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Bowel preparation in children and adolescents undergoing ileo-colonoscopy: what is new?

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Abstract:

Ileo-colonoscopy is a vital diagnostic and therapeutic tool undertaken for evaluating and treating gastrointestinal tract pathologies in children and adolescents as well as adults. Proper visualization of the lower intestinal mucosa, completion of the procedure including terminal ileum/cecal intubation, detection of pathological lesions and therapeutic maneuvers are hinged on how adequate the bowel preparation is.

About 25% percent of pediatric patients have inadequate bowel preparations, which can lead to prolonged colonoscopy procedure time, missed pathology, difficult ileal intubation/incomplete examination, and requiring cancellation or repeat procedure with attendant anesthetic risks.

An ideal bowel preparation regimen should clear the colon of fecal material with no alteration of the colonic mucosa that could affect the histological findings.

There is no acceptable universal regimen for bowel preparation in children; however wide variability of practices exists globally. Hence, the current review is aimed at analyzing recent published literature and personal practical experiences as well as developing a standard bowel preparation guideline that will improve outcome of the ileo- colonoscopy procedure in children particularly in resource limited settings.

Introduction

Ileo-colonoscopy is an important diagnostic and therapeutic tool in evaluating and treating Gastrointestinal (GI) tract pathologies.[1] The common indications for colonoscopy are wide and include abdominal pain, chronic diarrhea, and hematochezia/rectal bleeding, while less common indications include surveillance for polyposis syndromes.[1] Colonoscopy is the standard criterion that helps in the diagnosis of inflammatory bowel disease. It is also used for therapeutic purposes in individuals with diseases such as colonic polyps or lower gastrointestinal bleeding.[2]

Large amounts of stool compromise the ability to navigate the curves of the large intestine and prohibit the complete visualization of the intestinal mucosa. Stool adherent to the lens of the fiber optic colonoscope often requires further maneuvering and air-insufflation to clear the field of vision in order to continue the procedure. Liquid stools can be aspirated through the suction channel of the colonoscope, but may prolong the procedure time.

Adequate visualization of the intestinal lumen is necessary for detection of lesions, hence bowel preparation is a key component of the colonoscopy process. Over 25% of pediatric patients have sub-optimal bowel preparation.[3] This can lead to longer procedure times, missed pathology, unsuccessful ileal intubation,[4] and the probable repetition of the procedure with attendant anesthesia or intravenous sedation risks for the child.

There is no universal protocol for bowel preparation in children, and hence wide variability of practices exists from one center to the other. Possible variations include differing laxative agents, duration of preparation, timing of administration, and dietary changes.

The definition of an ideal bowel preparation regimen is one that is efficacious, safe, palatable, and with minimal disturbance to the child's daily life. However, no bowel cleansing agent or regimen meets these reference standards. An ideal bowel preparation regimen should clear the colon of fecal material with no alteration of the colonic mucosa.[5]

The current review is aimed at analyzing recent published articles regarding bowel preparations for colonoscopy procedures in children and adolescents in the last six years.

This work employed PUBMED searches of all English-language articles pertaining to pediatric colonoscopy preparation from 2000 to 2023. We analyzed 13 prospective studies, 10 randomized controlled trials, 4 review articles and 2 retrospective studies. These articles examined several factors involved in bowel preparation, including the role of patient education, types of bowel preparation, dosages, efficacy and their safety concerns, as well as current best practice regimen guidelines, particularly in children younger than 2 years of age.

Factors that determine the success of colonoscopy

Adequate patient preparation that is safe, fast, and with complete examination, is key. It is important to ensure a complete bowel clean up that forestalls the need for a repeat colonoscopy examination.

An ideal bowel preparation regimen could be defined as low volume and easy to complete in short time, palatable, inexpensive, and capable to ensure a successful complete colon cleanout.

The ideal bowel preparation regimen should be free of adverse events including no significant fluid or electrolyte abnormalities, prolonged dietary adjustments, daily life disruptions, or alteration of histology findings.

