



Ethical issues involving fertility preservation for transgender youth

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Abstract

Purpose To investigate ethical issues associated with fertility preservation (FP) in transgender youth based on reports of patients and their parents.

Methods Our qualitative study involved in-person interviews with 54 subjects (35 patients and 19 parents). Interviews were audio recorded, transcribed, and verified. Each subject completed a demographic questionnaire, and each patient's medical chart was reviewed for additional information. We analyzed the data using inductive thematic content analysis.

Results Themes that emerged included a range of desires and ambivalence about having genetically related children, variability in understanding the potentially irreversible impact of gender affirming hormones (GAHs) on fertility, use of adoption, and the impact of age on decision-making. Subjects (patients and parents) noted barriers to FP, such as cost and insurance coverage. Several parents expressed concern that their transgender children may have future regret about not attempting FP. Both transgender youth and their parents felt FP was an important precaution.

Conclusions Our study took advantage of the richness of personal narratives to identify ongoing ethical issues associated with fertility preservation in transgender youth. Transgender youth and their parents did not fully understand the process of FP, especially regarding the effects of GAHs, had fears that FP could reactivate gender dysphoria, and noted barriers to FP, such as cost, highlighting economic disparity and lack of justice. These findings highlight ethical issues involving the adequacy of informed consent and economic injustice in access to FP despite expressed interest in the topic.

Keywords Transgender · Transgender youth · Fertility preservation · Ethics · Pediatrics · Justice

Introduction

Fertility preservation (FP) has become a major ethical issue in the care of transgender youth [1–3]. Historically, professionals, patients, and families accepted loss of fertility “as the price to pay for transitioning” [4]. However, studies have shown that many transgender adults want children and would have considered FP had it been offered [5, 6]. Additionally, transgender adults who have children score higher on self-perceived mental health and vitality inventories [6]. Current guidelines from professional organizations, including the World Professional Association for Transgender Health

(WPATH) and the Endocrine Society, recommend fertility counseling before medical gender transition [7, 8]. No clear guidelines or standard practices for fertility preservation counseling exist for transgender youth.

Many factors complicate FP for transgender youth. Pubertal status at the time of FP affects its effectiveness, making FP options different for pre- and peri-pubertal patients compared with adults. Post-pubertal transgender youth can cryopreserve gametes (sperm or eggs) before initiating testosterone or estrogen. Peri-pubertal transgender youth may be able to cryopreserve gametes; however, no proven clinical or biochemical markers reliably indicate the presence of mature gametes [9–11]. Pre-pubertal individuals can have gonadal sections surgically removed and frozen; research on in vitro human gamete maturation is ongoing [12, 13].

Moreover, the medications used in the care of transgender youth may harm fertility. These include a gonadotropin-releasing hormone agonist (GnRHa), which “blocks” puberty and may be started before age 10, as well as gender affirming hormones (GAH), given as early as 13–14 years of age [7]. The effects of these agents on future fertility are still being

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investigated [14]. While GnRHa therapy in patients with central precocious puberty (CPP) does not reduce fertility [15], individuals with CPP were likely exposed to more endogenous sex hormone than transgender children before beginning GnRHa treatment, and children with CPP eventually stop taking GnRHa and undergo assigned-gender puberty, allowing their gametes to mature. For transgender youth, pre- or peripubertal GnRHa followed by GAHs may prevent full maturation of gametes with resultant infertility.

Data on the effects of GAHs on fertility in transgender adults show mixed results, with variable impact on gonad and gamete histology, morphology, and function [16–22]. Some of these effects may reverse with cessation of GAHs [19]. Only one study investigated the impact of GAHs on live births, finding that 84% of transgender individuals treated with testosterone could conceive using their own oocytes, with up to 20% using some form of assisted reproductive technology [23]. Many fertility studies in transgender individuals have significant limitations, including small sample size, lack of control groups, and variable dosing, route of administration, and duration of GAH use [19]. Additionally, FP outcomes in transgender adults do not apply to transgender youth as unlike their adult counterparts, many transgender youth do not undergo assigned-gender puberty.

To date, only a few studies have investigated the use of FP in transgender youth; they found a few patients enrolled in the process (2.8 and 4.8%) [24, 25]. Thus, up to 95% of transgender children undergoing medical treatment could experience permanent sterility. This raises concerns, given the findings that transgender adults regret not being able to have biological children [26, 27].

Transgender youth might not avail themselves of fertility preservation for many reasons. These include distress over the use and effects of assigned gender hormones during the preservation process; production of gametes of the assigned gender; dysphoria with the anatomic area involved or the procedures; the patients' immature decision-making or inability to consider the future; cost or lack of insurance coverage; invasiveness of gamete retrieval; lack of knowledge about how to access FP services; potential delay in gender affirming treatment; and mood disorders affecting decision-making [24, 26–32]. One study found that most transgender youth want children; however, only a quarter want genetically related children [33]. Another study found that transgender youth considered FP a low current and future priority [31].

