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Consensus Statement on Management of Intersex Disorders

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THE BIRTH of an intersex child prompts a long-term management strategy that involves myriad professionals working with the family. There has been progress in diagnosis, surgical techniques, understanding psychosocial issues, and recognizing and accepting the place of patient advocacy. The Lawson Wilkins Pediatric Endocrine Society and the European Society for Paediatric Endocrinology considered it timely to review the management of intersex disorders from a broad perspective, review data on longer-term outcome, and formulate proposals for future studies. The methodology comprised establishing a number of working groups, the membership of which was drawn from 50 international experts in the field. The groups prepared previous written responses to a defined set of questions resulting from evidence-based review of the literature. At a subsequent gathering of participants, a framework for a consensus document was agreed. This article constitutes its final form.

NOMENCLATURE AND DEFINITIONS

Advances in identification of molecular genetic causes of abnormal sex with heightened awareness of ethical issues and patient advocacy concerns necessitate a reexamination of nomenclature.[1] Terms such as "intersex," "pseudohermaphroditism," "hermaphroditism," "sex reversal," and gender-based diagnostic labels are particularly controversial. These terms are perceived as potentially pejorative by patients[2] and can be confusing to practitioners and parents alike. We propose the term "disorders of sex development" (DSD), as defined by congenital conditions in which development of chromosomal, gonadal, or anatomic sex is atypical.

The proposed changes in terminology are summarized in Table 1. A modern lexicon is needed to integrate progress in molecular genetic aspects of sex development. Because outcome data in individuals with DSD are limited, it is essential to use precision when applying definitions and diagnostic labels.[3,4] It is also appropriate to use terminology that is sensitive to the concerns of patients. The ideal nomenclature should be sufficiently flexible to incorporate new information yet robust enough to maintain a consistent framework. Terms should be descrip-

TABLE 1 Proposed Revised Nomenclature

Previous	Proposed
Intersex	DSD
Male pseudohermaphrodite, undervirilization of an XY male, and undermasculinization of an XY male	46,XY DSD
Female pseudohermaphrodite, overvirilization of an XX female, and masculinization of an XX female	46,XX DSD
True hermaphrodite	Ovotesticular DSD
XX male or XX sex reversal	46,XX testicular DSD
XY sex reversal	46,XY complete gonadal dysgenesis

tive and reflect genetic etiology when available and accommodate the spectrum of phenotypic variation. Clinicians and scientists must value the nomenclature's use, and it must be understandable to patients and their families. An example of how the proposed nomenclature could be applied in a classification of DSD is shown in Table 2.

Psychosexual development is traditionally conceptualized as 3 components: "gender identity" refers to a person's self-representation as male or female (with the caveat that some individuals may not identify exclusively with either); "gender role" (sex-typical behaviors) describes the psychological characteristics that are sexually dimorphic within the general population, such as toy preferences and physical aggression; and "sexual orientation" refers to the direction(s) of erotic interest (heterosexual, bisexual, homosexual) and includes behavior, fantasies, and attractions. Psychosexual development is influenced by multiple factors such as exposure to androgens, sex chromosome genes, and brain structure, as well as social circumstance and family dynamics.

Gender dissatisfaction denotes unhappiness with assigned sex. Causes of gender dissatisfaction, even among individuals without DSD, are poorly understood. Gender dissatisfaction occurs more frequently in individuals with DSD than in the general population but is difficult to predict from karyotype, prenatal androgen exposure, degree of genital virilization, or assigned gender.[5–7] Prenatal androgen exposure is clearly associated with other aspects of psychosexual development.[8,9] There are dose-related effects on childhood play behavior in girls with congenital adrenal hyperplasia (CAH), whereby those with the more severe mutations and marked genital virilization play more with boys' toys.[10] Prenatal androgen exposure is also associated with other psychological characteristics such as maternal interest and sexual orientation. It is important to emphasize the separability of sex-typical behavior, sexual orientation, and gender identity. Thus, homosexual orientation (relative to sex of rearing) or strong cross-sex interest in an individual with DSD is not an indication of incorrect gender assignment. Understanding variations in psychosexual development in individuals with DSD requires reference to studies in nonhuman species that show marked but complex effects of androgens on sex differentiation of the brain and on behavior. Outcomes can be influenced by the timing, dose, and type of androgen exposure, receptor availability, and modification by the social environment.[11–14]