Some colonic cleanout preparations contain non-absorbable carbohydrates including mannitol, or incompletely absorbed carbohydrates (sorbitol, lactose, or fructose) that could be metabolized by colonic bacteria to produce combustible gases - methane and hydrogen - which could give rise to explosion when exposed to electrocautery in the colon, *e.g.* in cases of polyposis removal using electrocautery.

Some decades ago, the use of whole-gut lavage was commonly applied in children for bowel preparation. Up to 12 liters of fluids could be administered over a period of time, often resulting in fluid and electrolyte imbalances. As the prescribed fluids would be given over a period of time necessitating the patient's hospitalization, there was an attendant risk of hypothermia. Due to these potential challenges, most gastroenterologists have now abandoned this practice, and now mainly use various forms of laxatives and Polyethylene Glycol (PEG) solutions. [6]

Patient education

Patient education is an important aspect of the bowel preparatory process, and inadequacies in the process will affect the quality of the bowel clean out.

Identifying institutional risk factors that may lead to poor bowel preparation and gaps in family and patient education should be an area of focus for all centers performing pediatric colonoscopy, as these factors vary from one standard care center to the other, as well as with some key societal guidelines. Risk factors implicated include: poor communication skills between the gastroenterologist and caregivers, language barriers, low socio-economic status, and low health literacy.

In a retrospective study exploring risk factors for suboptimal bowel preparations, the identified risk factors in a single center were language barriers (Spanish-speaking patients) and patients with Medicaid insurance coverage.[3] Language difficulties will result in lapses in communication with patients and thus subsequent understanding of the preparation instructions. In our setting, there is the need to use local vernacular to communicate the procedure preparations of bowel preparation. This, however, depends on the literacy level of the parents/caregivers.

Some studies have focused on ways of improving patient education as means of optimizing bowel preparation. It is therefore imperative that patients and their families understand the importance of achieving adequate bowel clean out (*i.e.* to achieve clear stools), as well as the goals of the bowel preparatory process.

In recent times some use a multi-targeted approach, including cell phone reminders, text messages (SMS), WhatsApp, e-mailed instructions, and animated videos to deliver instructions to patients and their families. Personal experience shows that such reminders help caregivers to abide by the protocol with favorable outcomes.

Bowel preparation assessment

Efforts should be made to include the report on the adequacy of bowel preparation in colonoscopy reports. The report will reveal the efficiency of adequate bowel preparation in visualizing the bowel. This adequacy of bowel preparation can be assessed by various indirect measures, including cecal/terminal intubation rates, and procedure duration. However, formal scoring systems allow for more accurate assessments, as they are more objectively scored.[7]

The three most commonly used scales are the Aronchik scale, Ottawa Bowel Preparation Scale (OBPS), and the Boston Bowel Preparation Scale (BBPS).

It is important to also note that most of these scoring systems are not validated in children. Some authors, including Tutar *et al*., showed that there is a close correlation between the OBPS and BBPS scores,[8] but no clear consensus exists, as most of the scoring systems are prone to interpersonal variability.

In order to circumvent this challenge, an Artificial Intelligence (AI) software program called ENDOANGEL, which assesses bowel preparation, has been developed.[9] This AI software was adapted by review of a number of pre-scored colonoscopy images, using the BBPS.

ENDOANGEL provides an assessment of the BBPS during the colonoscopy withdrawal phase, at an interval of every 30 s. This program is capable of achieving high accuracy in assessing BPPS, comparable to that of experienced endoscopists.[9]

Types of bowel preparation

Generally, bowel preparation is aimed at whole gut irrigation and lavage, resulting in fluid shifts, electrolyte changes, with many patients reporting discomfort and dissatisfaction.

Currently, various laxative agents have been adapted for use in bowel preparation for colonoscopy. Some of these agents now used for bowel preparation in colonoscopy have been previously approved for the treatment of chronic constipation as well, whereas others are primarily used for colonoscopy cleanout. Laxatives are categorized by their mechanisms of action - osmotic laxatives or stimulant laxatives - but some can have combined effects (Table 1).

