter sandwich, or previously cooked scrambled eggs). However, these methods have no binding property, and the tracer does not remain associated with the solid particles. *(14,15)*

Another common protocol variant seen in this study was to use whole eggs rather than the recommended liquid egg product. *(14)* Several laboratory protocols included instructions to inject the tracer directly into the egg yolk. $^{99m}$Tc-SC binds to the egg white albumen, and there is no evidence that egg yolk, which is primarily fat, binds $^{99m}$Tc-SC. *(14)* Egg white substitute is preferred over scrambled fresh whole eggs because it has a higher binding percentage and is less likely to disintegrate in gastric fluid. The labeling efficiency of egg substitute is approximately 85%. Approximately 80% of $^{99m}$Tc-SC remains bound to the egg substitute at 3 hours. An additional source of error is the increased fat content of the meal from the egg yolk which slows gastric emptying.

*Acquisition*

Frequency and duration of image acquisition were not performed according to guideline standards in 45.0% of laboratories. The consensus protocol recommends imaging up to 4 hours for improved sensitivity in detecting delayed gastric emptying. The literature has suggested that retention >10% of the meal at 4 hours is abnormal and is the best discriminator between normal and abnormal results. *(4,16,17)* Recently published articles suggest that a shortened protocol may be a satisfactory compromise, but consensus has not yet been established in the literature. This issue is complex because of differences in gastric fundal and antral actions. *(18)*

*Processing*

54% of laboratories in this study reported using half-time of emptying (T½) for assessment despite guidelines and literature to support reporting of percent retention of the meal in the stomach. Interpretation using T½ is potentially less accurate than percent retention, especially for patients with delayed emptying where extrapolation is needed to calculate T½ if half of the meal does not leave the stomach during the test. Furthermore, it has long been established that solid food does not empty from the stomach in a linear fashion, but has distinct phases corresponding to the roles played by the fundus and antrum. *(19)* The ideal methodology, such as percent retention, takes into account the entire time activity curve (non-exponential for solids).

Guideline Implementation

It is troubling that nearly eight years following publication of the GES guidelines, there is a low rate of compliance. In translational research, there is a well-known, documented gap in widespread implementation of published guidelines. *(20-22)* It usually takes an average of 9.3 years for guidelines to become customary practice. The results of this study, unfortunately, support this supposition. Our results showing poor adherence to guidelines are in agreement with a previous 2011 study in 134 laboratories in the Department of Veterans Affairs performed approximately two years after the publication of the consensus recommendations. *(23)* Only 12% of VA laboratories strictly followed the standardized protocol compared to 8.5% for the same criteria in our sample population.

What are the possible barriers to compliance with the published consensus recommendations? First, facility personnel may simply be unaware of the existence of the published guideline. *(24)* If this is true, it points to the need for better and more effective dissemination methods. For example, the results of this study showed that facilities were more likely to follow the consensus meal when ABNM certified physicians are on staff. One reason may lie in the fact that non-ABNM certified physicians may not consult the SNMMI guidelines for protocols and the American College of Radiology does not have a detailed, comprehensive guideline for this procedure. Even if aware of the published guidelines, the sheer volume of published material makes it impossible to read and remember the details of many articles and guidelines and, thus, apply them properly.

Another barrier may be interpreting physician preference or long-standing usage of a specific test meal or reporting method. Imaging physicians and technologists may have anxiety about changing procedures and may be resistant to change their habitual practice. For instance, there may be concerned that the longer protocol may “tie up” a camera and make scheduling more difficult and perhaps less efficient. Lack of staff time and lack of resources to make changes may be a factor. Simple inertia, lack of motivation, or refusal has been shown to play a small role. *(25)*

A final impediment may be related to controversies in the recent literature suggesting that assessment of liquid emptying may be more important than previously realized and issues concerning the most expedient duration of imaging time for GES. *(16,17)* These unresolved issues may cause practitioners to question whether a protocol change is warranted. *(26)* It has been reported that physicians may not follow guidelines if they think that they are based on poor evidence. *(27)* If the medical and technical staff do not believe that following the guideline recommendations make a difference in the test result, they are hardly inclined to implement them. *(28)* In addition if guidelines are convoluted or complex, facilities may be less likely to comply. These reasons may have been a factor in the results of this study where most of the labs had been through the accreditation process more than once but were still not completely following the consensus recommendations.