Data from rodent studies suggest that sex chromosome genes may also influence brain structure and behavior directly.[15,16] However, studies in individuals with complete androgen insensitivity syndrome (CAIS) do not indicate a behavioral role for Y-chromosome genes, although data are limited.[17] Sex differences in brain structures have been identified across species, some of which coincide with pubertal onset, perhaps suggesting hormonal responsivity.[18–20] The limbic system and hypothalamus, both of which play a role in reproduction, show sex differences in specific nuclei, but it is not clear

TABLE 2 An Example of a DSD Classification

Sex Chromosome DSD	46,XY DSD	46,XX DSD
45,X (Turner syndrome and variants)	Disorders of gonadal (testicular) development: (1) complete gonadal dysgenesis (Swyer syndrome); (2) partial gonadal dysgenesis; (3) gonadal regression; and (4) ovotesticular DSD	Disorders of gonadal (ovarian) development: (1) ovotesticular DSD; (2) testicular DSD (eg, SRY+, duplicate SOX9); and (3) gonadal dysgenesis
47,XXY (Klinefelter syndrome and variants)	Disorders in androgen synthesis or action: (1) androgen biosynthesis defect (eg, 17-hydroxysteroid dehydrogenase deficiency, 5αRD2 deficiency, StAR mutations); (2) defect in androgen action (eg, CAIS, PAIS); (3) luteinizing hormone receptor defects (eg, Leydig cell hypoplasia, aplasia); and (4) disorders of anti-Müllerian hormone and anti-Müllerian hormone receptor (persistent Müllerian duct syndrome)	Androgen excess: (1) fetal (eg, 21-hydroxylase deficiency, 11-hydroxylase deficiency); (2) fetoplacental (aromatase deficiency, POR [P450 oxidoreductase]); and (3) maternal (luteoma, exogenous, etc)
45,X/46,XY (MGD, ovotesticular DSD)		Other (eg, cloacal exstrophy, vaginal atresia, MURCS [Müllerian, renal, cervicothoracic somite abnormalities], other syndromes)
46,XX/46,XY (chimeric, ovotesticular DSD)		

Although consideration of karyotype is useful for classification, unnecessary reference to karyotype should be avoided; ideally, a system based on descriptive terms (eg, androgen insensitivity syndrome) should be used wherever possible. StAR indicates steroidogenic acute regulatory protein.

when these differences emerge. Interpretation of sex differences is complicated by the effect of cell death and synaptic pruning on normal maturation and by effects of experience on the brain. Structure of the brain is not currently useful for gender assignment.

INVESTIGATION AND MANAGEMENT OF DSD

General Concepts of Care

Optimal clinical management of individuals with DSD[21] should comprise the following: (1) gender assignment must be avoided before expert evaluation in newborns; (2) evaluation and long-term management must be performed at a center with an experienced multidisciplinary team; (3) all individuals should receive a gender assignment; (4) open communication with patients and families is essential, and participation in decision-making is encouraged; and (5) patient and family concerns should be respected and addressed in strict confidence.

The initial contact with the parents of a child with a DSD is important, because first impressions from these encounters often persist. A key point to emphasize is that the child with a DSD has the potential to become a well-adjusted, functional member of society. Although privacy needs to be respected, a DSD is not shameful. It should be explained to the parents that the best course of action may not be clear initially, but the health care team will work with the family to reach the best possible set of decisions in the circumstances. The health care team should discuss with the parents what information to share in the early stages with family members and friends. Parents need to be informed about sexual development, and Web-based information may be helpful, provided the content and focus of the information is balanced and sound.