Polyethylene Glycol (PEG): is a commonly used bowel preparation agent in children worldwide. It is a synthetic water-soluble polymer. The mode of action is by drawing of water into the gut thereby softening the stool.

PEG is available in various formulations, viz PEG with and without electrolytes. Some companies add some additives in PEG - ascorbic acid and bisacodyl.

PEG with Electrolytes (PEG-ELS) is usually a salty, unpalatable solution that is administered through a nasogastric tube in children.[10] It is an isosmotic preparation, as well as an osmotically balanced, high-volume, non-absorbable, and non-fermentable electrolyte solution.

PEG-ELS is efficacious and safe. Some workers have reported an adequate bowel cleansing rate of 88.4%.[11] Its drawbacks to its usage in children are the unpalatable taste and the difficulty of administration due to the large volumes. In a study of 35 patients who were given PEG-ELS for bowel preparation, 77.1% of them reported that the taste was "very bad" and 57.1% of the study participants described the process of the bowel preparation as "very difficult".[11] These experiences have been corroborated by other workers. Similar results were shown in other studies.[10-12]

However, many centers, including ours, continue to use this agent because of the long-term favorable results, due to the introduction of the newer PEG-ELS preparations that contain ascorbic acid, which increases the palatability with higher osmotic effect, which allows for half the required volume to be used.

These solutions (PEG-ELS) cleanse the bowel with minimal water and electrolyte shifts, and provide cleanout of the bowel primarily via the mechanical effect of large-volume lavage. In children, the dose ranges from 20 to 40 mL/kg, but not more than 1 litre/hour, and/or until bowel/rectal effluent is clear, and should not exceed 4 litres in adults (Table 2).[13]

PEG-ELS can be given as a split dose, with the second half given on the morning of the procedure. The drawbacks of the use of PEG-ELS in children and adolescents is that they usually undergo colonoscopy procedures in the morning, and so sedation restriction guidelines and challenges of administration may not allow the use of split dose regimen on them.

PEG 3350 without electrolytes (*e.g.*, Movicol, MiralaxR, Bayer Healthcare, Whippany, NJ), traditionally applied in the management of chronic constipation (both for fecal disimpassion as well as maintenance therapy) is now most commonly used for bowel preparation. This is due to its tastelessness (comes in powdered form) and the powder can easily be dissolved in clear liquid. Hence, comparable to PEG-ELS, PEG without electrolytes bowel preparation protocols also require large volume of fluid intake for the reconstitution.[14,15]

To circumvent this challenge, many protocols now use combination regimens of PEG with a stimulant (senna or bisacodyl) and thus allowing for lower volumes of liquid for the reconstitution. Initially regimens of PEG- 3350 without electrolytes applied protocols given over 4 days. Shorter courses of 1–2 days have been used recently and found to be effective and tolerable as well.[16]

Though the safety of PEG without electrolytes is doubtful, some studies compared the serum electrolytes pre- and post- PEG-3350 protocols, and no clinically significant differences in the serum potassium or bicarbonate levels of the study subjects were observed.[17]

However, there is a risk of concomitant hypoglycemia in children under 7 years of age.[17] It is recommended to obtain a pre- scope random blood glucose in all such children and to manage accordingly.

A clinical study that compared the bowel cleansing adequacy between PEG-ELS and PEG without electrolytes and bisacodyl showed similar efficacy in both groups (88.4 *vs* 87.8% respectively), but most importantly revealed more acceptability and tolerability in the PEG without electrolytes group.[18]

Nausea and vomiting have been reported as possible adverse effects associated with both PEG-ELS and PEG without electrolytes, but these side effects could be controlled using anti-emetics.

Magnesium cations or phosphate

They include magnesium sulfate, magnesium phosphate, magnesium citrate, and sodium phosphate. All have dual mechanisms of action - hyperosmolar and stimulant activity.

They can stimulate peristalsis by first increasing the intraluminal osmolarity with resulting water secretion and colonic wall stretching leading to faster transit. This effect is potentiated by cholecystokinin release.