The above considerations raise several ethical concerns [1–3]. It can be difficult to promote patient autonomy as well as shared decision-making with parents, posing special challenges, as FP can be emotionally charged and in some instances experimental, requiring parental permission and assent from a minor patient [34]. Medical professionals want to act

beneficently (i.e. “do good”) by providing options for transgender youth to maintain an “open future” for them. However, providers also want to act in a non-maleficent manner (i.e. “do no harm”), and prolonging initiation of GAHs for FP can cause emotional distress [24, 27, 28]. Some transgender individuals view medical professionals as gatekeepers who require FP prior to transitioning, thereby negating patient autonomy [35]. Justice considerations also arise, as lack of insurance coverage, high out-of-pocket expenses, or differences in state legislation [36] may limit access to FP.

Our study utilizes a narrative-based approach to explore the ethical issues surrounding FP in transgender youth from the perspectives of patients and their parents. Narrative-based, qualitative research is uniquely suited to the field of ethics as it allows each interviewee to discuss their experiences in their own words, providing a rich personal narrative through which to investigate ethical issues. Other studies have investigated perspectives on FP in transgender youth and their parents using a questionnaire-based approach or solely in transgender youth using an interview-based approach, but there are no studies using an interview-based approach in both populations [31, 32]. Moreover, our study does not solely focus on the perspectives of transgender youth and their parents but uses those perspectives to highlight the ethical issues surrounding FP.

Methods

Recruitment

The institutional review board at Ann & Robert H. Lurie Children's Hospital of Chicago approved the study. We recruited subjects (transgender youth and their parents) from the pediatric transgender clinic at Lurie Children's Hospital between December 2016 and May 2017. Subjects qualified for the study if they, or their children, received care at the Gender Development Clinic. We only included English-speaking subjects. The patient's practitioner described the study to potential subjects, and a study team member (RMH) reviewed the consent and assent forms with interested participants, obtaining appropriate permission before proceeding with the study.

Participants

A total of 54 subjects participated in the study (35 patients and 19 parents). The demographics of the subjects appear in Table 1. All patients identified as transgender. Patients' ages ranged from 14 to 23, with an average of 17 years. Eight identified as female, 20 as male, 4 as transmasculine, 2 as transfeminine, and 1 as agender. Five patients were not yet receiving medical

Table 1 Patient demographics

Patient (n=35)			
Age (years)		Living location*	
Min	14	Urban	n=4
Max	23	Suburban	n=11
Average	17	Rural	n=1
Gender		Household income*	
Female	n=8	<\$25,000	n=4
Male	n=20	\$25,001-\$50,000	n=3
Transmasculine	n=4	\$50,001-\$75,000	n=2
Transfeminine	n=2	\$75,001-\$100,000	n=3
Agender	n=1	>\$100,001	n=2
		Data not obtained	n=2
Language		Marital status*	
English	n=34	Single	n=16
English & Spanish	n=1		
Adopted[†]		Birth country*	
Yes	n=8	USA	n=16
Unknown	n=27		
Grade in school		Medical management	
8th	n=1	None	n=5
9th	n=4	GnRH agonist	n=1
10th	n=4	Estrogen	n=8
11th	n=7	Testosterone	n=21
12th	n=2	Average time on estrogen or testosterone	13.5 months
High school or equivalent	n=4	Fertility preservation (FP)	
Some college	n=11	FP not discussed	n=10
Vocational school	n=1	FP discussed but consult not completed	n=19
Bachelor's degree	n=1	FP consult completed	n=3
		Preserved eggs	n=1
		Preserved sperm	n=2
Race*		Mental health co-occurrences	
Caucasian/White	n=12	Anxiety	n=3
Hispanic	n=1	Depression	n=8
Multi-racial	n=2	Anxiety & depression	n=16
Would rather not say	n=1	Bipolar	n=1
		None	n=6
		Data not obtained	n=1

*Demographic questions only solicited from subjects >18 yo (n=16)

[†]Data obtained from medical chart

Table 2 Parent demographics

Parent/legal guardian (<i>n</i> = 19)			
Age (years)		Living location	
Min	42	Urban	<i>n</i> = 1
Max	57	Suburban	<i>n</i> = 17
Average	50	Rural	<i>n</i> = 1
Gender		Household income	
Female	<i>n</i> = 16	< \$25,000	<i>n</i> = 2
Male	<i>n</i> = 3	\$25,001–\$50,000	<i>n</i> = 4
		\$50,001–\$75,000	<i>n</i> = 4
Language	<i>n</i> = 19	\$75,001–\$100,000	<i>n</i> = 3
		> \$100,001	<i>n</i> = 6
Grade in school		Marital status	
Some college	<i>n</i> = 7	Divorced	<i>n</i> = 5
Bachelor's degree	<i>n</i> = 2	Married	<i>n</i> = 11
Master's degree	<i>n</i> = 6	Separated	<i>n</i> = 1
Professional degree/doctorate	<i>n</i> = 4	Single	<i>n</i> = 2
Race		Birth country	
Black	<i>n</i> = 1	USA	<i>n</i> = 17
Caucasian/White	<i>n</i> = 13	Not USA	<i>n</i> = 2
Hispanic	<i>n</i> = 4		
Multi-racial	<i>n</i> = 1		

treatment, 1 was on a GnRHa alone, 8 were on estradiol, and 21 were on testosterone. Of the parents, 16 were female and 3 were male. The average parental age was 50 with a range from 42 to 57 years (Table 2).