Ample time and opportunity should be made for continued discussion with review of information previously provided.[1]

The Multidisciplinary Team

Optimal care for children with DSD requires an experienced multidisciplinary team that is generally found in tertiary care centers. Ideally, the team includes pediatric subspecialists in endocrinology, surgery, and/or urology, psychology/psychiatry, gynecology, genetics, neonatology, and, if available, social work, nursing, and medical ethics.[22] Core composition will vary according to DSD type, local resources, developmental context, and location. Ongoing communication with the family's primary care physician is essential.[23]

The team has a responsibility to educate other health care staff in the appropriate initial management of affected newborns and their families. For new patients with DSD, the team should develop a plan for clinical management with respect to diagnosis, gender assignment, and treatment options before making any recommendations. Ideally, discussions with the family are conducted by one professional with appropriate communication skills.[24] Transitional care should be organized with the multidisciplinary team operating in an environment that includes specialists with experience in both pediatric and adult practice. Support groups can have an important role in the delivery of care to patients with DSD and their families[25] (see Appendix 1).

Clinical Evaluation

A family and prenatal history, a general physical examination with attention to any associated dysmorphic features, and an assessment of the genital anatomy in comparison to published norms need to be recorded (Table 3). Criteria that suggest DSD include (1) overt genital ambiguity (eg, cloacal exstrophy), (2) apparent female genitalia with an enlarged clitoris, posterior labial fusion, or an inguinal/labial mass, (3) apparent male genitalia with bilateral undescended testes, micropenis, isolated perineal hypospadias, or mild hypospadias with unde-

TABLE 3	Anthropometric Measurements of the External Genitalia					
Sex	Population	Age	Stretched Penile Length, Mean ± SD, cm (Males), or Clitoral Length, Mean ± SD, mm (Females)	Penile Width, Mean ± SD, cm (Males), or Clitoral Width, Mean ± SD, mm (Females)	Mean Testicular Volume, mL (Males), or Perineum Length, Mean ± SD, mm (Females)	Ref No.
M	United States	30 wk GA	2.5 ± 0.4			26
M	United States	Term	3.5 ± 0.4	1.1 ± 0.1	0.52 (median)	26 and 27
M	Japan	Term to 14 y	2.9 ± 0.4 − 8.3 ± 0.8			28
M	Australia	24–36 wk GA	2.27 + (0.16 GA)			29
M	China	Term	3.1 ± 0.3	1.07 ± 0.09		30
M	India	Term	3.6 ± 0.4	1.14 ± 0.07		30
M	North America	Term	3.4 ± 0.3	1.13 ± 0.08		30
M	Europe	10 years	6.4 ± 0.4		0.95–1.20	27 and 31
M	Europe	Adult	13.3 ± 1.6		16.5–18.2	27 and 31
F	United States	Term	4.0 ± 1.24	3.32 ± 0.78		32
F	United States	Adult nulliparous	15.4 ± 4.3			33
F	United States	Adult	19.1 ± 8.7	5.5 ± 1.7	31.3 ± 8.5	34

GA indicates gestational age.

scended testis, (4) a family history of DSD such as CAIS, and (5) a discordance between genital appearance and a prenatal karyotype. Most causes of DSD are recognized in the neonatal period; later presentations in older children and young adults include (1) previously unrecognized genital ambiguity, (2) inguinal hernia in a female, (3) delayed or incomplete puberty, (4) virilization in a female, (5) primary amenorrhea, (6) breast development in a male, and (7) gross and occasionally cyclic hematuria in a male.

Diagnostic Evaluation

Considerable progress has been made with understanding the genetic basis of human sexual development,[35] yet a specific molecular diagnosis is identified in only ~20% of cases of DSD. The majority of virilized 46,XX infants will have CAH. In contrast, only 50% of 46,XY children with DSD will receive a definitive diagnosis.[36,37] Diagnostic algorithms do exist, but with the spectrum of findings and diagnoses, no single evaluation protocol can be recommended in all circumstances. Some tests, such as imaging by ultrasound, are operator dependent. Hormone measurements need to be interpreted in relation to the specific assay characteristics and to normal values for gestational and chronological age. In some cases, serial measurements may be needed.