Phosphate salts are better absorbed than magnesium-based agents and therefore need to be given in larger doses.

The sodium phosphate oral solution contains 1.8 g of dibasic sodium phosphate and 4.8 g of monobasic sodium phosphate in 10 mL, while the tablet-form preparation contains 1.5 g total sodium phosphate per tablet.[5]

Sodium based composition

Sodium-based preparations are lower-volume osmotic laxatives, introduced as milder alternatives to PEG preparations. Examples include: sodium phosphate, sodium sulphate and sodium picosulphate.

However, their use in children is hampered by myriad of side effects including hyperphosphatemia, nephrotoxicity, while picosulphate may give colonic mucosal aphthoid lesions, and hence will confound endoscopy in suspected cases of inflammatory bowel disease.[19]

Sodium sulphate and sodium picosulphate are safe and may serve as alternatives to sodium phosphate. They require smaller volume of liquid for reconstitution and are equally effective, with results comparable to those of PEG.

Sodium picosulphate is used as a single bowel cleansing agent, or jointly with magnesium oxide and citric acid. In a randomized controlled trial of pediatric subjects that compared PEG-ELS (25mg/kg/hr) with sodium picosulphate (100 g×2 doses), the former was found to be more tolerable with regards to the taste, and simpler administration process. No significant difference was found in terms of potency in them.[14]

Sodium picosulphate is a pro-drug hydrolyzed by colonic bacteria to its active metabolite 4,4-dihydroxydiphenyl- (2-pyridyl) methane. The mechanism of action is by increasing the frequency and force of peristalsis.[20]

Sodium phosphate, in addition, is commonly used as an enema, and contains 6 g of sodium phosphate and 16 g of sodium biphosphate per 100mL. It is available in two formulations, of 67.5 mL for children, and 135 mL for the adult population.

Adjunctive stimulants laxatives:

Senna and bisacodyl

Senna is an anthraquinones laxative that occurs naturally in plants. It is not absorbed. After oral administration, sennoside is degraded in the colon to release its active metabolite, rhein anthrone, which fastens colonic transit and produces bowel movement within 6 to 12 hours. Senna is available in syrup and tablet forms.[21]

Bisacodyl is a diphenylmethane derivative used for the treatment of constipation and also in bowel preparation for colonoscopy. It is available in tablet, enema, and suppository formulations, and is commonly used for the treatment of acute and chronic constipation. Bisacodyl helps in cleansing by stimulating the enteric neurons to generate peristalsis. The mechanism of action is by inducing high-amplitude propagating contractions and shortening colonic transit time, resulting in bowel movement within 6 to 8 hours following oral administration or within 30 to 60 minutes when given via the rectal route. Generally, bisacodyl has minimal systemic absorption. [22]

Table 3 summarizes the mechanism of actions, efficacy and key safety concerns associated with the commonly used bowel cleansing agents.[5]

Use of dual therapy in bowel cleansing

PEG 3350 is the most popular osmotic laxative used in bowel preparation regimen for colonoscopy. The duration of use of PEG-3350 regimen ranges from one to four days. It is reported that the longer the duration of the drug use, the lower the compliance, and the longer the absence from school for the child, or from work for the supervising caregiver/parent. Hence, the need for the use of short course regimens that is more acceptable for children and their parents/caregivers.

Generally, the use of PEG -3350 with/without stimulant is the most common bowel preparation regimen.[3] Common dual regimens in use currently include: i) one day PEG -3350 with bisacodyl, this gives better bowel preparation (88.3% according to Boston scale and cecal intubation rate of 96.7% in one study);[23] also most commonly used dual therapy in children 6 years and older, as well as adults;[5] ii) PEG-3350 and Senna (most common product in children 2 to 5years).[5]

Table 4 shows the commonly used regimens with their recommended dosing, flavoring agents, adverse effects and possible double therapy in combination with a laxative.[5]

Practical guide to use of cleanout regimens

NASPGHAN recommended a guide (Table 5)[5] showing the best practice bowel cleanout regimens available in pediatric populations. However, every gastroenterologist has the liberty to practice what is safe, acceptable and efficacious based on local experience.