The findings of our study highlight the need for continued educational efforts to disseminate the published, standardized guideline protocols. Guideline implementation is complex. Therefore, the need for strategies to facilitate implementation and continued monitoring for compliance are essential. A review of literature on changing physician behavior demonstrates that active forms of continuing medical education (as opposed to passive forms) with multiple interventions are the most efficient methods for promoting the implementation of guidelines into customary practice. *(29-31)* This applies equally to technologists. Examples of active interventions include academic detailing (presentations by trained individuals at the physician office), educational outreach programs tailored specifically to the needs of a specific clinic, or small group workshops. Passive forms of information dissemination such as printed teaching materials or brochures and traditional conferences and lectures are effective in raising awareness but less effective for change. *(32)*

<u>Limitations</u>

This study was a retrospective evaluation of application materials submitted to the IAC for accreditation. The IAC database was designed to manage the accreditation process and is not specifically organized for observational research purposes. It is possible that laboratories are in reality following the guidelines, but their actual practice is not documented in the protocol. For this purpose of this research, the adage "Not documented, not done" was employed. Consequently, if processes were not explicitly stated, they were not considered compliant. An additional limitation is that adherence to guidelines was chosen as a surrogate for quality because measuring direct patient outcomes in diagnostic medicine is complicated. Finally, there are no data to compare with non-IAC accredited laboratories. Thus the results are only applicable to IAC accredited laboratories.

## Conclusion

Almost eight years after the publication of the SNMMI GES guidelines, there is low protocol adherence among laboratories applying for IAC Nuclear/PET accreditation. This substantial degree of guideline noncompliance is concerning. The variability in GES protocols may have a significant effect on patient management, as results may be inaccurate. Consistent use of the standardized GES protocol permits interpretation of results in a standard manner allowing inter-laboratory comparisons and fosters acceptance of the test validity by referring clinicians. The current low level of protocol adherence indicates a continued gap between guideline publication and implementation and points to a need for further dissemination of the consensus protocol and strategic education efforts.