First-line testing in newborns includes karyotyping with X- and Y-specific probe detection (even when prenatal karyotype is available), imaging (abdominopelvic ultrasound), measurement of 17-hydroxyprogesterone, testosterone, gonadotropins, anti-Müllerian Hormone, and serum electrolytes, and urinalysis. The results of these investigations are generally available within 48 hours and will be sufficient for making a working diagnosis. Decision-making algorithms are available to guide additional investigation.[38] These assessments include human chorionic gonadotropin– and adrenocorticotropin-stimulation tests to assess testicular and adrenal steroid biosynthesis, urinary steroid analysis by gas chromatography mass spectroscopy, imaging studies, and biopsies of gonadal material. Some gene analyses are performed in clinical service laboratories. However, current molecular diagnosis is limited by cost, accessibility, and quality control.[39] Research laboratories provide genetic testing, including functional analysis, but may face restrictions on communicating results.[40]

Gender Assignment in Newborns

Initial gender uncertainty is unsettling and stressful for families. Expediting a thorough assessment and decision is required. Factors that influence gender assignment include diagnosis, genital appearance, surgical options, need for lifelong replacement therapy, potential for fertility, views of the family, and, sometimes, circumstances relating to cultural practices. More than 90% of patients with 46,XX CAH[41] and all patients with 46,XY CAIS

assigned female in infancy[42] identify as females. Evidence supports the current recommendation to raise markedly virilized 46,XX infants with CAH as female.[43] Approximately 60% of 5-α-reductase (5αRD2)-deficient patients assigned female in infancy and virilizing at puberty (and all assigned male) live as males.[5] In 5αRD2 and possibly 17β-hydroxysteroid dehydrogenase deficiencies, for which the diagnosis is made in infancy, the combination of a male gender identity in the majority and the potential for fertility (documented in 5αRD2 but unknown in 17β-hydroxysteroid dehydrogenase deficiencies) should be discussed when providing evidence for gender assignment.[5,44,45] Among patients with partial androgen insensitivity syndrome (PAIS), androgen biosynthetic defects, and incomplete gonadal dysgenesis, there is dissatisfaction with the sex of rearing in ~25% of individuals whether raised male or female.[46] Available data support male rearing in all patients with micropenis, taking into account equal satisfaction with assigned gender in those raised male or female but no need for surgery and the potential for fertility in patients reared male.[42] Those making the decision on sex of rearing for those with ovotesticular DSD should consider the potential for fertility on the basis of gonadal differentiation and genital development and assuming that the genitalia are, or can be made, consistent with the chosen sex. In the case of mixed gonadal dysgenesis (MGD), factors to consider include prenatal androgen exposure, testicular function at and after puberty, phallic development, and gonadal location. Individuals with cloacal exstrophy reared female show variability in gender identity outcome, but >65% seem to live as female.[6]

Surgical Management

The surgeon has a responsibility to outline the surgical sequence and subsequent consequences from infancy to adulthood. Only surgeons with expertise in the care of children and specific training in the surgery of DSD should perform these procedures. Parents now seem to be less inclined to choose surgery for less severe clitoromegaly.[47] Surgery should only be considered in cases of severe virilization (Prader III–V) and be performed in conjunction, when appropriate, with repair of the common urogenital sinus. Because orgasmic function and erectile sensation may be disturbed by clitoral surgery, the surgical procedure should be anatomically based to preserve erectile function and the innervation of the clitoris. Emphasis is on functional outcome rather than a strictly cosmetic appearance. It is generally felt that surgery that is performed for cosmetic reasons in the first year of life relieves parental distress and improves attachment between the child and the parents[48–51]; the systematic evidence for this belief is lacking.

Currently, there is inadequate evidence in relation to establishment of functional anatomy to abandon the practice of early separation of the vagina and urethra.[52]

The rationale for early reconstruction is based on guidelines on the timing of genital surgery from the American Academy of Pediatrics,[53] the beneficial effects of estrogen on tissue in early infancy, and the avoidance of potential complications from the connection between the urinary tract and peritoneum via the Fallopian tubes. It is anticipated that surgical reconstruction in infancy will need to be refined at the time of puberty.[54–56] Vaginal dilatation should not be undertaken before puberty. The surgeon must be familiar with a number of operative techniques to reconstruct the spectrum of urogenital sinus disorders. An absent or inadequate vagina (with rare exceptions) requires a vaginoplasty performed in adolescence when the patient is psychologically motivated and a full partner in the procedure. No one technique has been universally successful; self-dilatation, skin substitution, and bowel vaginoplasty each have specific advantages and disadvantages.