Regimens used in infants and children younger than 2 years

Most centers reported using no preparation, clear liquids only (including breast milk), or PEG-3350 with clear liquids.

Often adequate bowel clean out can be achieved with use of small- olume enemas and substituting clear-liquids for breast- or formula feeding for about 12-24 hours.

Some practitioners often admit the patient for bowel preparation the night preceding the morning of the procedure.

Patients are allowed to drink the liquid regimen first and then later switch to passage of nasogastric tube to complete the rest of the dose or until bowel is clear.

Outpatient bowel preparation

The practice of outpatient bowel preparation is acceptable in children by a good number of pediatric gastroenterologists, however, some have reported prolonged procedural time and/or procedure cancellation and/or re-scheduling of the procedure due to poor/inadequate bowel preparation. This has resulted in outpatient preparation failure as the patients could not drink any or the entire product (*i.e.* "too much volume"). Cases of dehydration arising from vomiting that may require admission and further interventions have been reported.[5]

Timing and administration of bowel preparation

Shorter time

Some agents work better giving clear bowel when given over shorter period of time, *e.g.* PEG 3350.

Split- dose regimen

Here, half of the prescribed dose for the bowel preparation is given the evening before colonoscopy, while the second half is given on the morning of the procedure, resulting in shorter time between drug administration and carrying out of the procedure proper, duration between laxative and procedure time.[24] This split- dose regimen is a common practice in adults and some

studies have shown acceptability and tolerability in children.[19] However more studies are needed in children to fully understand the pharmacokinetics of the regimen in this regard.

Dietary prescription in children undergoing bowel preparation

Attention to adequate nutrition during the bowel cleansing procedure is important in children, as dietary restrictions could result in disruption or compliance to the bowel cleansing regimen, as well as the general well-being.

Generally, what is preferred is a clear liquid on the day before the surgery. In our practice, the child is admitted into the ward a day prior to the procedure, and after a soft lunch, is placed on clear fluids/diet and nil per os from 2 am of the morning of the procedure, and most times the procedure is started early, say from 8.30 am the next morning. It has been argued that the use of low residue diet should be the norm, as it allows for the consumption of dairies, soft diets like bread and pasta. Few pediatric studies have reported similar results of clear bowel cleansing with both clear liquids and a low-residue diet.[25]

Common examples of clear liquids are: water, Jell-O, soda, clear juice drinks without pulp, ice, popsicles, clear broth, pedialyte, sports drinks. It is advised that solid foods, milk or milk products, and juice with pulp, should be avoided during the period of bowel preparation, as they do not qualify as clear liquids.[5]

Bowel cleansing devices

These are devices used during the proper colonoscopy procedure in patients that have poor bowel preparations,[26-28] and they include: i) Pure-VuR system, a disposable sleeve that is attached to the colonoscope, and uses a vortex mixture of water and air to break up fecal matter. Here, the child undergoing the procedure receives only bisacodyl prior to the procedure; ii) HyGleaCare, here, the child for colonoscopy procedure sits in a personal sanitized basin; a disposable nozzle is then introduced into the rectum, and the nozzle is used to infuse a steady stream of warm water, which ultimately softens and break up the stool. This is more practicable in adults than children, as it could help to reduce frequent visits to the toilet.

Safety issues in use of bowel cleansing regimens in children

All colonoscopy preparations are associated with adverse events. Reported adverse events include electrolyte abnormalities, dehydration, abdominal pain/cramping, nausea, vomiting, bloating, sleep disturbance, and school absenteeism/work absence.

Bowel preparation is contraindicated in intestinal obstruction or bowel perforation, in order to prevent life threatening complications.

PEG-ELS are isosmotic preparations that are non-absorbable and therefore do not cause water or electrolyte shifts. Few studies have reported hypokalaemia among children in whom PEG-ELS was used to achieve bowel preparation. PEG allergy has been reported as well. In addition, PEG-ELS do not affect or change colonic tissues taken for histology during endoscopy.