Data collection

Subjects were assigned a unique identifier to maintain anonymity and completed a demographic questionnaire before the interview. Two demographic questionnaires were available based on the participant's age, with the age of majority (18 years) as the threshold. In-person, one-on-one semi-structured interviews were conducted by a single study team member (RMH). Different interview scripts were used depending on whether the subject was a patient or parent and patients' stage in their medical treatment (no treatment, GnRHa, or GAHs). Interview questions were open-ended and were grouped in several key areas: (1) gender identity, (2) social/psychological, (3) medical treatment, (4) decision-making, and (5) reproductive health. Interviews took between 10 and 45 min and were audio recorded. The audio recordings were transcribed professionally and were verified by a study team member (RMH). The subject's medical chart was reviewed for further demographic information.

Data analysis

Data were analyzed using inductive thematic content analysis [37]. A coding tree was created based on themes and sub-themes identified in the transcripts. Each transcript was reviewed by two of the authors to create the coding tree. Disputes about appropriate codes were mediated by the third author. Each transcript was then coded using Dedoose [38], an online qualitative software program. Two of the three authors coded each transcript; disagreements were resolved by discussion and third coder mediation. Representative quotes from the themes and sub-themes appear below.

Results

Identified themes include a range of desires for genetically related children, variability in understanding the potential irreversible impact of GAHs on fertility, specific barriers to FP, the use of adoption/alternative reproductive options, FP as a precaution, parental concern about future regret, and the impact of age on decision-making.

The desire for genetically related children among transgender youth varied (Table 3). Out of the 35 transgender patients, 13/35 (37%) said they wanted children, 5/35 (14%) did not want children, and 17/35 (49%) were not sure. Some subjects clearly stated their desire for genetically related children. Others expressed desire for children but did not specify whether they wanted genetically related children. For subjects who did not want children, two sub-themes emerged: (1) an inability to picture or imagine having children in the future and (2) concern over passing on their genetic material to their children, specifically regarding passing on mental health issues. Parents also expressed an understanding of why their children did not want their own children in the future.

Many patients understood and could articulate the likelihood that GAHs irreversibly impact fertility (Table 4). Parents were also able to express their understanding of the potential irreversible impact of GAHs on future fertility. Some patients and parents discussed the potential reversibility of GAHs on fertility. Other patients and parents thought that the effects of GAHs on fertility were fully reversible.

Several sub-themes emerged as barriers to FP including cost, dysphoria, and the desire not to delay or stop GAHs (Table 5). Some patients and parents discussed the first sub-theme, cost, as a significant deterrent. Often cost came up in relation to egg preservation as opposed to sperm preservation. Issues such as the cost of storage and the use of insurance were also discussed. Other patients felt that with the help of their families or insurance, they could afford the cost of FP. Some parents expressed the importance of FP and that the cost would be manageable. Dysphoria, the second sub-theme that emerged as a barrier to FP, was discussed in several ways.

Table 3 Range of desire for children in the future

Theme	Representative quotes
Desire for children	<p>“I just feel like I would want to have a child that’s biologically mine.”—14 yo</p> <p>“Well, I’ve always thought about having kids because every time I see a little kid at my school or something, I’ll be, like, oh, they are so cute. I work with kids up at my theatre because they do shows with the little kids and I help, like, direct the shows and stuff. I work with them and I like them. So I think I definitely want to have kids in my future.”—14 yo</p>
Lack of desire for children	<p>“I cannot even conceive of having kids because that’s part of a life that I have not come close to establishing.”—18 yo</p> <p>“I do not know. I cannot picture myself having kids...it’s just not something that I think about that often...” —15 yo</p> <p>“I do not want to have biological kids because I feel like I am kind of a sad man. I feel like my genes probably aren’t the healthiest to pass on. I mean, chronic depression runs in the family... I personally feel like I would not want to bring someone into the world just to have them suffer so much.” —19 yo</p> <p>“I thought about it and as far back as I can remember I never really wanted my own kids just because I know all the health things and my family -- just with me personally -- and if I were to see a kid go through that and know that it was genetically from me, I’d feel really bad about that.” —19 yo</p>
Parental understanding of lack of desire for children	<p>“I always assumed he would have kids. Then when he came out as transgender and really - and the comments that he made in the past about not wanting to have kids became crystal clear to me. It was, like, oh, this is why. So I was okay letting that dream go...” —44 yo mother</p>

Table 4 Variable understanding of the effects of GAHs on fertility

Theme	Representative quotes
Irreversible	<p>“So I know there’s going to be, like, risk, like, I may not be able to have my cycle back and, like, have it be healthy enough for my eggs to reproduce. So I know that there is a risk that I may not be able to even have the option to have kids.”—17 yo</p> <p>“I know it can fully take away my ability to have kids, even if I choose to go off testosterone to have a child.”—19 yo</p> <p>“Testosterone has the possibility to just -- I do not know what the term would -- like, shoot all my eggs, I guess they said? So it would mean I would not be able to have my own kids.” —14 yo</p> <p>“The fact that this would probably mean that, you know, would become sterile and that biological children would not be possible then.” —46 yo mother</p> <p>“My understanding was that it would prevent him from having children significantly.”—51 yo father</p>
Potential for reversibility	<p>“...some people could stop testosterone and then would regain normal egg production but maybe some people would not.” —18 yo</p> <p>“And then I was thinking, well, testosterone that kind of stops periods so that means my reproductive organs are kind of, like, they are not dead, but they are kind of just hibernating...”—17 yo</p> <p>“They said that not necessarily it would make me infertile, but it would probably just be harder to conceive a child.”—20 yo</p> <p>“I think if he were to go off of it, there’s a chance he could naturally have a child someday...”—47 yo mother</p>
Fully reversible	<p>“...they [medical professionals] have given me quite a few options that make me feel a lot better about my decisions because I can always stop testosterone, get pregnant, have the child naturally.” —17 yo</p> <p>“...he could probably stop taking testosterone for a period of time and he would ovulate again and that he could have kids.” —53 yo father</p>

Table 5 Barriers to FP**Cost**

Cost prohibitive	<p>“I was a 15-year-old who had to decide whether or not he wanted to be sterile his whole life. I did not want my parents to have to pay thousands of dollars for me to keep my eggs, so I made the decision at 15 to be sterile my whole life. So it was a big, like, effect on my mental health...”—16 yo</p> <p>“I cannot afford to like harvest eggs or stuff like that. Like that’s so expensive. Like I would if I could but there’s no way.”—23 yo</p> <p>“... it’s expensive so then how would you pay for that mom? You do not have enough money to pay for egg storage and it gets expensive and then we’d have to pay for the harvest.’ And at the time, there was just no way.”—50 yo mother</p>
Cost not prohibitive	<p>“I think my family definitely could have helped out with it. I do not think it would have broken us financially, but I do imagine that for some other people yes, it could be.”—19 yo</p> <p>“Yeah. We discussed the cost. And a lot of things were very costly but thankfully we have really, really good insurance.”—16 yo</p> <p>“And we told him, again, do not worry about the cost if this is something you feel that strongly about, and actually his dad was very, really wanted him to do it. You know, so we told - because at first he was like it’s too expensive. We’re like take that out of the equation, you know, in your decision.”—53 yo mother</p>
Storage	<p>“Well, I had called a clinic and they said it was \$300 to see if my sperm was even worth freezing. Then it was another \$300 to do something else. Then it was \$600 a year or \$600 a month just to keep it frozen. I’m like, if I do not plan on having kids for at least 10 years, I do not really want to drop \$60,000 on a child that I might not even want.”—20 yo</p> <p>“The money is a deterrent, because I’m not sure how much insurance would’ve covered. I have no idea. And then there’s the whole thing of storing them in somebody’s freezer.”—54 yo mother</p>

Dysphoria

Pregnancy or birth	<p>“Definitely not giving birth to any kids because, like, hella dysphoria. Other than my boobs, there are not a lot of things I get physically dysphoric about, but anytime even the concept of pregnancy comes up, it makes me physically nauseous.”—18 yo</p> <p>“I would not have like a kid coming out of me. No. No thanks.”—19 yo</p> <p>“He has no interest in bearing a child with his own body. That’s so traumatic to him he cannot even think about it. So we are fine. If he’s sterile, he’s fine.”—44 yo mother</p> <p>“And I think, you know, it’s hard if you are 13 years old, and you know the last thing you want to think about is having your body be pregnant or something like that. So, I think for him it was almost repellant.”—54 yo mother</p>
Menstruation	<p>“I just think of like the fact that she [physician] told me like I would have to stop taking T for a while and then wait for like - so then I would start my period again, so that would be like really uncomfortable.”—16 yo</p> <p>“Like they said that you’d be bleeding heavily like for I do not know how long. You’d have to take like estrogen, which is like the opposite of what I would be wanting to take and all of that.”—19 yo</p>
Discordance between assigned and affirmed genders	<p>“... mentally I feel like I would be the mother of the child and I do not want that. The entire time I’d just be, like, well, I’m the mom, I’m the mom, I’m the mom. It just mentally would not keep me sane. I’d be, like, but I’m the mom and I just do not like that. I want to be the dad.”—16 yo</p> <p>“As someone who felt so male, it feels like a slap in the face to be reminded of any possibility of pregnancy.”—19 yo</p> <p>“...you are trans and you do not want to remember that you were born female so -- but then they are going in there and doing something that’s very obviously because you were born female.”—19 yo</p>

Stopping or delaying GAHs

Patient’s desire not to stop/delay GAHs	<p>“My thoughts just came to, like, I want to start testosterone and I do not mind if I do not have to have my own kid.”—14 yo</p> <p>“Yeah, I was so eager to get on that I did not want to wait. I think it was maybe somewhere between one and three months more to, sort of, have that little process happen. No, I was really eager to start. So, yeah, I did not.”—19 yo</p> <p>“I mean, it’s a question of how long can I take to not transition yet.”—19 yo</p> <p>“I just think of like the fact that she told me like I would have to stop taking T for a while...”—16 yo</p>
Parental understanding of youth’s desire to start/continue GAHs	<p>“At that stage, anything that delayed his progress was, probably felt sort of unacceptable.”—54 yo mother</p> <p>“He was having an issue with I want to have kids but I do not want to stop the testosterone just to harvest eggs...”—50 yo mother</p>

Table 6 Adoption/alternative reproductive options

Theme	Representative quotes
Patient desire to adopt	<p>“I would mostly want to adopt anyway, just because everybody is like, oh, there’s so many kids out there who needs homes and then everybody else is like, oh, let us go have our own kid and I’m -- but there’s perfectly good children who need families and you need a kid, so why do not you just go together?”—19 yo</p> <p>“...honestly I’d prefer it because I know that there are an abundance of children without homes. I personally do not believe that there is any, you know, difference in the love that you’d feel for a child that genetically belongs to you and to one that you have choose to care for and to raise and love.”—19 yo</p>
Parental understanding of desire to adopt	<p>“...we have talked about it and he seems very comfortable with, you know, there are lots of kids out there that need a mom and dad, you know, and I’m -- just because it’s not my biological [child] does not mean I cannot love him and bring him into my family. So, that, you know, he feels there’s other options if he does change his mind.”—53 yo mother</p>
Alternative reproductive options	<p>“I would want a sperm donor, but I have not even talked to my brother about it because I feel like I would want my brother to be my sperm donor, if it was okay with him, obviously. I feel like I would have to talk to the person I’m with and then my brother. If that’s okay with them and, like -- my brother’s probably the only the closest thing I have to me so I would definitely want him to be there for that.”—16 yo</p> <p>“We talked about it in the beginning and he said he wasn’t concerned about it, that he could always adopt. Or his girlfriend could just, you know, get a sperm donor or whatever.”—47 yo mother</p>

Some patients and parents expressed concern about dysphoria in relation to being pregnant or giving birth. Other areas of dysphoria included menstruation and discordance between assigned and affirmed genders. The third sub-theme that emerged as a barrier was the patient’s desire not to delay or stop GAHs, a concern also recognized by parents.

Many patients commented on their desire to adopt in the future (Table 6). Many parents also stated their child expressed a desire to adopt in the future and acknowledged that as a viable option. Several patients and parents discussed alternative reproductive options, specifically sperm donation. Several patients who were either thinking of undergoing FP or who already underwent FP highlighted its use as a precautionary measure in case they wanted the option of genetically related children in the future (Table 7). Parents also thought about FP as a way for their child to keep their options open in the future. Many parents expressed concern about regret in the future if FP was not completed. Transgender youth and their parents also discussed their concern about ability of youth to make future decisions.

Discussion

Many ethical issues surround FP for transgender youth including autonomy, providing an “open future,” informed consent, beneficence, non-maleficence, and justice. This study shows that transgender youth expressed a range of desire for having

children. Some indicated a wish to have genetically related children, while others stated they want children but did not specify whether they want *genetically related* children. Several youth in this study who said they did not want children discussed their inability to visualize that aspect of their future. However, the possibility of evolving attitudes remains, and their decisions may change with maturation and experience. The ethical issue that arises at the time when it is necessary to make FP decisions concerns autonomy. Can these minors make adequately autonomous decisions in the present that may impact their opportunities in the future? This is less a question of decision-making capacity, as by age 14 years most youth have fully developed logical thinking, than a matter of sufficient life experience to know their future desires. In our study, both transgender youth and their parents commented on FP as a precautionary measure. How to maintain an “open future” for transgender youth is a common concern of parents and healthcare professionals. Parents and healthcare professionals often express worry about the ability of adolescents to make future-oriented decisions. One study found that healthcare providers reported fewer than 12% of transgender patients, but over 65% of parents asked about the effects of gender-affirming medical care on fertility [39]. Such discrepancies validate concerns about the frequency with which transgender youth consider future fertility when making potentially irreversible medical decisions. The fact that some of the transgender youth in our study articulated forward thinking provides some reassurance; however, we did not quantify

Table 7 FP and planning for the future

Theme	Representative quotes
Patient's view of FP as a precautionary measure	<p>"It's something I would like to do just as a precautionary measure."—19 yo</p> <p>"I'm planning on banking sperm before I start any hormone blockers or estrogen just in the off chance that I decide I want kids and want to pass down my genes."—18 yo</p> <p>"I said I want that option. So I was 18, I got eggs removed before I started testosterone. So it's always an option for me and I'm really glad I did that."—20 yo</p> <p>"So I, before I started hormone and testosterone blockers I got my specimens frozen. So if I do want to have biological kids in the future, I have a choice."—17 yo</p>
Parental goal of keeping an open future	<p>"...when she's 28, 30 and she gets married she might want to have a child biologically as opposed to having an adoption. And I'd rather her have that option later on as opposed to not having the option at all... At least have the option, create the option for yourself as opposed to removing everything from the table."—48 yo mother</p>
Parental concern about future regret	<p>"I think - you never know what someone will think 10 years from now. Maybe 10 years from now, you know, he might wish that we had done egg harvesting. He might wish that, I do not know."—46 yo mother</p> <p>"Although I did tell him, you know, later in life things could change and you might change your mind, so."—53 yo father</p> <p>"It was more so at my urging because I said, well, what if one day she changes her mind and it's too late..."—48 yo mother</p> <p>"It makes you leery as a parent because you do not want your child to second-guess themselves and to regret their decision and that's such a young age, you know."—51 yo mother</p>
Ability to make future decisions	<p>"At the time, I did not think that it would ever be a thing I wanted, but when you are 15, you do not really know if you want kids or not."—16 yo</p> <p>"I mean, that is the conundrum then of making decisions when they are this young before they can experience life, but I keep going back to my son wanting to live and being happy about living."—57 yo mother</p>

the number of transgender youth who expressed forward thinking. One study found that parents deferred fertility preservation decisions to their child regardless of minor status [27]. Assessing an adolescent's ability to consider their future and probing their understanding of the consequences of their decision should be an important element of FP counseling.

The variability in desire for children can concern medical professionals and parents, especially given the potential irreversible effects of GAHs on FP. Medical professionals try to act in the best interests (beneficence) and avoid harm (non-maleficence), but the potential irreversible effects of GAHs on FP challenge these goals. As youth mature and can more concretely picture their future, their outlook on creating a family may change. We note that some cancer patients who chose to forego FP prior to treatment regretted those decisions, though it is impossible to know how that might apply to the transgender population. A prospective, longitudinal study of transgender youth examining attitudes toward becoming parents could elucidate the consistency of such decisions. If decisions remain stable over time, the concerns of medical professionals and parents may abate. In our study, several parents expressed

understanding and support for their children not wanting to have children. However, if youthful decisions change significantly over time, professionals and parents may want to more enthusiastically encourage FP conversations.

Some of the transgender youth who did not want children discussed concern over passing on their genetic material, specifically the desire to prevent heritable mental health problems, a common concern of individuals who have a family history of mental health concerns [40]. These worries raise questions about the trans population's access to information about the nature of mental health disorders within the group as well as the availability of mental health treatment for these youth. Adequate mental healthcare could allay some fears about psychological risks for future generations.

We found widely varying understanding of the effects of GAHs despite extensive counseling by a dedicated transgender clinic, with some transgender youth and their parents stating that GAHs have a completely irreversible impact on fertility, others acknowledging that the degree of irreversibility is unknown, and still others stating that the impact of GAHs on fertility is completely reversible. These differences may reflect

how little is known about the impact of GAHs on future fertility, some variability in how professionals presented FP, or relate to difficult-to-change prior beliefs patients and parents have before FP discussions occur. One study of 202 medical providers from 12 countries found that provider knowledge varied depending on the background of the provider, with physicians having greater knowledge than MA-level mental health providers. In that study, clinicians varied in understanding the potential impacts of GnRHa and GAHs on fertility, knowledge of guidelines in the literature, and what constituted experimental versus non-experimental FP. That study also reported differences in how often clinicians discussed fertility, referral for and completion of FP consultations, and whether the professionals explored alternative options, such as adoption [39]: While mandating FP consultation may not be feasible or practical in all cases, standardized training for and adequacy of providers' understanding of FP are necessary so transgender youth and their parents are provided with current medical information and can make an informed decision.

A significant barrier to FP that transgender youth and their parents highlighted in our study was cost, specifically the discrepancy in cost between egg and sperm preservation and the cost of gamete storage. These costs raise justice concerns regarding the fact that (1) some patients and their families can afford FP while others cannot and (2) FP may be covered by insurance for some diagnoses but not for others. Cost is one of the most significant barriers to FP for transgender youth; healthcare professionals should take an active role in advocating for universal insurance coverage for and minimizing the cost of FP [35]. In addition, we note that some jurisdictions in the USA mandate insurance coverage for FP for those facing particular clinical circumstances, such as cancer treatments, that reduce fertility. Justice considerations should lead to similar coverage for trans patients about to undergo hormonal or surgical treatments which threaten fertility.

Many transgender youth and their parents commented on adoption and alternative reproductive options. At least a quarter of the patients in the study were adopted, which is more than the national average, potentially skewing perspectives toward adoption. While adoption and surrogacy are both viable options for family planning, both pose challenges that families may not appreciate, including cost, bias of surrogates, biological parents, or adoption agencies against transgender individuals, and long waitlists [27, 41]. Cost and long waitlists may impact transgender and cisgender individuals equally; however, bias of surrogates, biological parents, and adoption agencies raise justice concerns. We do not have data about whether transgender youth and their parents receive counseling on these issues or, if so, the thoroughness of such counseling, which is an important aspect of informed consent. Ideally, clinicians assess the applicable barriers in each case and include relevant information when counseling transgender youth and their families.

Using a narrative-based approach, our study provides a rich understanding of transgender youth and parental perspectives on transgender youth decisions about their care. We focused on ethical issues associated with this care and here report on concerns regarding fertility preservation. We found substantial variability in patients' and parents' understanding of the medical facts regarding reproductive options, raising concerns about barriers to achieving adequate consent. In addition, we found that some FP choices depended on cost considerations, highlighting unjust differential access to FP based on financial status, rather than the reasonableness of proceeding with medical interventions. While insufficient consent for care or economic disparity in access to care for FP do not distinguish medical care for transgender youth from the rest of healthcare in the USA, our study highlights the need for attention to patient and family education and sensitivity to family decisions based on economic resources in programs for transgender youth.

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References

1. Harris RM, Frader JE. Ethical considerations of GnRHa treatment and consent process. In: *Pubertal suppression in transgender youth*, C. Ed. Elsevier: Finlayson; 2019.
2. Kimberly LL, et al. Ethical issues in gender-affirming care for youth. *Pediatrics*. 2018;142(6):1–9.
3. Harris RM, Tishelman AC, Quinn GP, Nahata L. Decision making and the long-term impact of puberty blockade in transgender children. *Am J Bioeth*. 2019;19(2):67–9.
4. T'Sjoen G, Van Caenegem E, Wierckx K. Transgenderism and reproduction. *Curr Opin Endocrinol Diabetes Obes*. 2013;20(6): 575–9.
5. De Sutter P, Kira K, Verschoor A, Hotimsky A. The desire to have children and the preservation of fertility in transsexual women: a survey. *Int J Transgen*. 2002;6(3):1–12.
6. Wierckx K, van Caenegem E, Pennings G, Elaut E, Dedeker D, van de Peer F, et al. Reproductive wish in transsexual men. *Hum Reprod*. 2012;27(2):483–7.
7. Hembree WC, Cohen-Kettenis PT, Gooren L, Hannema SE, Meyer WJ, Murad MH, et al. Endocrine treatment of gender-dysphoric/gender-incongruent persons: an endocrine society clinical practice guideline. *J Clin Endocrinol Metab*. 2017;102(11):3869–903.
8. Coleman E, Bockting W, Botzer M, Cohen-Kettenis P, DeCuypere G, Feldman J, et al. Standards of care for the health of transsexual, transgender, and gender-nonconforming people, version 7. *Int J Transgenderism*. 2012;13(4):165–232.

9. Nielsen CT, et al. Onset of the release of spermatozoia (supermarche) in boys in relation to age, testicular growth, pubic hair, and height. *J Clin Endocrinol Metab.* 1986;62(3):532–5.
10. Radicioni AF, Anzuini A, De Marco E, Nofroni I, Castracane VD, Lenzi A. Changes in serum inhibin B during normal male puberty. *Eur J Endocrinol.* 2005;152(3):403–9.
11. Schaefer F, Marr J, Seidel C, Tilgen W, Scharer K. Assessment of gonadal maturation by evaluation of spermaturia. *Arch Dis Child.* 1990;65(11):1205–7.
12. Picton HM, Wyns C, Anderson RA, Goossens E, Jahnukainen K, Kliesch S, et al. A European perspective on testicular tissue cryopreservation for fertility preservation in prepubertal and adolescent boys. *Hum Reprod.* 2015;30(11):2463–75.
13. Penzias A, et al. Fertility preservation in patients undergoing gonadotoxic therapy or gonadectomy: a committee opinion. *Fertil Steril.* 2019;112(6):1022–33.
14. Barnard EP, et al. Fertility preservation outcomes in adolescent and young adult feminizing transgender patients. *Pediatrics.* 2019;144(2):1–6.
15. Pasquino AM, Pucarelli I, Accardo F, Demiraj V, Segni M, Di Nardo R. Long-term observation of 87 girls with idiopathic central precocious puberty treated with gonadotropin-releasing hormone analogs: impact on adult height, body mass index, bone mineral content, and reproductive function. *J Clin Endocrinol Metab.* 2008;93(1):190–5.
16. De Roo C, et al. Ovarian tissue cryopreservation in female-to-male transgender people: insights into ovarian histology and physiology after prolonged androgen treatment. *Reprod BioMed Online.* 2017;34(6):557–66.
17. Lierman S, Tilleman K, Braeckmans K, Peynshaert K, Weyers S, T'Sjoen G, et al. Fertility preservation for trans men: frozen-thawed in vitro matured oocytes collected at the time of ovarian tissue processing exhibit normal meiotic spindles. *J Assist Reprod Genet.* 2017;34(11):1449–56.
18. Schneider F, Neuhaus N, Wistuba J, Zitzmann M, Heß J, Mahler D, et al. Testicular functions and clinical characterization of patients with gender dysphoria (GD) undergoing sex reassignment surgery (SRS). *J Sex Med.* 2015;12(11):2190–200.
19. Adeleye AJ, Reid G, Kao CN, Mok-Lin E, Smith JF. Semen parameters among transgender women with a history of hormonal treatment. *Urology.* 2019;124:136–41.
20. Schneider F, Kliesch S, Schlatt S, Neuhaus N. Andrology of male-to-female transsexuals: influence of cross-sex hormone therapy on testicular function. *Andrology.* 2017;5(5):873–80.
21. Futterweit W, Deglisch L. Histopathological effects of exogenously administered testosterone in 19 female to male transsexuals. *J Clin Endocrinol Metab.* 1986;62(1):16–21.
22. Ikeda K, Baba T, Noguchi H, Nagasawa K, Endo T, Kiya T, et al. Excessive androgen exposure in female-to-male transsexual persons of reproductive age induces hyperplasia of the ovarian cortex and stroma but not polycystic ovary morphology. *Hum Reprod.* 2013;28(2):453–61.
23. Light AD, Obedin-Maliver J, Sevelius JM, Kerns JL. Transgender men who experienced pregnancy after female-to-male gender transitioning. *Obstet Gynecol.* 2014;124(6):1120–7.
24. Chen D, Simons L, Johnson EK, Lockart BA, Finlayson C. Fertility preservation for transgender adolescents. *J Adolesc Health.* 2017;61(1):120–3.
25. Nahata L, Tishelman A, Caltabellotta N, Quinn G. Low fertility preservation utilization among transgender youth. *J Adolesc Health.* 2017;61:40–4.
26. von Doussa H, Power J, Riggs D. Imagining parenthood: the possibilities and experiences of parenthood among transgender people. *Cult Health Sex.* 2015;17(9):1119–31.
27. Chen D, Simons L. Ethical considerations in fertility preservation for transgender youth: a case illustration. *Clin Pr Pediatr Psychol.* 2018;6(1):93–100.
28. Wierckx K, Stuyver I, Weyers S, Hamada A, Agarwal A, de Sutter P, et al. Sperm freezing in transsexual women. *Arch Sex Behav.* 2012;41(5):1069–71.
29. Schmidt L, Levine R. Psychological outcomes and reproductive issues among gender dysphoric individuals. *Endocrinol Metab Clin N Am.* 2015;44(4):773–85.
30. Payne JG, Erbenius T. Conceptions of transgender parenthood in fertility care and family planning in Sweden: from reproductive rights to concrete practices. *Anthropol Med.* 2018;25(3):329–43.
31. Chiniara LN, Viner C, Palmert M, Bonifacio H. Perspectives on fertility preservation and parenthood among transgender youth and their parents. *Arch Dis Child.* 2019;104(8):739–44.
32. Chen D, et al. Factors affecting fertility preservation decision-making among transgender adolescents and young adults. *LGBT Heal.* 2019;64(3):107–15.
33. Strang JF, Jarin J, Call D, Clark B, Wallace GL, Anthony LG, et al. Transgender youth fertility attitudes questionnaire: measure development in nonautistic and autistic transgender youth and their parents. *J Adolesc Health.* 2018;62:128–35.
34. Murphy TF. The ethics of fertility preservation in transgender body modifications. *J Bioeth Inq.* 2012;9(3):311–6.
35. Bartholomaeus C, Riggs DW. Transgender and non-binary Australians' experiences with healthcare professionals in relation to fertility preservation. *Cult Health Sex.* 2019:1–17.
36. Kyweluk MA, Reinecke J, Chen D. Fertility preservation legislation in the United States: potential implications for transgender individuals. *LGBT Heal.* 2019;6(7):331–4.
37. Burnard P, Gill P, Stewart K, Treasure E, Chadwick B. Analysing and presenting qualitative data. *Br Dent J.* 2008;204(8):429–32.
38. “Dedoose Version 8.3.17, web application for managing, analyzing, and presenting qualitative and mixed method research data.” SocioCultural Research Consultants, LLC, Los Angeles, 2020.
39. Chen D, Kolbuck VD, Sutter ME, Tishelman AC, Quinn GP, Nahata L. Knowledge, practice behaviors, and perceived barriers to fertility care among providers of transgender healthcare. *J Adolesc Health.* 2019;64(2):226–34.
40. Meiser B, et al. Attitudes towards childbearing, causal attributions for bipolar disorder and psychological distress: a study of families with multiple cases of bipolar disorder. *Psychol Med.* 2007;37(11):1601–11.
41. Tishelman AC, Sutter ME, Chen D, Sampson A, Nahata L, Kolbuck VD, et al. Health care provider perceptions of fertility preservation barriers and challenges with transgender patients and families: qualitative responses to an international survey. *J Assist Reprod Genet.* 2019;36:579–88.
42. Rothenberg SS, Witchel SF, Menke MN. Oocyte cryopreservation in a transgender male adolescent. *N Engl J Med.* 2019;380(9):886–7.

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