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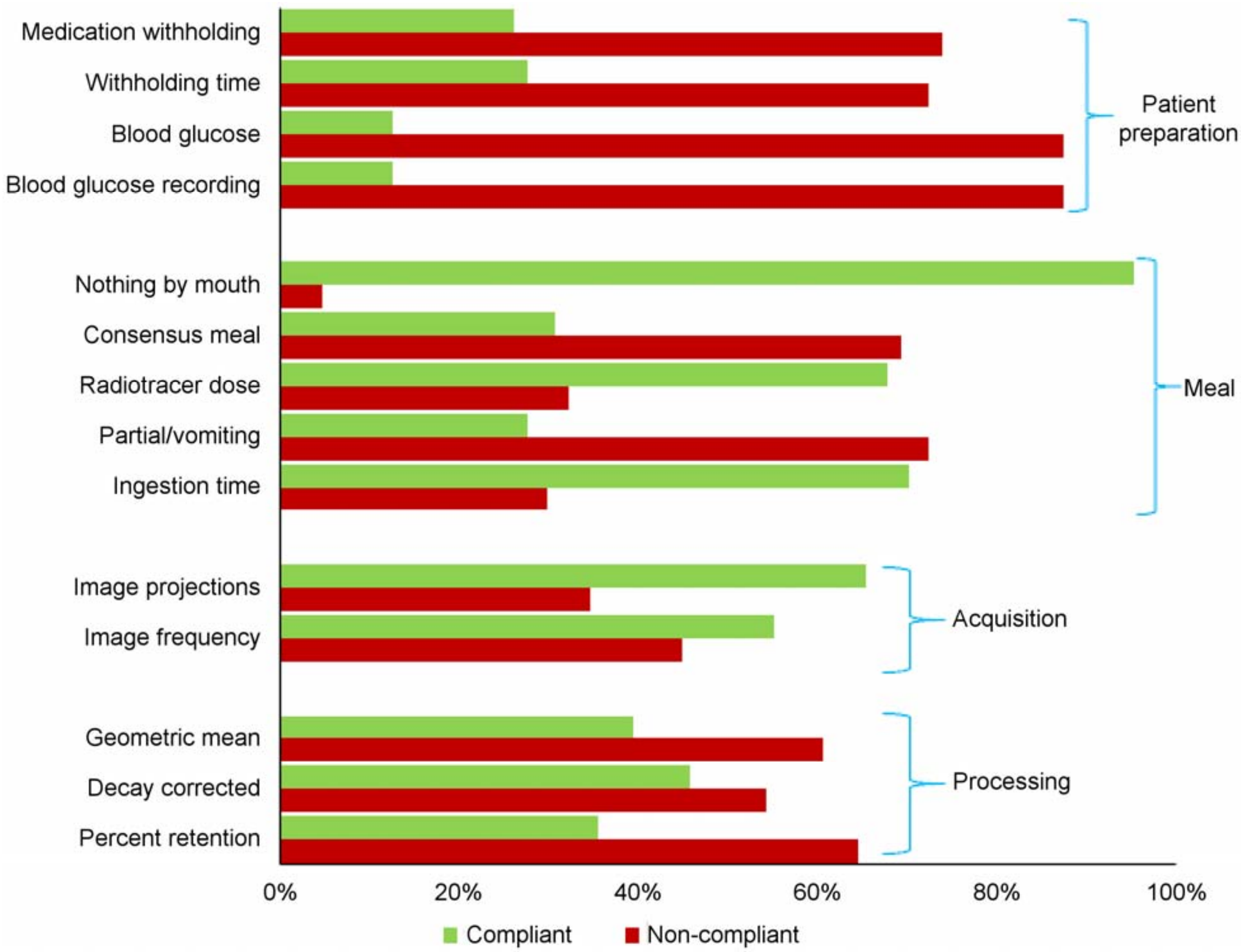


FIGURE 1. Compliance with 14 individual protocol variables. The results demonstrate that laboratories did not adhere to the gastric-emptying scintigraphy guidelines for a majority of variables (9/14). (n = 127)