PEG-3350 without electrolytes has been used for bowel cleanout without any significant incidence of electrolyte abnormalities. Electrolyte abnormalities in children following use of senna include

mild hypermagnesemia, but most are not clinically significant. Hypoglycaemia is not known with either the use of senna or PEG in children. It is advised that random blood glucose level should be obtained in all cases booked for colonoscopy prior to the commencement of the procedure, and if there are any adverse results of hypoglycaemia, they must be treated according to protocol.[29]

For sodium phosphate preparations, notable metabolic disturbances - hyperphosphatemia, hypocalcemia, hypernatremia, hyponatremia, hypokalemia, and anion gap metabolic acidosis, have been reported in adults.[20]

Adverse events with sodium phosphate colonoscopy preparation in children include volume depletion and Acute Kidney Injury (AKI) resulting from tubular injury. This AKI could present early or in late phase of the bowel preparation. The features are change in mental status, tetany, or cardiovascular collapse, usually within hours of bowel preparation. There is associated severe hyperphosphatemia and hypocalcemia (resulting in seizures) and needing urgent fluid resuscitation, rapid correction of electrolyte abnormalities, and possibly hemodialysis.[30]

There is a need to further educate caregivers on its proper use. Possibility of changes in micro- and macroscopic appearance of the colon in adults mimicking inflammatory changes with sodium phosphate use has been reported.[31]

The Food and Drug Administration (FDA) of the United States has recommended the withdrawal of oral sodium phosphate use for bowel preparation, owing to the association with AKI.[29]

There is still paucity of scientific data on pediatric bowel preparation regimens and their usage. There is a need therefore for gastroenterologists in the field to embark on further large, multicenter, and randomized controlled clinical studies on the subject to investigate existing as well as newer agents with regards to their dose profiles and safety in pediatric populations.

Adequacy of samples from colonoscopy following adequate bowel preparation

An adequate bowel preparation is pertinent for the colonoscopy to identify and possibly biopsy colonic lesions such as polyps. Current and past guidelines state that determination of the appropriate interval for repeat colonoscopy assumes "adequate" bowel preparation.[32] If bowel preparation is not adequate, guidelines recommend early repeat colonoscopy to adequately examine the colon and determine the appropriate interval for repeat colonoscopy. Inadequate bowel preparation has been associated with reduced adenoma detection rate and increased Post-Colonoscopy Colorectal Cancer (PCCRC) in adults.[33]

Conclusions

The ideal pediatric bowel preparation regimen has not been determined. Oral sodium phosphate has been withdrawn owing to its association with renal injury. However, PEG-3350 solutions, senna, bisacodyl, and magnesium salts still remain the commonly used agents. Their efficacy is fairly comparable. Most regimens still need some dietary restrictions.

Generally, most available preparations for bowel cleansing still present usage challenges in children including taste, volume, dietary and activity restrictions. These could lead to poor

compliance resulting in incomplete bowel cleansing for colonoscopy and attendant need for repeat colonoscopy with attendant risks of repeat anesthesia.

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Table 1. Laxatives used in bowel preparation in children: types and mechanism of action.

S/N	Laxative	Stimulant	Osmotic	Combined stimulant/osmotic
1.	Senna	+		
2.	Bisacodyl	+		
3.	PEG preparations with electrolytes (PEG-ELS)	-	+	
4.	PEG-350 without electrolytes	-	+	
5.	Magnesium citrate			
6.	Magnesium sulphate			+
7.	Magnesium phosphate			+
8.	Sodium picosulfate			+
	MECHANISM OF ACTION	Stimulant laxatives induce colonic motility by stimulating enteric nervous system and colonic electrolyte and water secretion		

Table 2. Bowel preparation using PEG-ELS oral solution.

Weight of child (kg)	**Volume (mL) each 10 minutes until passage of clear fecal effluent**	**Maximum volume (mL)**
<10	80	1,100
10 -20	100	1,600
20- 30	140	2,200
30- 40	180	2,900
40- 50	200	3,200
>50	240	4000

Table 3. Mechanisms of action, efficacy and safety.

Medication	Mechanism of action	Dose	Ease of use/efficacy	Adverse effects
PEG -3350	Osmotic	1.5-4 g/kg for 1-2 days	Effective in 93% of cases. Good tolerance/effective cleansing. Recommend electrolyte solutions to avoid electrolyte imbalance.	None
PEG –ELS	Osmotic	25 mL/kg/hr	Poor tolerance-taste, vomiting, nausea, may need NG Tube. Not approved for children younger than 6 mos.	None
Magnesium citrate	Osmotic. Stimulates CCK (increased secretion & motility)	1 oz/yr (max. 10 *oz*)*****	Variable tolerance/efficacy. Needs stimulants or PEG for effectiveness. Caution in RF.	Increased Mg^{2+}
Bisacodyl	Stimulant/secretory/absorptive/prokinetic	5 mg tablet/10 mg suppository	Excellent cleansing. 92-93% along with PEG-3350	None
Senna	Secretory/prokinetic	15-30 mg	Effective only when used with other agents.	None

Pico- Salax	Osmotic	One- fourth to 1 sachet in 2 divided doses	Well tolerated and effective. Caution in renal failure.	Increased Mg^{2+}

- 1 fluid ounce (oz) = 29.57mL

Table 4. Oral bowel cleansing solutions.

Bowel cleansing solution (Trade name)	**Dosing**	**Flavouring strategy**	**Adverse effects**	**Double therapy in combination with a laxative**
PEG-ELS (GoLyte, GoLYTELY)	25 mL/kg/hr (max. 450 mlL/hr in those >6 mos)	Flavour packs/use sugar free flavoring to taste (Crystal Light)	Hyponatraemia	Bisacodyl 5-10 mg on day 1; fleet or saline enemas before cleanout dose 100mL - 500mL same day of procedure if stool not clear.
Sulfate-free PEG-ELS (NuLYTELY, TriLYTE)	25 mL/kg/day (in children >6 mos)	Flavour packs/use sugar free flavoring to taste (Crystal Light)	Hyponatraemia Hypokalaemia Allergy	Same
PEG-3350 (Movicol, MiraLax)	2 g/kg/day (2-day regimen) or 4 g/kg/day (1-day regimen, <50 kg); 238 g in 1.5 of sports drink (1-day regimen, >50 kg)	In flavoured sports drinks; large amounts of free water not recommended	Hyponatraemia Hypokalaemia Allergy (rare)	Bisacodyl 5 mg orally (<50 kg) or 10 mg (>50 kg) on day 1; bisacodyl rectal suppository 5 mg (<50 kg) or 10 mg (>50 kg) on day 1; or senna 15 mg (<50 kg) or 30 mg (>50 kg) orally on day 1

Saline laxatives (Mg2+- citrate, milk of magnesia)	For children older than 6 yr) 4-6 mL/kg/day (1-day regimen in single or divided doses)	Mixed with citrus drink or flavored	Hyponatraemia Hypermagnesaemia	Same
Oral sodium phosphate (*NOT RECOMMENDED)	-	-	-	-

Table 5. NASPGHAN best practices cleanout regimens.

Options	**Dosing regimens**
Option 1*****: PEG-3350, 1-day cleanout	<50 kg = 4 g/kg/day + bisacodyl 5 mg >50 kg = 238 g in 1.5 L sports drink + bisacodyl 10 mg
Option 2: PEG-3350, 2-day cleanout	<50 kg = 2 g/kg/day + bisacodyl 5 mg >50 kg = 2 g + bisacodyl 10 mg
Option 3: NG cleanout	PEG-ELS: 25 mL/kg/hr (max. 450 mL/hr). Sulfate-free PEG-ELS 25 mL/kg/hr (max. 450 mL/hr).
Option 4: Non-PEG cleanout	Mg^{2+} - citrate: 4-6 mL/kg/day + bisacodyl 3-10 mg

*****Note that children with significant stool load will benefit from modified preparation regimen through doubling the duration of clean out of option 1 in the table 5 above.