In the case of a DSD associated with hypospadias,[57] standard techniques for surgical repair such as chordee correction, urethral reconstruction, and the judicious use of testosterone supplementation apply. The magnitude and complexity of phalloplasty in adulthood should be taken into account during the initial counseling period if successful gender assignment depends on this procedure.[58] At times, this may affect the balance of gender assignment. Patients must not be given unrealistic expectations about penile reconstruction, including the use of tissue engineering. There is no evidence that prophylactic removal of asymptomatic discordant structures, such as a utriculus or Müllerian remnants, is required, although symptoms in the future may indicate surgical removal. For the male who has a successful neophalloplasty in adulthood, an erectile prosthesis may be inserted but has a high morbidity.

The testes in patients with CAIS[35] and those with PAIS, raised female, should be removed to prevent malignancy in adulthood. The availability of estrogen-replacement therapy allows for the option of early removal at the time of diagnosis that also takes care of the associated hernia, psychological problems with the presence of testes, and the malignancy risk. Parental choice allows deferment until adolescence, recognizing that the earliest reported malignancy in CAIS is at 14 years of age.[59] The streak gonad in a patient with MGD raised male should be removed laparoscopically (or by laparotomy) in early childhood.[35] Bilateral gonadectomy is performed in early childhood in females (bilateral streak gonads) with gonadal dysgenesis and Y-chromosome material. In patients with androgen biosynthetic defects raised female, gonadectomy should be performed before puberty. A scrotal testis in patients with gonadal dysgenesis is at risk for malignancy. Current recommendations are testicular biopsy at puberty seeking signs of the premalignant lesion termed carcinoma in situ or undifferentiated intratubular germ cell neoplasia. If positive, the option is sperm banking before treatment with local low-dose radiotherapy that is curative.[60]

Surgical management in DSD should also consider options that will facilitate the chances of fertility. In patients with a symptomatic utriculus, removal is best performed laparoscopically to increase the chance of preserving continuity of the vas deferens. Patients with bilateral ovotestes are potentially fertile from functional ovarian tissue.[35,61] Separation of ovarian and testicular tissue can be technically difficult and should be undertaken, if possible, in early life.

Sex-Steroid Replacement

Hypogonadism is common in patients with dysgenetic gonads, defects in sex-steroid biosynthesis, and resistance to androgens. The timing of initiation of puberty may vary, but this is an occasion that provides an opportunity to discuss the condition and set a foundation for long-term adherence to therapy. Hormonal induction of puberty stimulates replication of normal pubertal maturation to induce secondary sexual characteristics, a pubertal growth spurt, and optimal bone mineral accumulation, together with psychosocial support for psychosexual maturation.[62] Intramuscular depot injections of testosterone esters are commonly used in males; another option is oral testosterone undecanoate, and transdermal preparations are also available.[63–65] Patients with PAIS may require supraphysiologic doses of testosterone for optimal effect.[66] Females with hypogonadism require estrogen supplementation to induce pubertal changes and menses. A progestin is usually added after breakthrough bleeding develops or within 1 to 2 years of continuous estrogen. There is no evidence that the addition of cyclic progesterone is beneficial in women without a uterus.

Psychosocial Management

Psychosocial care provided by mental health staff with expertise in DSD should be an integral part of management to promote positive adaptation. This expertise can facilitate team decisions about gender assignment/reassignment, timing of surgery, and sex-hormone replacement. Psychosocial screening tools that identify families at risk for maladaptive coping with a child's medical condition are available.[67] Once the child is sufficiently developed for a psychological assessment of gender identity, such an evaluation must be included in discussions about gender reassignment. Gender identity development begins before the age of 3 years,[68] but the earliest age at which it can be reliably assessed remains unclear. The generalization that the age of 18 months is the upper limit of imposed gender reassignment should be treated with caution and viewed conservatively. Atypical gender-role behavior is more common in children with DSD than in the general population but should not be taken as an indicator for gender reassignment. In

affected children and adolescents who report significant gender dysphoria, a comprehensive psychological evaluation[69] and an opportunity to explore feelings about gender with a qualified clinician is required over a period of time. If the desire to change gender persists, the patient's wish should be supported and may require the input of a specialist skilled in the management of gender change.