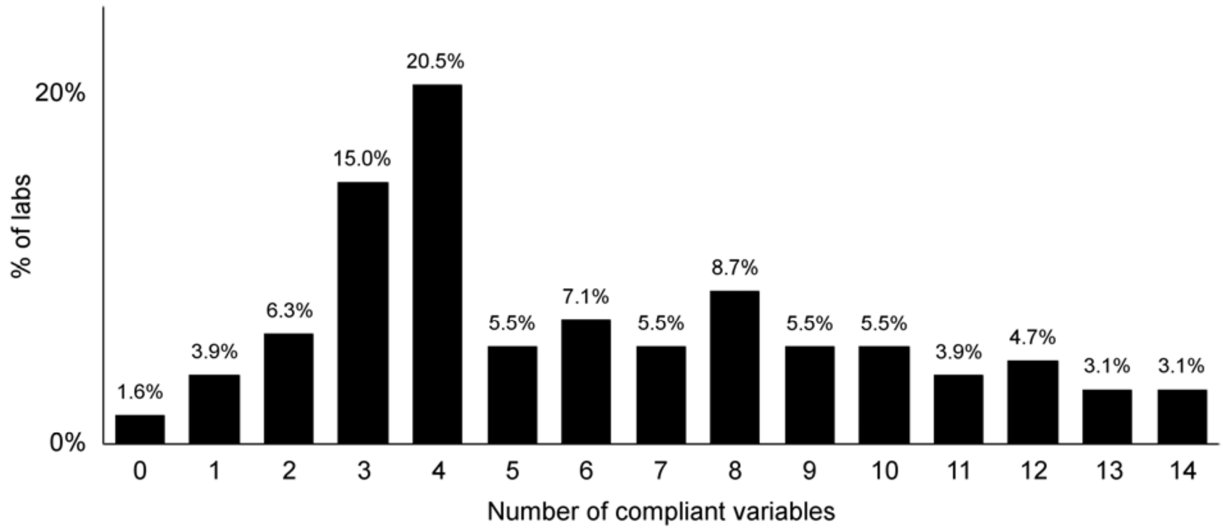


FIGURE 2. Number of variables compliant with the guidelines per laboratory. Very few laboratories were compliant with all 14 variables.

TABLE 1. Standard Protocol Variables[1,2]

| Category | Variable | Definition |
|---|---|---|
| Patient Preparation | Medication Withholding | - Instructions for withholding all of the following medications:<br>• Prokinetic agents: metoclopramide, domperidone, and erythromycin<br>• Opiates<br>• Anticholinergics/Antispasmodic agents<br>• Other: atropine, nifedipine, progesterone, octreotide, theophylline, benzodiazepine, phentolamine |
| | Withholding Time | - Protocol clearly states all of the above medications withheld for 2 days |
| | Blood Glucose | - Instructions for testing serum glucose level prior to the test to ensure the level is less than 200 mg/dL |
| | Blood Glucose Recording | - Instructions to record blood glucose level and include in final report |
| Meal | Consensus Meal | - Meal includes all four ingredients with no additional ingredients listed and the meal is properly prepared:<br>• 118 ml (4 oz) liquid egg whites,<br>• 120 ml water,<br>• 2 slices toast,<br>• 30 g jam/jelly. |
| | Nothing by mouth | - Protocol states the patient may not have anything by mouth for a minimum of 4 hours |
| | Meal Ingestion Time | - Protocol includes instructions for the patient to eat the meal rapidly in less than 10 minutes |
| | Partial Meal | - Protocol includes documentation of vomiting or if the patient only ingests a portion of the meal |
| | Radiopharmaceutical Dose | - The prescribed radiopharmaceutical and dose is 18.5 – 37 MBq (0.5 – 1.0 mCi) technetium-99m-sulfur colloid |
| Acquisition | Image Projections | - Both anterior and posterior images acquired |
| | Image Frequency | - Images acquired immediately upon meal completion and hourly to 4 hours |
| Processing | Geometric Mean | - Instructions to calculate the geometric mean using the anterior and posterior projections. (Geometric mean =√ (anterior counts x posterior counts) |
| | Decay Corrected | - The protocol includes instructions for decay correcting the counts in the region of interest |
| | Percent Retention Reported | - Reporting of final measurements as a percentage of gastric retention at each time point |

**TABLE 2.** Description of Meal Content Subgroups

| **Meal type** | **Ingredients** |
|---|---|
| Full consensus (using egg white) | - egg white, white toast, jelly, and water |
| Egg white partial | - liquid egg white but only some of the other standard ingredients |
| Egg white plus | - liquid egg white meal plus the addition of non-standard ingredients, e.g. butter or juice |
| Whole eggs meal | - whole eggs substituted for egg whites, white toast, jelly, water |
| Whole eggs partial | - whole eggs but only some of the other standard ingredients |
| Whole eggs plus | - Whole eggs meal plus addition of non-standard ingredients, e.g. butter or juice |
| Oatmeal | - oatmeal alone or combined with other ingredients |
| Other | - unusual meals, e.g., burrito or peanut butter sandwich |

**TABLE 3.** Laboratory Demographic Data (n = 127)

| **Variable** | **Category** | **Frequency (#)** | **Percent (%)** |
|---|---|---|---|
| Laboratory Type | Hospital-based | 80 | 63.0 |
| | Nonhospital | 47 | 37.0 |
| 1st Time vs. Reaccredit Application | 1st time | 5 | 3.9 |
| | Reaccredited | 122 | 96.1 |
| GNM Decision | Delayed | 76 | 59.8 |
| | Granted | 51 | 40.2 |
| Medical Director ABNM* | Yes | 72 | 56.7 |
| | No | 55 | 43.3 |
| Any ABNM Certified Staff | Yes | 85 | 66.9 |
| | No | 42 | 33.1 |
| | **Mean (± SD†)** | **Median** | **Range** |
| Gastrointestinal Study Annual Volume | 428.3 (± 460.3) | 310 | 15 – 3466 |
| General Nuclear Medicine Annual Volume | 1709.4 (± 1805.2) | 1201 | 38 - 10030 |
| Number of Medical Staff (N=880) | 9.6 (± 7.9) | 7 | 1 - 38 |
| Number of Technical Staff | 6.8 (± 6.0) | 5 | 1 - 31 |
| Number of Gamma Camera | 4.0(± 3.7) | 3 | 1 – 22 |

*ABNM – American Board of Nuclear Medicine, †SD – Standard Deviation

**TABLE 4.** Meal Component Variation (n = 127)

| Group | Frequency (#) | Percent (%) |
|---|---|---|
| **Consensus Meal (egg white, white toast, jelly, water)** | | |
| Complete | 39 | 30.7 |
| Partial | 3 | 2.4 |
| Plus Additional Ingredients | 3 | 2.4 |
| **Whole Egg Meal (whole eggs, white toast, jelly, water)** | | |
| Complete | 2 | 1.6 |
| Partial | 41 | 32.3 |
| Plus Additional Ingredients | 18 | 14.2 |
| **Oatmeal** | 15 | 11.8 |
| **Other Meal Types** | 6 | 4.7 |

**APPENDIX A**. Medications that Alter Gastric Emptying*

| Medication Type | Generic Name (Brand Name) |
|---|---|
| Prokinetic Agents | • metoclopramide (Reglan, Maxeran)<br>• domperidone (Motilium)<br>• erythromycin |
| Opiates | • codeine<br>• fentanyl (Duragesic)<br>• hydrocodone (Lortab, Lorcet, Norco, Vicodin, Vicoprofen)<br>• hydromorphone (Dilaudid)<br>• meperidine (Demerol)<br>• methadone (Dolophine, Methadose)<br>• morphine (MS Contin Kadian)<br>• naloxone (Narcan)<br>• oxycodone (Oxycontin, Percocet, Percodan)<br>• oxymorphone (Opana) |
| Anticholinergics/ Antispasmodic Agents | • atropine<br>• belladonna (Belladonna Tincture, Belladonna Leaf)<br>• belladonna alkaloids/phenobarbital (Donnatal, Hyosophen)<br>• chloridiazepoxide/clidinium, chlordiazepoximide/methscopolamine, clidinium bromide (Librax)<br>• dicyclomine (Bentyl, Triactin)<br>• hyoscyamine (Levsin)<br>• hyoscyamine/phenyltoloxamine (Digex)<br>• glycopyrrolate (Robinul)<br>• mepenzolate (Cantil)<br>• methscopolamine (Pamine)<br>• scopolamine (Maldemar, Scopace) |
| Other medications | • benzodiazepine (Ativan, Valium, Xanax)<br>• nifedipine (Adalat, Afeditab, Nifediac, Nifedical, Procardia)<br>• octreotide (SandoSTATIN)<br>• phentolamine (OraVerse, Regitine)<br>• progesterone (Prometrium)<br>• theophylline (Aerolate, Bronkodyl, Elixophyllin, Quibron, Respid Slo-Bid, Slo-Phyllin, Theobid, Theoclear, Theodur, Theolair, Theovent, Uni-Dur, Uniphyl) |

*Unless a treatment response is the purpose of the GES study, patients should withhold medications that alter gastric-emptying for 48 – 72 hours.