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Expectations and Experience: Parent and Patient Perspectives Regarding Treatment for Severe Combined Immunodeficiency (SCID)

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Abstract

Introduction: Infants with SCID are treated with hematopoietic cell transplantation (HCT) or gene therapy (GT). Caregiver perceptions of pre-treatment counseling and understanding of durability of HCT/GT are poorly understood.

Methods: A survey was designed and distributed to families of patients with SCID. Topics in the questionnaire included SCID genotype and treatment, family recollections of pre-treatment counseling and present clinical status.

Results: 151 surveys were analyzed. 132 were treated with HCT, 19 with GT. From counseling received, 37% expected HCT/GT would lead to "cure"; 43% expected HCT/GT would last a lifetime. Of 136 living patients, 59% reported overall good health but 65% reported some persistent health challenges.

Conclusions: For some, interpretation of the word "cure" varied, leading to misunderstanding regarding need for continued medical evaluations and additional therapies. Clear communication regarding the importance of lifelong follow-up, no matter the treatment outcome, will help to optimize good health and quality of life.

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Keywords

Patient Perspective; Patient Reported Outcomes; Severe Combined Immunodeficiency; Genetic Counseling; Hematopoietic Stem Cell Transplant; Gene Therapy

1. Introduction

Severe Combined Immunodeficiency (SCID) is a rare primary immune deficiency characterized by absence of T lymphocytes, B lymphocyte numbers and/or function that affects 1/66,000 live births[1]. There are at least 20 different genetic defects that can cause SCID, and some cases with unknown genetic cause despite genetic investigation[2, 3]. Infants with SCID have extreme susceptibility to very serious infections that without definitive therapy result in death before the first year of life. Allogeneic hematopoietic cell transplantation (HCT) was shown over 50 years ago to restore immunity in patients with SCID, making this disease no longer inevitably fatal[4]. Fortunately, early treatment with HCT or autologous gene therapy (GT) can, in most cases, establish effective immunity[5]. In addition, early identification of infants with SCID through population-based newborn screening (NBS) has identified newborns with SCID prior to the onset of clinical symptoms, with potential for better outcomes by allowing early treatment before life-threatening infections have developed[5,6,7]. However, SCID patients can experience late complications of treatment, late manifestations of the underlying genetic disorders and declines in immunity with time[5, 8–12]. As we have now learned, not only is early transplant critical, but T and B cell reconstitution may vary depending upon patient genotype, infections prior to and during transplant, donor match, donor cell source and conditioning regimen[8, 913]. For these reasons, guidelines for follow-up of patients with SCID post HCT have been developed based on the available, but limited data, to help inform the clinical long-term management[14].

How physicians explain outcomes after treatment to parents of newly diagnosed babies with SCID and how they set parents' expectations are a critical part of early management of infants with SCID. Prior study of families' perceptions of the informed consent process prior to HCT indicate that many feel personally, not externally, compelled to proceed with treatment, and believe that their questions have been answered[15]. However, they recognize that their capacity to understand the long term ramifications of pursuing the treatment may be limited at the time consent is obtained, particularly in light of the seriously ill status of a child being considered for HCT[15,16]. In the case of patients receiving GT, the process of informed consent was not limited to discussion of a clinical treatment option and potential outcomes thereof, but also the consent for participation of the infant or child in a clinical research study, since GT was available only as a research based intervention.

Concerns about expectations and experiences of families affected by SCID prior to and following HCT or GT led to a collaborative project between the SCID Angels for Life Foundation, the Immune Deficiency Foundation (IDF) and the Primary Immune Deficiency Treatment Consortium (PIDTC), an NIH-funded rare disease consortium of 47 academic centers in the U.S. and Canada. We collected nationwide historical data on the patient/family

experience to illuminate the path from diagnosis to immune system recovery with HCT or GT in an effort to improve future communications between medical providers and families.

2. Material and Methods

The questions from this survey were based on a pilot survey that SCID Angels for Life had emailed to some SCID families in its contact database in 2018. Following the responses from those SCID families, SCID Angels for Life, IDF and PIDTC collaborators revised the survey, obtained IRB approval and sent the survey to members of the SCID Angels for Life and IDF contact registries (Supplemental Appendix 1). Major topics covered in the questionnaire included form of SCID, type of transplant, recollections of counseling received from providers, and quality of life at the time the survey was completed. The study was granted a waiver of formal informed consent by the Advarra Institutional Review Board. It was performed in accordance with the Declaration of Helsinki, with electronic consent obtained from each participant prior to presentation of the survey questions. The survey was performed electronically utilizing the Survey Monkey Platform from April 1 to 30, 2019. Question types included: bivariate, multiple choice, multiple selection, scaled, open-end text, and open-end numeric. Adult patients and caregivers of patients with SCID (n=309) were contacted. The survey was completed by 169, for a response rate of 55%. Eleven responses from parents whose child died prior to HCT or GT and were eliminated from the analysis. An additional seven were eliminated from the analysis because the SCID patient had not yet had HCT or GT at the time of the survey (Figure 1).

De-identified survey data were analyzed utilizing the IBM SPSS 23.0 Statistical Software package. Descriptive statistics were used to examine the distribution of key outcomes and predictor variables. Means and standard deviations were computed for continuous variables and percentages for categorical variables.

3. Results

3.1 Population Characteristics and treatments received for SCID

Completed survey responses were analyzed for 151 patients with SCID who received at least 1 HCT or GT (Table 1). Most respondents (n=145) were family caregivers of patients with SCID; 6 adult SCID patients also participated. Caregivers most commonly completed the survey on behalf of 1 child (n=124), but some completed separate responses for each of 2 (n=14), 3 (n=9), or 4 (n=4) affected children. Patients received treatment from 41 different centers for HCT and 7 for GT. Genetic forms of SCID most commonly included IL2RG (44%), ADA (12%), or RAG1/2 (10%) genotypes; there were 11% without a known genotype. The majority of the patients received an HCT (n=132) and 19 patients received GT as their initial therapy for SCID. Sixty-three respondents reported that the SCID patient was diagnosed via NBS. Fifteen respondents reported that the patient with SCID was deceased; of these patients, 12 did not survive their first HCT, and 3 survived HCT but died later. Two of the deceased patients had been diagnosed based on NBS, and neither survived their first BMT.

HCT donor sources reported for the 132 initial HCT treated patients with SCID included mismatched related donors (MMRD)/haploidentical transplant most commonly (45%), but matched unrelated donor (MUD) (27%), matched related donor (MRD) (14%), and umbilical cord blood (UCB) (13%) were all also used. Three respondents did not recall the donor source. Pre-HCT conditioning or immunotherapy was recalled in 55%.

Of the 132 patients treated with HCT initially, 27 required additional treatment with a boost (infusion of additional donor stem cells with no chemotherapy) or second HCT (stem cells from a different donor or the same donor but with chemotherapy) (Figure 2). The specific treatments were not specified, but 20 patients received one additional cell therapy, 5 received 2, and one each received 3 and 4. In addition, 7 patients were treated with GT after their initial HCT. The median time since most recent HCT in surviving patients was 5.5 years (range 0–42 years).

Twenty-six patients had received GT for: deficient ADA (n=12), IL2RG (n=10), and DCLRE1C (Artemis) (n=4); in 19 this was their initial therapy for SCID. Two of these were treated with GT twice. All patients who received GT were enrolled in a clinical research trial. Despite 42% of GT patients having severe infections prior to GT, survival following GT was 100%, with median time since most recent GT of 3.25 years (range 0.2 to 28.6 years). Some form of conditioning was given prior to 80% of GT treatments.

Ages of the 136 living patients with SCID at the time of the survey were: 18 under 2 years, 32 were 2 to <5 years, 31 were 5 to 10 years, 27 were 11 to 20 years, 20 were 21 to 30 years, and 8 were 31 to 42 years. Of the patients who were under 10 years of age at the time of the survey 74% were diagnosed via SCID NBS. Of the patients alive at the time of the survey 69% were male.

3.2 Caregiver Recollections of Their Expectations and Counseling Received

The meaning of cure—To determine what “cure” meant to caregivers, respondents were provided three possible answers from which to choose: 1) My child would be completely “normal”; 2) My child would live, but would need life-long treatment such as IgG replacement therapy; or 3) Other. This question was answered by 61 respondents but left blank by 90. Of the 61, nearly half believed that cure meant their child would be completely normal, and a third believed that life-long treatment such as immunoglobulin replacement would be necessary. The remaining who chose “Other” indicated in written comments that they understood that their child could need lifelong therapy. Five understood possible (but not definite) need for IgG replacement after HCT. One wrote that lifelong monitoring would be needed; one stated that there is no cure; and one wrote, “In the absence of complications, e.g., graft vs host disease (GVHD), and with immune response from later given vaccinations and exposure, it was very likely that our child would live a normal/healthy life”.

Counseling prior to Treatment—When caregivers were asked for their recollection of counseling regarding HCT as therapy for SCID, 49/132 (37%) reported that they were counseled that it would lead to “cure” of SCID, and 57/132 (43%) reported they were counseled that HCT would last for the lifetime of their child. Twenty-six left the question unanswered. We assessed differences based on era of transplant; there was no difference

over time when four decades were considered (1977–1990; 1991–2000; 2001–2010; 2011–2019; Supplemental Table 1). Those who reported having been counseled that HCT would lead to cure were asked to list the source of this information and instructed to choose one or more options. A clinical immunologist was cited by 71%, a transplant specialist by 15%, a pediatrician by 31%, and a nurse by 2%, reflecting that caregivers receive counseling from multiple sources prior to HCT.

When caregivers were asked their recollection of counseling regarding GT as therapy for SCID, 8/26 (31%) reported that they were counseled that GT would lead to “cure” of SCID, and 13/26 (50%) reported they were counseled that GT would last for the lifetime of their child. Five left the question unanswered. Of those who reported that they were counseled that GT would lead to cure, equal numbers reported that this information was provided by a clinical immunologist vs. a transplant specialist.

In terms of genetic counseling regarding the risk for children of SCID patients to be affected with SCID or to be carriers of SCID, the majority of respondents reported that they were counseled at some point that there was a risk of the SCID patient passing the genetic defect to future generations. However, 15% reported that the risk of SCID in future offspring was never discussed and 4% reported being counseled that SCID or SCID carrier status could not be passed on to future generations.

Long term follow-up—Regarding long-term medical follow-up and immune surveillance, of those treated with HCT, 81% (n=107) reported they had been advised of expectations for follow-up reassessments that ranged from a minimum of 3 years post-transplant to life-long. Nineteen percent reported that they were not given recommendations concerning the duration of periodic immunologic re-evaluations following HCT. For those treated with GT, 62% recalled being told that immunology follow-up would be needed for a minimum of 15 years post-therapy to life-long reassessments, while 38% reported that they were not given recommendations for the duration of immunologic re-evaluation following GT.

3.3 Current health status and Medical Needs

Current Health Status: Comparison to Expectations—In the subgroup of 136 surviving SCID patients, 59% of respondents reported that the SCID patient’s current health status was better than they had expected it would be at the time therapy was given, 33% reported the current health status was about the same as expected, and 7% reported the current health status was worse than expected. Table 2 illustrates representative comments by survey participants contrasting their expectations with the actuality of the SCID patient’s post-treatment health status.

Current Medical Therapy Needs at least 2 years after HCT/GT—Survival to 2 years after HCT is considered the threshold at which surviving patients with persistent medical issues can be considered to have late effects of the therapy. Of 105 patients at least 2 years from their last HCT or GT, 66 indicated a continued need for ongoing medical treatments; 52% were receiving IgG replacement, 15% antibiotic prophylaxis (antibiotic prophylaxis and immunoglobulin n=14, antibiotic prophylaxis alone n=2), 3% antiviral prophylaxis, 1% on antifungal prophylaxis. Ten percent required antibiotics for infection,

while 5% received treatment for GVHD. Of the 14 respondents regarding patients with ADA SCID at least 2 years from last HCT or GT, three stated that the patients were on enzyme replacement therapy at the time of the survey; two reported that they had not been counseled that the patients' HCT or GT would lead to cure, while one could not recall counseling with regard to cure.

When these data were considered in the context of the caregiver's report of having been told the treatment would "cure" their child, of the 92 patients treated with HCT who were at least 2 years from treatment at the time of the survey, most (53%) reported that they were not counseled that treatment would lead to cure, while the remainder reported that they either were counseled that treatment would lead to cure (32%) , or did not recall whether or not they were counseled that treatment would lead to cure (15%). Similarly, of the 13 patients treated with GT, most (54%) reported that they were not counseled that treatment would lead to cure, while the remainder reported that they either were counseled that treatment would lead to cure (23%), or did not recall whether or not they were counseled that treatment would lead to cure (23%). Most caregivers whose children with SCID continued to require therapy reported that they were not counseled that treatment would lead to cure (Figure 3A).

Current Physical Challenges and Functional Status at least 2 years after HCT/GT—A majority (65%; n=68) reported that the SCID patient continued to have health challenges more than two years out from transplant. Slow growth (21%; n=22) and infectious symptoms (sinusitis 20% (n=21), warts 13% (n=14)) were the most common challenges. The patients in this cohort also had challenges with pulmonary disease (11%; n=12), chronic GVHD (5%; n=5), and declining immunity (8%; n=8). Warts were reported only in patients with IL2RG, JAK3 and ADA deficient SCID. The majority of patients with reported declining immunity had IL2RG deficient SCID. This was 13% (n=6) of the IL2RG patients over 2 years from transplant; the genotypes of other patients with this concern included Artemis, RAG1/2 and PAX1. Most caregivers whose children with SCID continued to have challenges reported that they were either not counseled that treatment would lead to cure or could not recall counseling given with regard to treatment leading to cure (Figure 3B).

In addition to immune impairment, 37% (n=39) of patients were reported to have other health challenges, including neurologic issues (attention deficit disorders, depression, developmental delays, headaches, hearing impairment, obsessive compulsive disorder seizures, speech and language delay, stroke); endocrine issues (adrenal insufficiency, diabetes, thyroid disease); skin conditions (eczema, hives, scleroderma); and others (anemia, autoimmune disease, chronic kidney disease, cardiac disease, chronic diarrhea, scoliosis). Five percent were awaiting another cellular therapy.

When asked to compare the behavior of their child with SCID to other children of the same age, 89% of parents reported their SCID child to have good to excellent behavior compared to age matched peers. There was no predominant SCID genotype among those reported to have fair to poor behavior compared to age matched peers.

Although the majority (92%) of responses for patients who were at least 2 years from last treatment at the time of the survey indicated that the patient with SCID was currently in school or employed, some were either still in isolation or not of school age (Table 3).

4. Discussion

With newborn screening for SCID being performed in all 50 states in the U.S. as of December 2018, virtually all affected infants can be identified and referred to treatment centers promptly; but, because SCID is rare, some providers may have limited experience in the diagnosis, early management and long term follow up needs for this population. It is essential that the clinical immunologist and transplant specialist explain to families the urgency for treatment in infancy, but also discuss the possibility that even after an initial transplant further HCT or GT treatment may be needed, that continued medical therapy may be needed and that lifelong follow-up is important[7,14]. In addition, limitations of the family's ability to receive complex information at the stressful time of receiving a serious diagnosis should be taken into consideration[15–17]. When shared early on and reiterated throughout the management discussions for patients with SCID, information about the potential need for future therapies could help manage caregivers' expectations. Unfortunately, this information may not be presented in a way that can be fully comprehended and remembered, and the literature regarding the experiences of patients with SCID and their families during the years following immune restoring treatments is sparse[15,17]. In one report, patient perceptions of health-related quality of life (HR-QOL) were reported to vary by genotype, with patients with Artemis and RAG1/2 deficiency having lower HR-QOL scores than the general population, but those with IL-7Ra deficiency having comparable scores to the general population. When presence of ongoing medical issues was taken into account, scores of those without ongoing medical issues of either genotype were similar to the general population[18].

Our survey collected subjective recollections of what caregivers were told about predicted long-term outcomes of a transplant for their child with SCID. The responses indicated that caregivers' expectations often, but not always matched the actual events that they experienced. Most thought one treatment would be adequate; this was indeed the case for the majority, but 20% of survey respondents reported that the SCID patient needed more than one HCT, and 5% required further HCT or GT. Of those who required additional treatments after first HCT, 26% reported that they had been told that the initial and subsequent treatments would last a lifetime. Few families anticipated that treatment with additional cell therapies might be necessary.

Families need to understand that even when their child is doing well, his or her immune function and overall status needs to be monitored and recorded. More than 31% of the caregivers of recipients of HCT and GT for SCID reported a recollection of hearing that current therapies for SCID, if implemented early, before the onset of life-threatening infections, would lead to a "cure." The word cure may have had different meanings to different people, so establishing a definition before treatment begins is imperative for better understanding by all involved. Additionally, 50% of the caregivers who supplied an answer reported having been counseled to believe that the treatment for SCID, either by HCT or GT,

would last a lifetime. The majority of respondents reported that the SCID patient's current health status was about the same or better than they had expected it would be at the time therapy was given. However, recall of recommendations for immunologic re-evaluation was inconsistent, and a small number of patients (15%) reported receiving no guidance in this area. Additionally, improvement is needed in the consistency of genetic counseling provided to caregivers since 20% percent reported that there was not clarity in counseling regarding risk of passing the SCID genotype on to future generations.

Our results were limited by the survey method, which was subject to recall bias and did not require all participants to answer every question. This led to some questions being left unanswered by a sizable minority of participants. In addition, the participant pool was limited to those who had signed up to be included in the databases of the SCID Angels and IDF, which selected for families who participate in patient advocacy groups, rather than an unbiased recruitment strategy. We have noted that families diagnosed through NBS have tended to stay connected to the support groups for about 3 to 4 years while they are seeking treatment, waiting for immune reconstitution and undertaking the initial adventures out into the real world; but then they tend to be less involved as they adapt to their new lifestyle outside of SCID. Another cohort active in the support groups are older individuals with SCID, teenagers or adults who never regained full immune reconstitution or whose immunity has waned. These patients are now seeking additional treatment and reach out for additional guidance and support along their journey.

This study did not address what clinicians actually said, but as with many areas of medical communication there may be a disconnect between what clinicians thought they said and what families recalled hearing. It is important to develop better ways to communicate. Indeed, physician communication skills have been reported to correlate with patient satisfaction[19,20]. It is striking that even for those who received GT in the setting of participation in a clinical trial, the recollection of counseling was similar to that of HCT recipients, considered the standard therapy for SCID. In the setting of clinical research, clear communication of the limitations of investigational therapies is both clinically and ethically paramount. However, differences in recollections of conversations regarding consent compared to the consent document itself, have been reported, indicating that communication at the time of consent may not always convey the intended content[17]. Additionally, training in improved communication techniques in the clinical setting for physicians has been demonstrated in some areas to improve patient health literacy and in turn, medical outcomes. [21]. Facing a serious diagnosis in an infant requiring urgent treatment is a difficult time for communication of detailed information about the future, and caregivers are unlikely to understand the complicated and unfamiliar concepts in a single meeting[15]. Communicating these concepts with the family repeatedly over time, while the process is ongoing, is likely to be more successful for both the clinician and the family. Evidence-based guidelines for the long-term follow-up of patients following HCT or GT for SCID could standardize long-term follow-up and facilitate each family's ability to understand the health status of their child with SCID, as well as learn of progress in the field. In addition, there are supportive resources available through patient advocacy groups, such as SCID Angles for Life Foundation and the Immune Deficiency Foundation that can be utilized to facilitate these discussions. As more data detailing the late outcomes for SCID following

HCT and GT become available, those who are counseling families should understand and communicate in detail to the family what the expectations are for the SCID journey during each of the following phases: diagnosis; pre-treatment; treatment; post-treatment; and life at home, noting special attention to symptoms that may indicate waning immunity, need for longitudinal clinical and laboratory testing, and late complications.[14,21,22]

5. Conclusions

In the era of SCID NBS, infants with SCID are being diagnosed early postnatally before developing clinical symptoms. Parents with no prior experience with SCID are suddenly faced with having a child who may appear healthy, but have a life-threatening disease requiring strict isolation from germs and an urgent bone marrow transplant or gene therapy. It is important for the treatment team--the immunologist, transplant physician, nurse, social worker, and genetic counselor caring for the infant with SCID--to deliver clearly communicated, consistent counseling over several sessions, before and after the transplant, allowing for families to express what they understand, and tailoring information to the family accordingly. Providing written materials for reference can also be helpful. While it may be tempting to use the term “cure” in relation to SCID, the reality of the need for continued medical evaluations and potential additional cell therapies can lead to a perception of broken promises for those who perceived “cure” to mean a life completely free of health concerns. Patient advocacy groups can work collaboratively with immunologists and transplant physicians to help develop effective tools for communication of likely outcomes of HCT and GT for the treatment of SCID. Improved guidelines and clear communication to caregivers and patients regarding the importance of lifelong follow-up, no matter the treatment outcome, will help to ensure that patient health and quality of life can be optimized.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

ERT	Enzyme Replacement Therapy
FH	Family History

GT	Gene Therapy
HSCT	Hematopoietic Stem Cell Transplant
NBS	Newborn Screening
PIDTC	Primary Immunodeficiency Treatment Consortium
SCID	Severe Combined Immunodeficiency

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Highlights

- Parent's expectations regarding long-term outcome post hematopoietic cell transplantation (HCT) for patients with severe combined immunodeficiency (SCID) may differ from what the health care team intended to communicate.
- In communication with parents of children undergoing treatment for SCID, health care providers need to emphasize the possible need for additional therapies and ongoing treatments following HCT.
- Appropriate counseling is important throughout each phase of the journey through treatment experienced by children with SCID and their parents.
- Lifelong medical follow-up for patients with SCID is essential to recognize and manage late adverse outcomes.

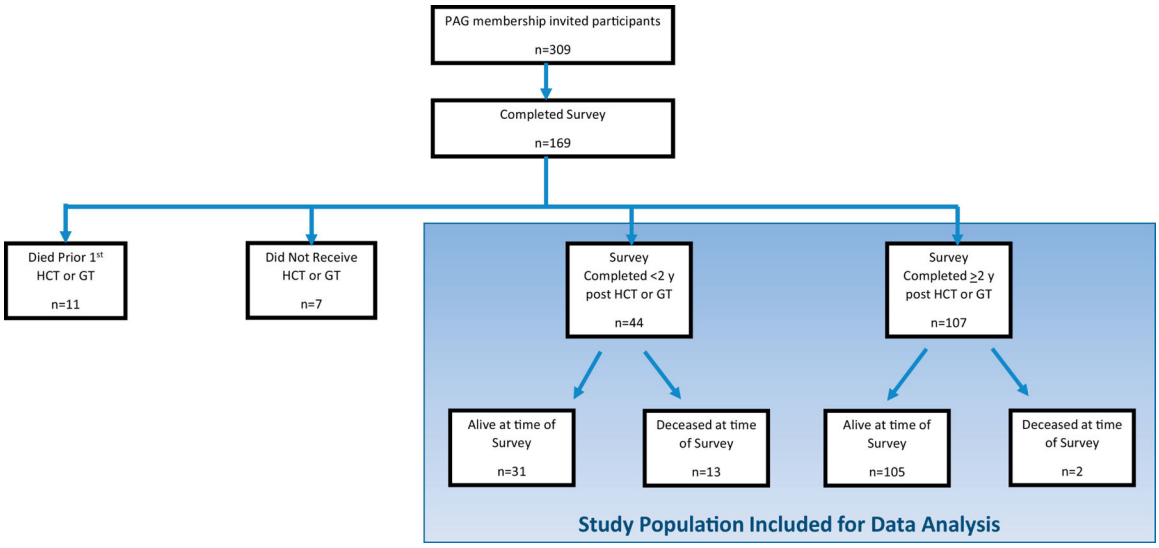

Figure 1: Study Population.

Legend: 309 potential participants were identified from patient advocacy group databases; 169 completed the survey. Those who had died prior to receiving HCT or GT or who had never received HCT or GT were excluded from analysis. Of the 151 subjects analyzed, 107 had survived to at least 2 years after HCT or GT.

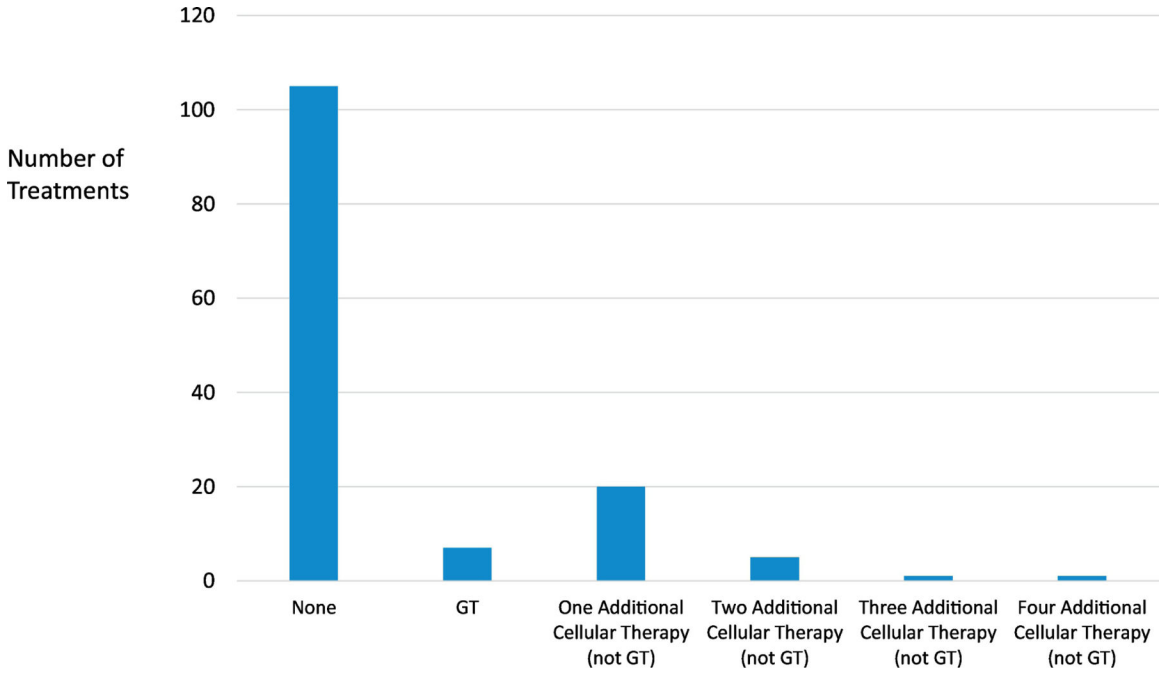

Figure 2. Additional Treatments after Initial HCT.

132 patients were initially treated with HCT. Of these, 105 required no further treatment, while 7 were treated with GT, 20 received 1 additional therapy, 5 received 2 additional therapies, and one each received 3 and 4 additional therapies.

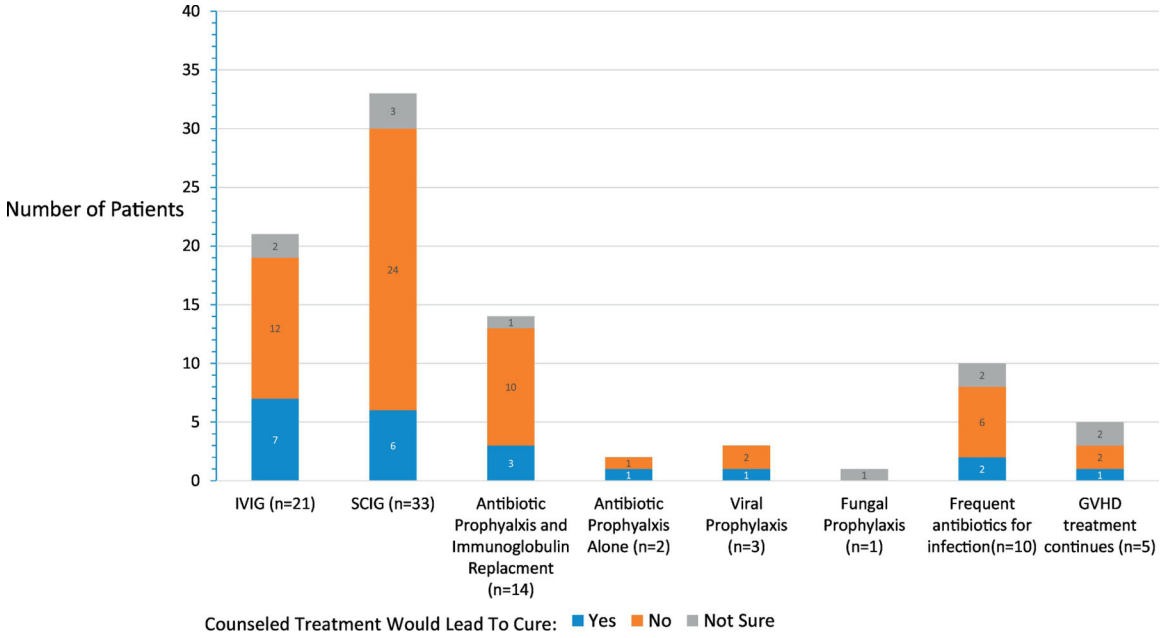

Figure 3A. Number of Caregivers Counseled that Treatment Would Lead to Cure by Subgroup Receiving Listed Therapies.

Depiction of patients on immunoglobulin replacement, antibiotic prophyalxis, viral prophylaxis, fungal prophylaxis, in need of frequent antibiotics for infection or continued GVHD therapy stratified by recollection of being counseled that treatment would lead to cure.

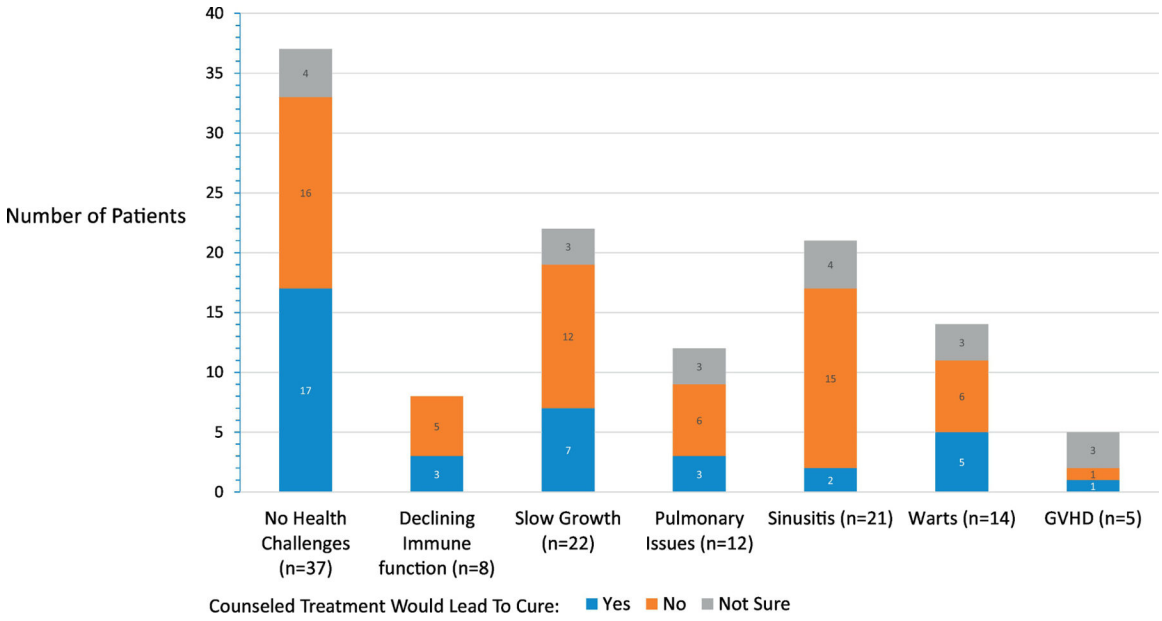

Figure 3B. Number of Caregivers Counseled that Treatment would Lead to "Cure" by Subgroup Experiencing Health Challenges after Two Years from Treatment.

Depiction of patients with no health challenges, those with declining immune function, slow growth, pulmonary issues, sinusitis, warts or GVHD stratified by recollection of being counseled that treatment would lead to cure.

Table 1:

SCID Cohort Characteristics

Sex (n=151)	105 male (70%)	
Proportion who had newborn screening (n=151)	63 (42%)	
Age (years) of survivors (n=136) at time of survey	<2	18 (13%)
	2 – 5	32 (24%)
	5 – 10	31 (23%)
	10 – 20	27 (20%)
	20 – 30	20 (15%)
	30 – 42	8 (6%)
Age (years) of survivors (n=61) at time of survey who had been diagnosed by newborn screening	<2	17 (28%)
	2 – 5	28 (46%)
	5 – 10	15 (24%)
	11	1 (2%)
Median age and range (years) of patients with SCID responding for themselves (n=6)	31.5 (range 20 – 42)	
Median age and range (years) of patients with SCID for whom a parent or caregiver responded (n=146)	5 (range 0–36)	

Table 2:

Parent Quotes Stratified by Meeting or Not Meeting Expectations

Expectations Met
“I assumed that my child would struggle with illness through his first couple of years outside of isolation… especially for the first few years in preschool. However, overall, my son has been the healthiest of my three children.”
“Meeting our son today, you would never know that our son had any medical treatment, let alone a BMT[*] as a baby.”
“He is engrafting very well, no hospitalizations since the first couple of weeks after transplant, no infections other than *C. diff.*, no fevers or colds. Overall, he is doing very well!”
“He’s done very well for 23 years. It was not until recently that his numbers have started to decline. This was always a possibility in the back of my mind.”
“My first expectations were based off outcomes prior to the newborn screening. Since my son was treated before illness, he has done better than I initially expected.”
“He was the 13th person in our family to have the disorder but the first to live past the age of two. We were all pleasantly surprised.”
Expectations Not Met
“I really just remember praying he would survive. But once he was through the transplant, I was expecting him not to need IVIG[**] and that was not the case.”
“His BMT was successful, however, he developed complications thought to be from cytoxin, liver engorged, ascites, which lead on to multisystem failure in ICU.”
“Our little one has normal counts of B-cells so we assumed he wouldn’t need SCIG[***], now we are finding out it is because all those B-cells are his and don’t function properly because of the SCID, that he will need IgG replacement for life.”
“Our son has been diagnosed with a chronic lung disease that we believe is a result of the chemo he received. He was diagnosed 12 years post-transplant, so it was completely unexpected.”
“Other medical problems arising from the transplant caused developmental delay which was unexpected.”
“His health is better than it was prior to transplant; so, in that sense it is better than expected. However, as the years go on a few new things pop-up which is worse than expected from the years before.”

*Bone marrow transplant, HCT

**Intravenous immunoglobulin infusions

***Subcutaneous immunoglobulin infusions

Table 3:

School enrollment/employment for those at least 2 years post last treatment

Age range (years)	Pre-K	K-12	2 year college	4 year college	Part time job	Concurrent school and employment	Full time job	Not in school or work	Other
2–4 (n=25)	12	1						7	7
5–17 (n=47)	24	21						1	2
18–23 (n=16)		2	3	4	2	4	2	1	2
>23 (n=19)			1	1	2	1	12		4*

*One each of MBA; Army, West Point graduate; Adult stay-at-home parent; attending medical daycare facility)

Table 4:

Challenges and Suggested Future Directions of Study and Patient Care

Challenge	Suggested Intervention/Future Studies
Counseling regarding potential diagnosis, treatment and long-term outcome of definitive therapies is given to families of infants with SCID diagnosed via NBS at a time of high stress.	Providers should consider delivering counseling over several sessions, with visual aids or written/tangible educational materials that have been developed in cooperation with patient representatives or patient advocacy groups. The efficacy of this approach should be monitored to document caregiver perceptions of the counseling received.
Currently there is no direct assessment of caregiver understanding of counseling given.	Caregivers could consider using standardized questions immediately after counseling and at later times to ensure that the intended message was received and understood by the caregiver or patient.
Caregivers and adult SCID patients have not always recognized the need for long term, life-long follow-up and may need guidance where to seek this follow-up.	There is a critical need to maintain long-term care throughout childhood and to develop transition programs with expertise in post-transplant evaluation to improve the ability of patients to transition from pediatric-focused to adult-care focused centers.