The process of disclosure concerning facts about karyotype, gonadal status, and prospects for future fertility is a collaborative, ongoing action that requires a flexible individual-based approach. It should be planned with the parents from the time of diagnosis.[70] Studies in other chronic medical disorders and of adoptees indicate that disclosure is associated with enhanced psychosocial adaptation.[71] Medical education and counseling for children is a recurrent gradual process of increasing sophistication that is commensurate with changing cognitive and psychological development.[72]

Quality of life encompasses falling in love, dating, attraction, ability to develop intimate relationships, sexual functioning, and the opportunity to marry and raise children, regardless of biological indicators of sex. The most frequent problems encountered in DSD patients are sexual aversion and lack of arousability, which are often misinterpreted as low libido.[73] Health care staff should offer adolescent patients opportunities to talk confidentially without their parents and encourage the participation in condition-specific support groups that enhance the ability of the patient to discuss their concerns comfortably. Some patients avoid intimate relationships, and it is important to address fears of rejection and advise them on the process of building a relationship with a partner. The focus should be on interpersonal relationships and not solely on sexual function and activity. Referral for sex therapy may be needed. Repeated examination of the genitalia, including medical photography, may be experienced as deeply shaming.[74] Medical photography has its place for record keeping and education but should be undertaken, whenever possible, when the patient is under anesthesia for a procedure. Medical interventions and negative sexual experiences may have fostered symptoms of posttraumatic stress disorder, and referral to a qualified mental health professional may be indicated.[75]

OUTCOME IN DSD

As a general statement, information across a range of assessments is insufficient in DSD. The following is based on those disorders for which some evidence base is available. They include CAH, CAIS, and PAIS, disorders of androgen biosynthesis, gonadal dysgenesis syndromes (complete and partial), and micropenis. Long-term outcome in DSD should include external and internal genital phenotype, physical health including fertility, sexual function, and social and psychosexual adjustment, mental health, quality of life, and social participation. There are additional health problems in individuals with DSD, including the consequences of associated problems such as other malformations, developmental delay and intellectual impairment, delayed growth and development, and unwanted effects of hormones on libido and body image.[76]

Surgical Outcome

Some studies suggest satisfactory outcomes from early surgery.[43,46,47,77] Nevertheless, outcomes from clitoroplasty identify problems related to decreased sexual sensitivity, loss of clitoral tissue, and cosmetic issues.[78] Techniques for vaginoplasty carry the potential for scarring at the introitus necessitating repeated modification before sexual function can be reliable. Surgery to construct a neovagina carries a risk of neoplasia.[79] The risks from vaginoplasty are different for high and low confluence of the urethra and vagina. Analysis of long-term outcomes is complicated by a mixture of surgical techniques and

TABLE 4 Risk of Germ Cell Malignancy According to Diagnosis

Risk Group	Disorder	Malignancy Risk, %	Recommended Action	Patients, n	Studies, n
High	GD[a] (+Y)[b] intraabdominal	15–35	Gonadectomy[c]	12	>350
	PAIS nonscrotal	50	Gonadectomy[c]	2	24
	Frasier	60	Gonadectomy[c]	1	15
	Denys-Drash (+Y)	40	Gonadectomy[c]	1	5
Intermediate	Turner (+Y)	12	Gonadectomy[c]	11	43
	17β-hydroxysteroid	28	Watchful waiting	2	7
	GD (+Y)[b] scrotal	Unknown	Biopsy[d] and irradiation?	0	0
	PAIS scrotal gonad	Unknown	Biopsy[d] and irradiation?	0	0
Low	CAIS	2	Biopsy[d] and ???	2	55
	Ovotesticular DSD	3	Testicular tissue removal?	3	426
	Turner (−Y)	1	None	11	557
No (?)	5αRD2	0	Unresolved	1	3
	Leydig cell hypoplasia	0	Unresolved	1	2

[a] Gonadal dysgenesis (including not further specified, 46,XY, 46,X/46,XY, mixed, partial, and complete).
[b] GBY region positive, including the TSPY (testis-specific protein Y encoded) gene.
[c] At time of diagnosis.
[d] At puberty, allowing investigation of at least 30 seminiferous tubules, preferentially diagnosis on the basis of OCT3/4 immunohistochemistry.

TABLE 5 Genes Known to be Involved in DSD

Gene	Protein	OMIM No.	Locus	Inheritance	Gonad	Müllerian Structures	External Genitalia	Associated Features/Variant Phenotypes
46,XY DSD								
Disorders of gonadal (testicular) development: single-gene disorders								
WT1	TF	607102	11p13	AD	Dysgenetic testis	+/−	Female or ambiguous	Wilms' tumor, renal abnormalities, gonadal tumors (WAGR, Denys-Drash and Frasier syndromes)
SF1 (NR5A1)	Nuclear receptor TF	184757	9q33	AD/AR	Dysgenetic testis	+/−	Female or ambiguous	More severe phenotypes include primary adrenal failure; milder phenotypes have isolated partial gonadal dysgenesis
SRY	TF	480000	Yp11.3	Y	Dysgenetic testis or ovotestis	+/−	Female or ambiguous	
SOX9	TF	608160	17q24-25	AD	Dysgenetic testis or ovotestis	+/−	Female or ambiguous	Camptomelic dysplasia (17q24 rearrangements; milder phenotype than point mutations)
DHH	Signaling molecule	605423	12q13.1	AR	Dysgenetic testis	+	Female	The severe phenotype of 1 patient included minifascicular neuropathy; other patients have isolated gonadal dysgenesis
ATRX	Helicase (? chromatin remodeling)	300032	Xq13.3	X	Dysgenetic testis	−	Female, ambiguous, or male	α-Thalassemia, mental retardation
ARX	TF	300382	Xp22.13	X	Dysgenetic testis	−	Ambiguous	X-linked lissencephaly, epilepsy, temperature instability
Disorders of gonadal (testicular) development: chromosomal changes involving key candidate genes								
DMRT1	TF	602424	9p24.3	Monosomic deletion	Dysgenetic testis	+/−	Female or ambiguous	Mental retardation
DAX1 (NR0B1)	Nuclear receptor TF	300018	Xp21.3	dupXp21	Dysgenetic testis or ovary	+/−	Female or ambiguous	
WNT4	Signaling molecule	603490	1p35	dup1p35	Dysgenetic testis	+	Ambiguous	Mental retardation
Disorders in hormone synthesis or action								
LHGCR	G-protein receptor	152790	2p21	AR	Testis	−	Female, ambiguous, or micropenis	Leydig cell hypoplasia
DHCR7	Enzyme	602858	11q12-13	AR	Testis	−	Variable	Smith–Lemli-Opitz syndrome: coarse facies, second-third toe syndactyly, failure to thrive, developmental delay, cardiac and visceral abnormalities
StAR (steroidogenic acute regulatory protein)	Mitochondrial membrane protein	600617	8p11.2	AR	Testis	−	Female	Congenital lipoid adrenal hyperplasia (primary adrenal failure), pubertal failure
CYP11A1	Enzyme	118485	15q23-24	AR	Testis	−	Female or Ambiguous	CAH (primary adrenal failure), pubertal failure
HSD3B2	Enzyme	201810	1p13.1	AR	Testis	−	Ambiguous	CAH, primary adrenal failure, partial androgenization caused by dehydroepiandrosterone sulfate

TABLE 5 Continued

Gene/Protein	Type	OMIM	Locus	Inheritance	Gonad		External genitalia	Phenotype/associated features
CYP17	Enzyme	202110	10q24.3	AR	Testis	−	Female, ambiguous, or micropenis	CAH, hypertension caused by corticosterone and 11-deoxycorticosterone (except in isolated 17,20-lyase deficiency)
POR (P450 oxidoreductase)	CYP enzyme electron donor	124015	7q11.2	AR	Testis	−	Male or ambiguous	Mixed features of 21-hydroxylase deficiency, 17α-hydroxylase/17,20-lyase deficiency, and aromatase deficiency; sometimes associated with Antley Bixler craniosynostosis
HSD17B3	Enzyme	605573	9q22	AR	Testis	−	Female or ambiguous	Partial androgenization at puberty, androstenedione/testosterone ratio
SRD5A2	Enzyme	607306	2p23	AR	Testis	−	Ambiguous or micropenis	Partial androgenization at puberty, testosterone/dihydrotestosterone ratio
Anti-Müllerian hormone	Signaling molecule	600957	19p13.3-13.2	AR	Testis	+	Normal male	Persistent Müllerian duct syndrome; male external genitalia, bilateral cryptorchidism
Anti-Müllerian hormone receptor	Serine-threonine kinase transmembrane receptor	600956	12q13	AR	Testis	+	Normal male	
Androgen receptor	Nuclear receptor TF	313700	Xq11-12	X	Testis	−	Female, ambiguous, micropenis, or normal male	Phenotypic spectrum from CAIS (female external genitalia) and PAIS (ambiguous) to normal male genitalia/infertility
46,XX DSD								
Disorders of gonadal (ovarian) development								
SRY	TF	480000	Yp11.3	Translocation	Testis or ovotestis	−	Male or ambiguous	
SOX9	TF	608160	17q24	dup17q24	Not determined	−	Male or ambiguous	
Androgen excess								
HSD3B2	Enzyme	201810	1p13	AR	Ovary	+	Clitoromegaly	CAH, primary adrenal failure, partial androgenization caused by dehydroepiandrosterone sulfate
CYP21A2	Enzyme	201910	6p21-23	AR	Ovary	+	Ambiguous	CAH, phenotypic spectrum from severe salt-losing forms associated with adrenal failure to simple virilizing forms with compensated adrenal function, 17-hydroxyprogesterone
CYP11B1	Enzyme	202010	8q21-22	AR	Ovary	+	Ambiguous	CAH, hypertension caused by 11-deoxycortisol and 11-deoxycorticosterone
POR (P450 oxidoreductase)	CYP enzyme electron donor	124015	7q11.2	AR	Ovary	+	Ambiguous	Mixed features of 21-hydroxylase deficiency, 17α-hydroxylase/17,20-lyase deficiency, and aromatase deficiency; associated with Antley Bixler craniosynostosis
CYP19	Enzyme	107910	15q21	AR	Ovary	+	Ambiguous	Maternal androgenization during pregnancy, absent breast development at puberty, except in partial cases
Glucocorticoid receptor	Nuclear receptor TF	138040	5q31	AR	Ovary	+	Ambiguous	Adrenocorticotropin, 17-hydroxyprogesterone and cortisol; failure of dexamethasone suppression (patient heterozygous for a mutation in CYP21)

OMIM indicates Online Mendelian Inheritance in Man; TF, transcription factor; AD, autosomal dominant (often do novo mutation); AR indicates autosomal recessive; Y, Y-chromosomal; X, X-chromosomal. Chromosomal rearrangements likely to include key genes are included. Modified from Achermann JC, Ozisik G, Meeks JJ, Jameson JL. Genetic causes of human reproductive disease. *J Clin Endocrinol Metab.* 2002;87:2447–2454.

diagnostic categories.[80] Few women with CAIS need surgery to lengthen the vagina.[81]

The outcome in undermasculinized males with a phallus depends on the degree of hypospadias and the amount of erectile tissue. Feminizing genitoplasty as opposed to masculinizing genitoplasty requires less surgery to achieve an acceptable outcome and results in fewer urologic difficulties.[46] Long-term data regarding sexual function and quality of life among those assigned female as well as male show great variability. There are no controlled clinical trials of the efficacy of early (<12 months of age) versus late (in adolescence and adulthood) surgery or of the efficacy of different techniques.

Risk of Gonadal Tumors

Interpretation of the literature is hampered by unclear terminology and effects of normal cell-maturation delay.[82–84] The highest tumor risk is found in TSPY (testis-specific protein Y encoded) positive gonadal dysgenesis and PAIS with intraabdominal gonads, whereas the lowest risk (<5%) is found in ovotestis[85] and CAIS.[83,86] