

First registry of adult patients with chronic intestinal failure due to short bowel syndrome in Argentina: The RESTORE project

Gabriel E. Gondolessi MD¹  | Mariana L. Ortega LD¹  | Mariana Doeyo MD¹ |
 Martin Buncuga MD² | Claudia Pérez MD³ | Eduardo Mauriño MD⁴ |
 Florencia Costa MD⁴ | Silvia De Barrio MD⁵ | Alejandra Manzur MD⁶ |
 Luciana Donnadio MD⁷ | Dolores Matoso MD⁸ | Rodrigo Sánchez Claria MD⁸ |
 Adriana Crivelli MD⁵ | Héctor Solar MD¹ 

¹Unidad de Soporte Nutricional, Rehabilitación y Trasplante Intestinal, Hospital Universitario Fundación Favaloro (HUFF), Buenos Aires, Argentina

²Unidad de Soporte Nutricional, Sanatorio Delta, Rosario, Argentina

³Servicio de Clínica Médica, Hospital Nacional Profesor Alejandro Posadas, Buenos Aires, Argentina

⁴Unidad de Nutrición, Hospital de Gastroenterología Bonorino Udaondo, Buenos Aires, Argentina

⁵Sala de Soporte Nutricional y Enfermedades Malabsortivas, Hospital Interzonal General de Agudos San Martín, La Plata, Argentina

⁶Unidad de Trasplante de Organos y Tejidos, Hospital Central, Mendoza, Argentina

⁷Departamento de Medicina Interna, Hospital Militar, Buenos Aires, Argentina

⁸Centro de Rehabilitación Intestinal y Trasplante, Hospital Italiano de Buenos Aires, Buenos Aires, Argentina

Correspondence

Gabriel E. Gondolessi, MD, Unidad de Soporte Nutricional, Rehabilitación y Trasplante Intestinal, Hospital Universitario Fundación Favaloro (HUFF), Av Belgrano 1782, 7mo Piso, CABA (1093), Buenos Aires, Argentina.
 Email: gondolessi@ffavaloro.org

Funding information

Fundación de Ciencias Exactas (FCE), National University of La Plata (UNLP).

Abstract

Background: Short bowel syndrome (SBS) is considered a low prevalence disease. In Argentina, no registries are available on chronic intestinal failure (CIF) and SBS. This project was designed as the first national registry to report adult patients with this disease.

Methods: A prospective multicenter observational registry was created including adult patients with CIF/SBS from approved centers. Demographics, clinical characteristics, nutrition assessment, home parenteral nutrition (HPN) management, surgeries performed, medical treatment, overall survival, and freedom from HPN survival were analyzed.

Results: Of the 61 enrolled patients, 56 with available follow-up data were analyzed. At enrollment, the mean intestinal length was 59.5 ± 47.3 cm; the anatomy was type 1 ($n = 41$), type 2 ($n = 10$), and type 3 ($n = 5$). At the end of the interim analysis, anatomy changed to type 1 in 31, type 2 in 17, and type 3 in 8 patients. The overall mean time on HPN before enrollment was 33.5 ± 56.2 months. Autologous gastrointestinal reconstruction surgery was performed before enrollment on 21 patients, and afterward on 11. Nine patients (16.1%) were weaned off HPN with standard medical nutrition treatment; 12 patients received enterohormones, and 2 of them suspended HPN; one patient was considered a transplant candidate. In 23.7 ± 14.5 months, 11 of 56 patients discontinued HPN; Kaplan-Meier freedom from HPN survival was 28.9%. The number of cases collected represented 19.6 new adult CIF/SBS patients per year.

Conclusion: The RESTORE project allowed us to know the incidence, the current medical and surgical approach for this pathology, as well as its outcome and complications at dedicated centers.

KEYWORDS

chronic intestinal failure, enterohormones, home parenteral nutrition, intestinal rehabilitation, short bowel syndrome

CLINICAL RELEVANCY STATEMENT

RESTORE is the first ongoing prospective, observational, epidemiological, multicenter registry of adult patients with chronic intestinal failure (CIF) due to short bowel syndrome (SBS) in Argentina. The interim analysis enabled an estimate of the incidence of adult CIF/SBS of 19.6 new adult CIF/SBS patients per year in our country and would serve for a better understanding of the current care provided, the manner to continue improving that condition, the current treatment outcomes, and a more accurate definition of the national needs.

INTRODUCTION

Short bowel syndrome (SBS)—a rare, devastating, and life-threatening condition resulting from a partial or total intestinal resection—produces malnutrition, diarrhea, dehydration, and electrolyte disturbances.^{1,2} Symptoms severity, involving insufficient absorption of macronutrients and/or water and electrolytes, can vary markedly depending on the postsurgical intestinal length (IL), anatomy type, and a disease-free intestinal remnant.³ The requirement of parenteral nutrition (PN) to maintain health and/or growth is the definition of intestinal failure by the European Society for Clinical Nutrition and Metabolism⁴ and—when required for months, years, or one's lifetime—is classified as chronic intestinal failure (CIF). After intestinal resection, natural structural and functional changes known as “intestinal adaptation” occur in a process that determines whether intestinal sufficiency will, or will not, be recovered from.^{3–16}

The pathology and management of CIF patients secondary to SBS (CIF/SBS) are complex requiring a multi-interdisciplinary approach. PN is the first form of support, whereas home parenteral nutrition (HPN) is the cornerstone of long-term management. Surgical procedures to improve an unfavorable anatomy or increase IL—aka autologous gastrointestinal tract reconstruction surgery (AGIRS)—must be performed on all patients with reconstructable intestinal tracts, independent of their ILs. Medical rehabilitation includes nutrition and pharmacologic management along with enterohormones (EHs), like the semisynthetic glucagon-like peptide-2 (sGLP-2), that modify CIF natural history by increasing the possibilities of weaning off HPN,^{17–24} thus limiting the number of patients requiring intestinal transplantation.^{25,26}

CIF/SBS management has improved, although access to appropriate care remains limited. Recent publications from middle-income countries exposed the current inequality regarding the different therapies available within a given region,^{23,25,26} despite economic status.^{27,28}

The absence of prospectively collected information constitutes one of the main difficulties in understanding this pathology, determining its prevalence, and investigating how CIF/SBS patients are being handled in nonspecialized centers.

The RESTORE (impRovE underSTanding of short bOwel syndrome in Argentina) project aims at being the first prospective, observational, epidemiological multicenter study developed in Argentina to provide valuable information about CIF/SBS natural history, incidence, and etiology in addition to the complications and local-treatment implementation.

MATERIALS AND METHODS

The institutional research and ethics committee approved the RESTORE project. The first center (DDI 1384–2017), began enrolling patients in June 2017, collecting data in standard case report forms at weeks 4, 8, 12, 20, 24, and yearly. Regular visits were scheduled in each center, performance was monitored by an external monitor to assess the compliance and accurate data entering. The end points were death, wean off HPN, or intestinal transplant.

For each patient, the following variables were analyzed at enrollment and at the conclusion of the interim analyses.

Demographics

We analyzed patients age and sex, center's location, number of patients enrolled, and overall survival.

Clinical characteristics

The cause of intestinal loss, the anatomy type, and the length of the remaining intestine were included. The anatomy type was reported as type 1 (end-enterostomy), type 2 (jejunocolonic anastomosis), or type 3 (jejunocolonic anastomosis), after previous definitions.^{3,6} Also reported were stool frequency and urine and ostomy output.

Nutrition assessment

The weight and the subjective global assessment (SGA) of the nutrition status of patients were registered. Accordingly, the patients were grouped into three categories²⁹: A (well-nourished), B (moderately nourished or suspected of being malnourished), or C (severely malnourished).

HPN management

We analyzed the HPN volume, kilocalories, and number of days infused per week and registered related complications—including liver disease, catheter-related infections, and central venous access loss—along with freedom from PN survival.

Surgery

In some patients, AGIRS was performed before the enrollment in RESTORE, whereas in another group of patients this surgery was performed after inclusion in the registry.

The postsurgical IL and anatomy type were recorded in both groups. The time between enrollment and the performance of surgery was also analyzed. Postsurgical complications were registered according to the Dindo-Clavien classification.³⁰

Medical treatment

The use of antisecretory and antimotility drugs, antibiotics, pancreatic enzymes, or cholestyramine were registered as standard treatment. Those patients who required treatment with the EH analogues—the semisynthetic glucagon-like peptide-1 (sGLP-1) or sGLP-2—needed to provide an informed consent for treatment. A colonoscopy (to exclude the existence of polyps, malignancies, or evidence of inflammatory bowel disease) was performed in all patients' candidates to EH treatment.

Monitoring and data collection

Each center approved for participation in the RESTORE project received a principal-investigator binder with the complete project protocol, the data-completion instructions manual, and the case report forms.

The Scientific Steering Committee of RESTORE was responsible for electing the participating centers based on experience with the management of CIF/SBS patients. Each center had to have a multidisciplinary team that included a surgeon, a therapist with nutrition support experience, a dietitian, and specialized pharmaceutical resources. Those teams, however, did not necessarily have to offer rehabilitation surgery or transplantation capabilities or have access to EH therapies to be elected for participation.

Statistical analysis

Demographic and baseline characteristics were summarized by descriptive statistics. The values were expressed as the means and SDs when they were normally distributed; whereas the chi-square test, paired-sample Student *t* test, or analysis of variance were used

to determine the statistical significance of the measurements of PN volume and kilocalories, patient weight, and urine output during treatment. Patient survival was calculated with standard Kaplan-Meier curves, whereas the survival curves evaluating the possibility of patients discontinuing PN (referred to as “freedom from PN-dependent survival”) were plotted as the reciprocal of the Kaplan-Meier value; a $P < 0.05$ was considered statistically significant for all comparisons. Those statistical analyses were performed by the IBM SPSS version 25.0 computer.

RESULTS

Demographics

From June 2017 to May 2020, 12 centers were approved for participation in the project, with 2 more being under regulatory assessment (Figure 1). The approved centers, belonging to both public ($n = 6$) and private ($n = 6$) healthcare systems, are located mainly in the city of Buenos Aires ($n = 7$).

Sixty-one patients were enrolled in the registry. Figure 2 summarizes the total cases admitted per center. Five patients were excluded because of incomplete written consents ($n = 2$), loss from follow-up ($n = 2$), or inadequate inclusion criteria detected during monitoring ($n = 1$). Thus, 56 patients remained for data analysis. The mean age was 50 ± 17 years and 52% were female ($n = 29$).

A mean time of 14.5 ± 11.3 months of follow-up constituted the cutoff for the interim analysis.

Clinical and surgical characteristics

The overall main causes leading to CIF/SBS were postsurgical complications in 16 patients (29%), ischemia in 12 patients (21%), volvulus in 4 patients (7.1%), and trauma in 4 patients (7.1%). At enrollment, the most frequent intestinal anatomy was type 1 ($n = 41$; 73%); comprising jejunostomies ($n = 31$), ileostomies ($n = 9$), and duodenostomy ($n = 1$). Anatomy type 2 was present in 10 patients (18%), and in 5 (8.9%) the anatomy was type 3.

The IL at enrollment could be recorded in 71% of the patients ($n = 40$), in whom the mean length was 59.5 ± 47.3 cm. In anatomy type 1 patients, the IL was 68.3 ± 49.1 cm; in anatomy type 2, 54.5 ± 45.2 cm; and in anatomy type 3, 20.4 ± 7.9 cm.

The overall mean daily ostomy output in anatomy type 1 patients was 1433.1 ± 1014.4 ml/day, without a significant difference ($P = 0.98$) registered between the outputs of the jejunostomy (1435.9 ± 1001.7 ml/day) and the ileostomy (1383.3 ± 1164.6 ml/day). In patients with a total or partial colon in continuity, the mean stool frequency was 4.25 ± 3.04 , recorded in 12 of 15 patients. The overall mean urine output was 1641.9 ± 851.8 ml/day.

AGIRS was the only reconstructive surgery register by the participating centers. Neither serial transverse enteroplasty nor longitudinal intestinal lengthening and tailoring were reported.

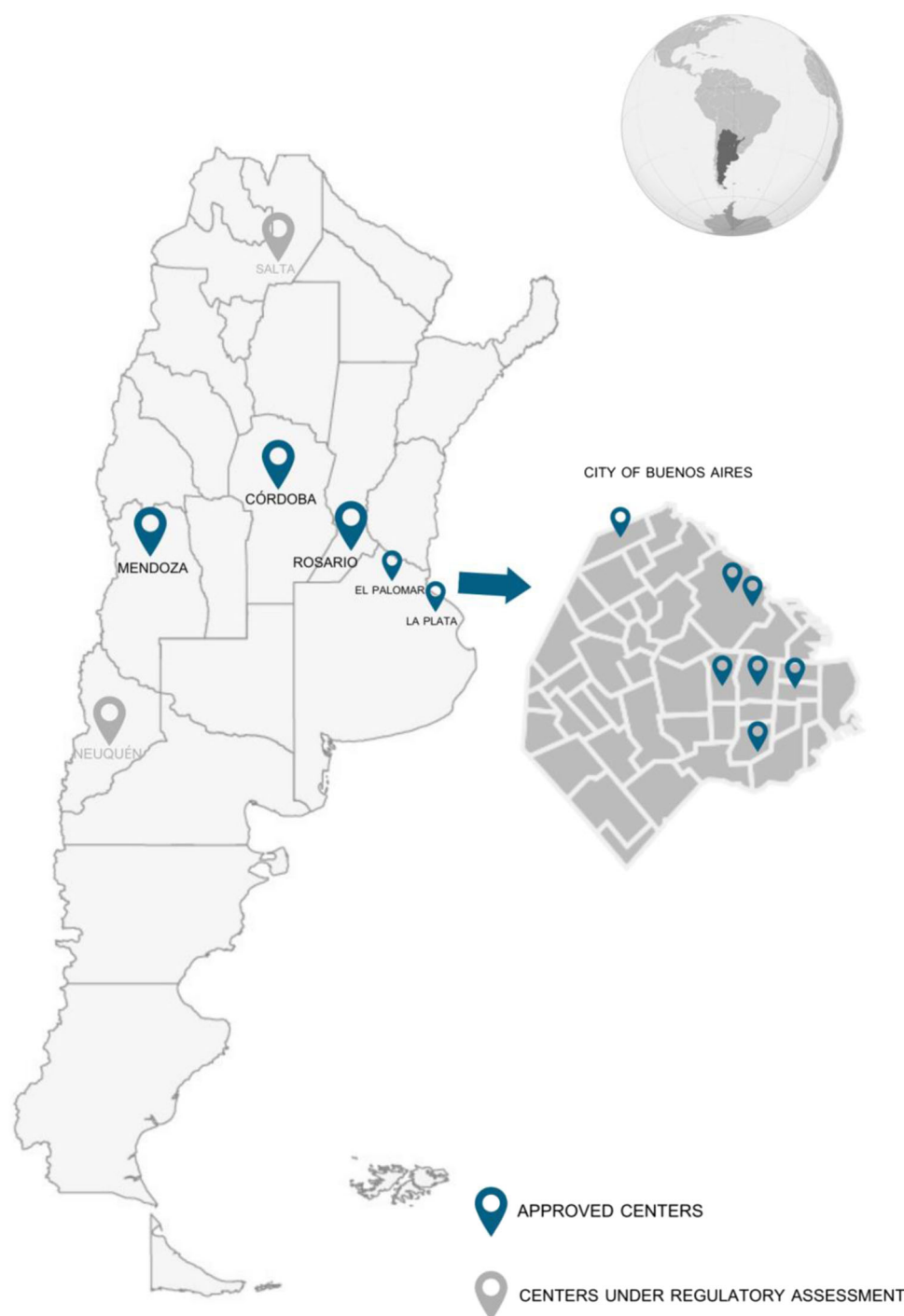


FIGURE 1 RESTORE centers' geographical location. The figure to the right depicts the locations within Argentina of the centers within the RESTORE project that have been approved (black symbols) or are currently under regulatory assessment (gray symbols) throughout the provinces in north and central Argentina. The inset to the upper right indicates the position of Argentina within South America, whereas the inset to the lower right is a map of Buenos Aires city illustrating the locations of the seven centers there

In 21 patients with anatomy type 1, AGIRS had been performed before enrollment. All those patients remained with CIF despite the surgery. Thirty-five patients were included without previous surgery and all of those had anatomy type 1. During the follow up, the intestinal anatomy type and IL changed in those patients in whom AGIRS surgery had been performed. From the patients enrolled with

anatomy type 1 ($n = 41$), 11 received a total of 13 surgery procedures to improve their anatomy. The mean time from study inclusion to AGIRS surgery was 2.7 ± 2.5 months. At the end of the interim analysis, 10 of the 11 operated patients (91%) improved their initial anatomy from type 1 to type 2 or type 3 ($n = 7$ and $n = 3$, respectively). One patient remained with anatomy type 1 but added

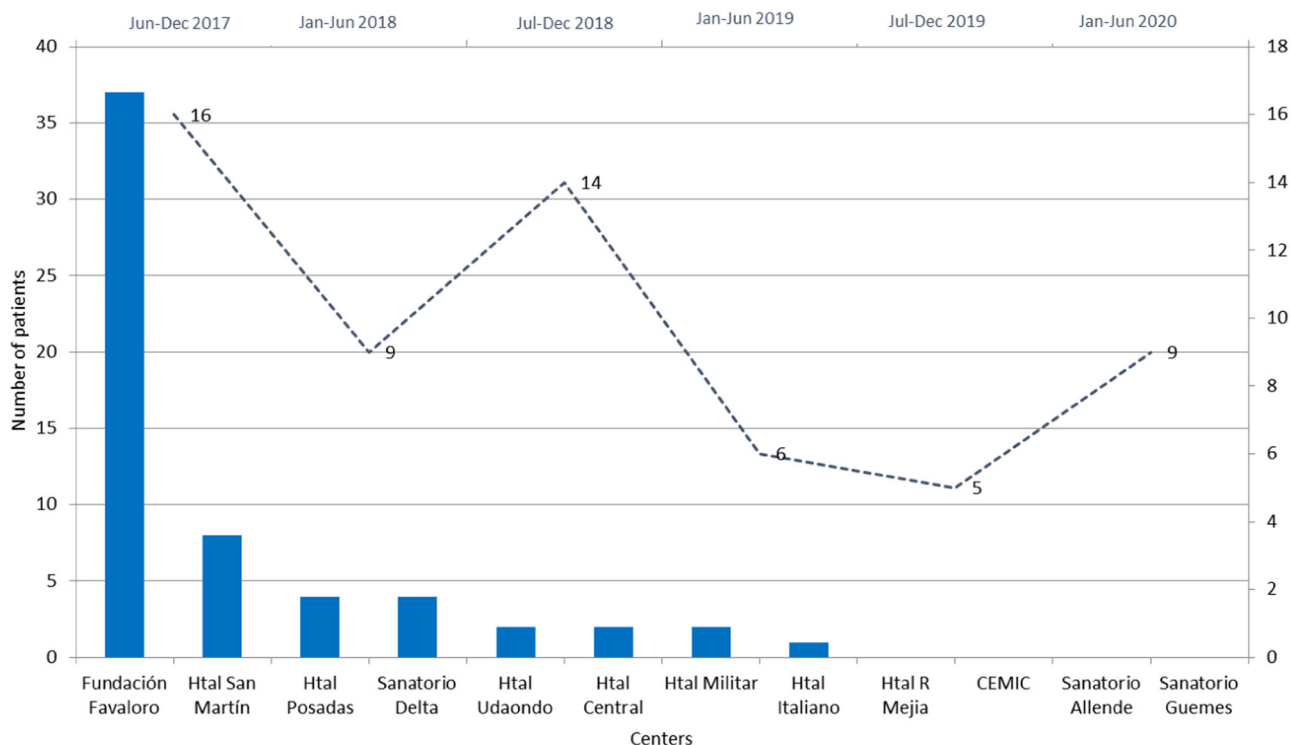


FIGURE 2 Number of patients included per center and over time. In the bar graph of the figure, the total number of patients participating in the program is plotted on the left ordinate for each of the centers listed on the lower abscissa, whereas the total number of new patients added to the follow-up period are plotted on the right ordinate as individual points joined by broken lines for the different years indicated on the upper abscissa

163 cm of IL after the surgery. Of all the patients enrolled, 31 remained with anatomy type 1, whereas the number of patients with anatomy type 2 increased from 10 to 17, and those with anatomy type 3 increased from 5 to 8.

Of those patients, 6 of 11 (55%) reported postsurgical complications (4 Dindo-Clavien III-b and 7 Dindo-Clavien II).

The analysis of those patients receiving AGIRS after enrollment manifested a benefit in postsurgical IL (10 of 11 gained 101.0 ± 19.5 cm) and in decrease of PN requirements (see HPN and EH sections).

Nutrition assessment

The overall mean weight was 60.4 ± 15.0 kg. The SGA percentages at the enrollment were: A, 52.6%; B, 19.3%; and C, 26.3%. The data were not available in 1.7% of the patients. At the end of the interim analysis, the SGA improved to A in 61%, B in 25%, and C in 11%, with two data missing.

HPN and EH

Of the 56 patients included in the registry, all received HPN before enrollment for a mean time of 33.5 ± 56.2 months. The mean number

of days of infusion were 6.0 ± 1.4 per week, and the mean HPN volume and kilocalories provided were $14,945.0 \pm 5227.6$ ml/week and 8930.6 ± 3646.5 kcal/week, respectively. We observed a significant difference in volume requirement based on the anatomy type in types 2 and 3 vs type 1 ($P = 0.02$), whereas the energy requirement was not different ($P = 0.49$) (Table 1). This trend could be related to the presence of colon-in-continuity (partial or complete).

At enrollment, the mean PN volume and kilocalories in patients without EH treatment were $15,306.2 \pm 4539.1$ ml/week and 9345.5 ± 3518.1 kcal/week, whereas in those with sGLP-2 treatment the mean PN volume and kilocalories were 9980.0 ± 2980.2 ml/week and 6436.0 ± 2312.6 kcal/week, respectively. The complications related to HPN were central-line infections in 14 patients (25%), intestinal failure-associated liver disease in 5 (8.9%), thrombosis in 4 (7.1%), accidental catheter exit in 2 (3.6%), and catheter rupture in 1 (1.8%).

Of the 12 patients receiving EH, AGIRS had been previously performed in all. Of those 12 patients, 11 received sGLP-2 and 1 received sGLP-1. Five patients had started sGLP-2 therapy before enrollment for a mean time of 5.7 ± 6.3 weeks. During the follow-up, 10 more patients were considered candidates for sGLP-2, with the treatment being initiated in 6. The number of patients per anatomy type receiving sGLP-2 were: 1 for type 1, 5 for type 2, and 5 for type 3, with those having a mean IL of 39.4 ± 29.1 cm. The overall mean time on sGLP-2 treatment was 82 ± 51.7 weeks. No significant

TABLE 1 Clinical and nutrition characteristics according to anatomy type

Anatomy type	Weight (kg)			Urine output (ml/24 h)			PN* kilocalories (kcal/week)			PN volume (ml/week)		
	Baseline	1-year follow-up	P	Baseline	1-year follow-up	P	Baseline	1-year follow-up	P	Baseline	1-year follow-up	P
1	62.8	64.1	0.45	1632.8	1700.0	0.78	9461.1	7923.1	0.14	16,363.6	16,718.2	0.80
2	57.3	61.6	0.16	1500.0	1650.0	0.5	7843.6	5073.2	0.10	12,300.0	7600.0	0.09*
3	48.1	48.9	0.62	2416.7	1950.0	0.85	5628.5	2048.2	0.03*	9125.0	3625.0	0.009*

Abbreviation: PN, parenteral nutrition.

*indicate statistical significant values.

changes were recorded in the weight, urine output, oral intake, or PN-requiring days during the follow up compared with baseline; but significant differences in the reduction of PN volume occurred between weeks 8 and 12 ($P=0.04$), the baseline value and week 24 ($P=0.02$), and the baseline value and the first year ($P=0.03$). The baseline PN kilocalories became significantly reduced between the baseline and week 24 ($P=0.03$) or 1 year ($P=0.05$). All the patients treated with sGLP-2 responded (decreasing the HPN volume by >20% from the baseline value); 9 patients were early responders (before 6 months of treatment). Two of 11 patients (18%) discontinued PN support within a mean time of 4.98 ± 2.7 months. The oral fluid intake increased significantly between weeks 12 and 20 ($P=0.04$).

One patient received sGLP-1. She was aged 70 years, female with SBS secondary to postsurgical complications. She had anatomy type 1 with a nonreconstructable intestinal tract and hyperphagia. Her history of pituitary adenoma prevented her from receiving sGLP-2 therapy. Her weight and body mass index classified her as obese patient, therefore PN requirements were adapted to ideal weight. With the standard medical treatment, she decreased PN volume from 18,000 to 10,000 ml/week and from 6060 kcal/week to 5260 kcal/week. We would like to mention that despite the main indication for using it was to (a) control patient hyperphagia and (b) decrease her ostomy output, and not for medical rehabilitation, after 24 weeks with sGLP-1 treatment, the PN volume could be reduced by 20% from the baseline value.

Intestinal rehabilitation rate

In 32 of 56 patients enrolled in RESTORE, surgery was performed: 21 before enrollment and 11 afterward. Of those 32 patients, 9 were able to wean off HPN with standard medical nutrition treatment within a mean time of 3.7 ± 3.99 months. The remnant anatomy of this group of patients was type 2 ($n=5$) and type 3 ($n=4$), with a mean postsurgical IL of 202.14 ± 79.6 cm.

In 12 of 32 patients, EHs were prescribed when those patients could not continue decreasing the PN volume despite standard treatment as well as after other causes—such as small intestinal bacterial overgrowth—had been ruled out. Eleven patients received sGLP-2 (5 before enrollment and 6 afterward), whereas one patient received sGLP-1. Of the 12 patients receiving EH treatment, 2 suspended HPN within a mean time of 3.47 ± 2.22 months (both had anatomy type 3, with 25 and 30 cm of IL,

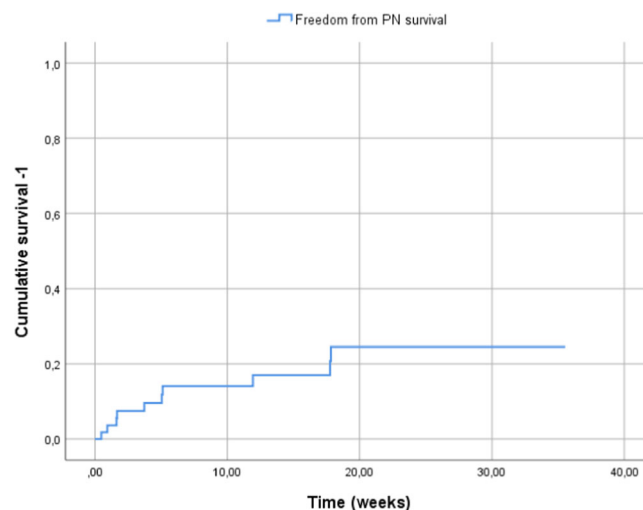


FIGURE 3 Overall freedom from requirement of parenteral nutrition (PN) for survival. In the figure, the reciprocal of the cumulative-survival function is plotted on the ordinate as a function of time in weeks on the abscissa. Key to the symbols for survival: upshifts in lines, freedom from PN dependence for survival; intersections in lines, censored

respectively). At the end of this analysis, 24 patients were still waiting for surgery with none being able to attain intestinal rehabilitation.

The overall freedom from HPN requirement for survival was 28.9% (Figure 3). Thus far, only one patient (1.8%) developed PN-related complications necessitating consideration for being an intestinal transplantation candidate and thus dropping out of RESTORE. He was listed and received a combined transplantation of liver, intestine, and kidney. The overall patient survival was 71% (Figure 4). The causes of mortality were septic shock due to other causes not related to HPN ($n=3$) and sudden death ($n=1$).

The current interim analysis enabled to estimate an incidence of 19.6 new adult CIF/SBS patients per year.

DISCUSSION

CIF is rare and SBS is the most common cause.^{1–4,7} The CIF/SBS epidemiology remains poorly characterized and the incidence is difficult to determine because of CIF's rarity, diverse etiologies,

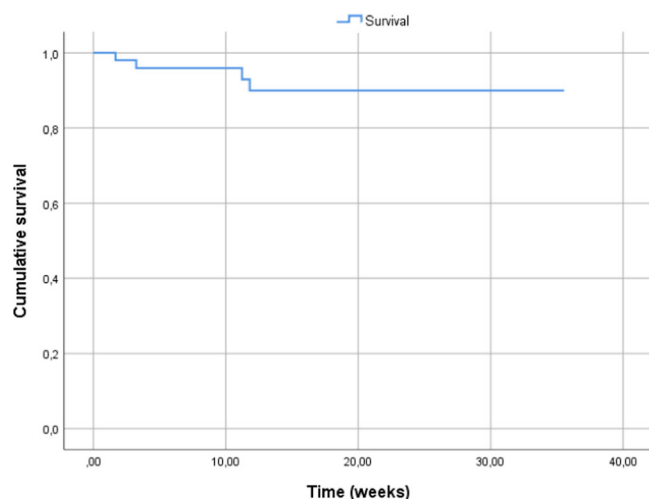


FIGURE 4 Overall survival. In the figure, the cumulative-survival function in patients is plotted on the ordinate as a function of time in weeks on the abscissa. Key to the symbols: upshifts in blue lines, survival; intersections in lines, censored

and incomplete registration.^{6–9} Cases are estimated from the number of patients receiving chronic HPN, or from the number undergoing intestinal transplant, a heretofore recognized bias.^{31–43}

A publication from the British Medical Association suggested that the disease had been underestimated.³³ In a multifractionated healthcare system like Argentina's, obtaining an accurate estimation is certainly more difficult without a national registry.

The Copenhagen intestinal failure database—an exemplary prospective, long-term national system—recorded data from 1970 to 2010. The registry's incidence of HPN is ~15 CIF-HPN patients per 1,000,000 inhabitants per year, with 24% having been weaned from HPN and 50% of those after AGIRS. From this information, the Danish health system estimated at least 10 hospital beds per 1,000,000 inhabitants are continually needed for patients with intestinal failure.³²

Dutch Registry of Intestinal Failure and Transplantation (DRIFT), a Dutch multicenter registry used as a quality instrument by different participating centers, determined a prevalence of 11.6 patients with intestinal failure per 1,000,000 inhabitants.³⁹

Our team's reports^{43–45} have addressed the currently available therapy and access in middle-income countries. That information from personally sent surveys, based on the HPN services provided, indicated a prevalence of 0.25–6.75 per 1,000,000 inhabitants, having been prescribed for 90% of patients with intestinal failure. The real incidence, however, remains unknown.

Argentina needed to establish registries to more completely understand CIF's incidence and natural history. Therefore, in 2016 RESTORE was established, which aimed at creating a CIF/SBS adult patient registry. Thus, for the first time, we can report the number of new adult CIF/SBS patients per year, for a population of 45,380,000 habitants, evaluated in 12 centers.

RESTORE's interim analysis revealed that, despite being a federal country, most of Argentina's complex care remained centralized in the nation's capital and the Buenos Aires province.

HPN is available nationwide; however, most complex procedures and therapies are not available nationwide. This interim analysis concluded with AGIRS being performed in 3 of 12 centers (36%) and EHs being initiated in 2 of 12 (21.4%).

Those findings raised questions regarding (1) which centers fulfill the requirements for being intestinal failure centers of expertise, (2) which of them have dedicated multidisciplinary teams for providing the complete therapies currently available, and (3) who has the experience, authority, and responsibility to endorse those centers' expertise.

The RESTORE project is the first registry developed to know the incidence and management of CIF/SBS in Argentina. The main limitation of the current study is that it only includes centers with experience treating adult patients with CIF/SBS. By taking this into account, an amendment was developed, and it is currently being performed, including new centers, not only from Argentina, but also from other Latin America countries, and expanding the inclusion criteria to the pediatric population. The development of the new "Restore amendment" included an electronic case report form to ensure the integrity of the data collection.

The change in anatomy after AGIRS enabled patients to achieve an autonomy early after surgery, with a major benefit occurring in patients with surgery after inclusion in RESTORE. That finding was for two main characteristics: (1) a more systematic postsurgical approach and (2) benefits to patients from having therapy in a single center. Patients with less favorable anatomies also improved through EH administration.

This interim analysis emphasized the relevance of prospectively collected data for determining disease incidence, current therapeutic complications, and outcomes; information that should be shared with the main local healthcare authorities to underscore the need to recognize CIF as a "rare disease." Therefore, many efforts like the Atlas program have been launched in Europe—it is led by a steering group of CIF experts and involving representation from patients and physicians as well as policymakers committed to ensuring that CIF care is a priority in the European healthcare systems.⁴⁶

RESTORE might hereafter be considered a model quality instrument for developing new centers dedicated to intestinal failure in Argentina. Moreover, to expand the project's knowledge and initial aim, starting this year the study has been amended to extend the duration of the RESTORE project with the combined goals of completing 5 years of follow-up, including the pediatric population, and expanding to centers throughout the entirety of Latin America.

AUTHOR CONTRIBUTIONS

Gabriel E. Gondolesi and Héctor Solar equally contributed to the conception and design of the research; Gabriel E. Gondolesi, Héctor Solar, Mariana L. Ortega, Mariana Doeyo, Martín Buncuga, Claudia Pérez, Eduardo Mauriño, Florencia Costa, Silvia De Barrio, Alejandra Manzur, Luciana Donnadio, Dolores Matoso, Rodrigo Sánchez Claria,

and Adriana Crivelli contributed to the acquisition of the data; Gabriel E. Gondolesi, Héctor Solar, and Mariana L. Ortega contributed to the analysis of the data; Gabriel E. Gondolesi and Héctor Solar contributed to the interpretation of the data; and Gabriel E. Gondolesi and Héctor Solar drafted the manuscript.

CONFLICTS OF INTEREST

Gabriel E. Gondolesi, MD, acted as speaker and consultant for Shire-Takeda. Héctor Solar, MD, acted as speaker and consultant for Shire-Takeda. The other authors do not have conflicts of interest to declare.

ORCID

Gabriel E. Gondolesi  <http://orcid.org/0000-0002-3869-6213>

Mariana L. Ortega  <http://orcid.org/0000-0002-7709-8910>

Héctor Solar  <http://orcid.org/0000-0001-8631-7073>

REFERENCES

- Vanderhoof JA, Langnas AN. Short-bowel syndrome in children and adults. *Gastroenterology*. 1997;113(5):1767-1778.
- Hollwarth ME. Short bowel syndrome: pathophysiological and clinical aspects. *Pathophysiology*. 1999;6(1):1-19.
- Tappenden KA. Pathophysiology of short bowel syndrome: considerations of resected and residual anatomy. *JPEN J Parenter Enteral Nutr*. 2014;38(suppl 1):14S-22S.
- Pironi L, Arends J, Baxter J, et al. ESPEN endorsed recommendations. Definition and classification of intestinal failure in adults. *Clin Nutr*. 2015;34(2):171-180.
- Nightingale JMD. The short bowel. In: Nightingale JMD, ed. *Intestinal Failure*. Greenwich Medical Media; 2001:177-198.
- Matarese LE, Jeppesen PB, O'Keefe SJ. Short bowel syndrome in adults: the need for an interdisciplinary approach and coordinated care. *JPEN J Parenter Enteral Nutr*. 2014;38(suppl 1):60S-64S.
- Pironi L. Definitions of intestinal failure and the short bowel syndrome. *Best Pract Res Clin Gastroenterol*. 2016;30(2):173-185.
- Pironi L. Home artificial nutrition and chronic intestinal failure special interest group of ESPEN. Revised ESPEN clinical classification of chronic intestinal failure: from 16 to 8 categories. *JPEN J Parenter Enteral Nutr*. 2017;41(6):911.
- Shaffer J. Intestinal failure: definition and service development. *Clin Nutr*. 2002;21(suppl 1):144-145.
- Jeppesen PB. Spectrum of short bowel syndrome in adults: intestinal insufficiency to intestinal failure. *JPEN J Parenter Enteral Nutr*. 2014;38(suppl 1):8S-13S.
- Buchman AL. Short bowel syndrome. 9th ed. In: Feldman, Sleisenger, Fordtran, eds. *Gastrointestinal and Liver Disease*. Saunders Elsevier; 2010:1779-1795.
- Donohoe CL, Reynolds JV. Short bowel syndrome. *Surgeon*. 2010;8(5):270-279.
- Nightingale J, Woodward JM. Guidelines for management of patients with a short bowel. *Gut*. 2006;55(suppl 4):iv1-iv12.
- Di Biase JK. Management of the short bowel syndrome. In: DeLegge MH, ed. *Nutrition and Gastrointestinal Disease*. Humana Press; 2008:177-203.
- Matarese LE. Nutrition and fluid optimization for patients with short bowel syndrome. *JPEN J Parenter Enteral Nutr*. 2013;37:161-170.
- Tappenden K. Intestinal adaptation following resection. *JPEN J Parenter Enteral Nutr*. 2014;38(suppl 1):23-31.
- Gondolesi GE, Doeyo M, Echevarria Lic C, et al. Results of surgical and medical rehabilitation for adult patients with type III intestinal failure in a comprehensive unit today: building a new model to predict parenteral nutrition independency. *JPEN J Parenter Enteral Nutr*. 2020;44(4):703-713.
- Solar H, Doeyo M, Ortega M, et al. Postsurgical intestinal rehabilitation using semisynthetic glucagon-like peptide-2 analogue (sGLP-2) at a referral center: can patients achieve parenteral nutrition and sGLP-2 independency? *JPEN J Parenter Enteral Nutr*. 2021;45(5):1072-1082.
- Jeppesen PB, Sanguinetti EL, Buchman A, et al. Teduglutide (ALX-0600), a dipeptidyl peptidase IV resistant glucagon-like peptide 2 analogue, improves intestinal function in short bowel syndrome patients. *Gut*. 2005;54(9):1224-1231.
- Marier JF, Beliveau M, Mouksassi MS, et al. Pharmacokinetics, safety, and tolerability of teduglutide, a glucagon-like peptide-2 (GLP-2) analog, following multiple ascending subcutaneous administrations in healthy subjects. *J Clin Pharmacol*. 2008;48(11):1289-1299.
- Schwartz LK, O'Keefe SJ, Fujioka K, et al. Long-term teduglutide for the treatment of patients with intestinal failure associated with short bowel syndrome. *Clin Transl Gastroenterol*. 2016;7(2):e142.
- Jeppesen PB, Pertkiewicz M, Messing B, et al. Teduglutide reduces need for parenteral support among patients with short bowel syndrome with intestinal failure. *Gastroenterology*. 2012;143(6):1473-1481.
- Gondolesi G, Pattin F, Nikkoupour H. Management of intestinal failure in middle-income countries, for children and adults. *Curr Opin Organ Transplant*. 2018;23(2):212-218.
- Abu-Elmagd KM, Armanyous SR, Fujiki M, et al. Management of five hundred patients with gut failure at a single center: surgical innovation versus transplantation with a novel predictive model. *Ann Surg*. 2019;270(4):656-674.
- Gondolesi GE, Fernandez A, Burghardt KM, et al. Meeting report of the XIV international small bowel transplant symposium: summary of presentations, workshops, and debates from a comprehensive meeting on intestinal failure, rehabilitation, and transplantation, Buenos Aires, Argentina, June 10-13, 2015. *JPEN J Parenter Enteral Nutr*. 2018;42(2):477-489.
- Gondolesi GE, Doeyo M, Solar-Muñoz H. A detailed analysis of the current status of intestinal transplantation in Latin America. *Curr Opin Organ Transplant*. 2020;25(2):189-195.
- Kurlberg G, Forsell H, Aly A. National registry of patients with short bowel syndrome. *Transplant Proc*. 2004;36(2):253-254.
- Totonelli G, Tambucci R, Boscarelli A, et al. Pediatric intestinal rehabilitation and transplantation registry: initial report from a European Collaboraty Registry. *Eur J Pediatr Surg*. 2018;28(1):75-80.
- Detsky AS, McLaughlin JR, Baker JP, et al. What is subjective global assessment of nutritional status? *JPEN J Parenter Enteral Nutr*. 1987;11(1):8-13.
- Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg*. 2009;250(2):187-196.
- Batra A, Keys SC, Johnson MJ, Wheeler RA, Beattie RM. Epidemiology, management and outcome of ultrashort bowel syndrome in infancy. *Arch Dis Child Fetal Neonatal Ed*. 2017;102(6):F551-F556.
- Brandt CF, Hvistendahl M, Naimi RM, et al. Home parenteral nutrition in adult patients with chronic intestinal failure: the evolution over 4 decades in a tertiary referral center. *JPEN J Parenter Enteral Nutr*. 2017;41(7):1178-1187.
- Barclay AR, Paxton CE, Gillett P, et al. Regionally acquired intestinal failure data suggest an underestimate in national service requirements. *Arch Dis Child*. 2009;94(12):938-943.

34. Pironi L, Konrad D, Brandt C, et al. Clinical classification of adult patients with chronic intestinal failure due to benign disease: an international multicenter cross-sectional survey. *Clin Nutr.* 2018; 37(2):728-738.
35. Andolina JM, Metzger LC, Bishop J. The Oley Foundation and consumer support groups. *Gastroenterol Clin North Am.* 2019;48(4):625-635.
36. Pironi L, Goulet O, Buchman A, et al. Outcome on home parenteral nutrition for benign intestinal failure: a review of the literature and benchmarking with the European prospective survey of ESPEN. *Clin Nutr.* 2012;31(6):831-845.
37. Pironi L, Boeykens K, Bozzetti F, et al. ESPEN guideline on home parenteral nutrition. *Clin Nutr.* 2020;39(6):1645-1666.
38. Wanden-Berghe Lozano C, Cuerda Compes C, Maíz Jiménez M, et al. Nutrición parenteral domiciliaria en España 2018. Informe del Grupo de Nutrición Artificial Domiciliaria y Ambulatoria NADYA. *Nutr Hosp.* 2020;37(2):403-407.
39. Neelis EG, Roskott AM, Dijkstra G, et al. Presentation of a nationwide multicenter registry of Intestinal failure and intestinal transplantation. *Clin Nutr.* 2016;35(1):225-229.
40. Keane N, Fragkos KC, Patel PS, et al. Performance status, prognostic scoring and Parenteral Nutrition Requirements predict survival in patients with advanced cancer receiving home parenteral nutrition. *Nutr Cancer.* 2018;70(1):73-82.
41. Solar H, Ortega M, Gondolesi G. Quality of life after intestinal transplantation. *Curr Opin Organ Transplant.* 2021;26(2):200-206.
42. Compher C, Winkler M, Guenter P, Steiger E. Nutritional management of home parenteral nutrition among patients with enterocutaneous fistula in the sustain registry. *JPEN J Parenter Enteral Nutr.* 2018;42(2):412-417.
43. Solar H, Crivelli A, Buncuga M, et al. First cohort of Type III intestinal failure under GLP-2 therapy in Argentina Preliminary report of the RESTORE Group. Abstract Book, # 2b-152, CIRTA, 2017, New York. *Transplantation.* 2017;101(6S2):S150.
44. Solar H, Crivelli A, Buncuga M, et al. RESTORE project (improve under standing of small bowel syndrome in Argentina): first report of a prospective, observational, epidemiological, multicenter study of adult pts with short gut syndrome in Argentina. Abstract # 179, STALYC 2019, Merida, Mexico.
45. Doeyo M, Buncuga M & Perez C et al. RESTORE project (improve under standing of small bowel syndrome in Argentina): follow-up report of a prospective, observational, epidemiological, multicenter study of adult pts with short gut syndrome in Argentina. Abstract # 1359, TTS virtual congress, 2020.
46. ATLAS Launch. What more can we do to support chronic intestinal failure patients? A discussion on rare diseases, European Reference Networks, EU health policy. 2020. The Parliament Magazine. <https://www.theparliamentmagazine.eu/event/atlas-launch-what-more-can-we-do-support-chronic-intestinal-failure-patients-discussion-rare>

How to cite this article: Gondolesi GE, Ortega ML, Doeyo M, et al. First registry of adult patients with chronic intestinal failure due to short bowel syndrome in Argentina: The RESTORE project. *J Parenter Enteral Nutr.* 2022;1-9. doi:10.1002/jpen.2387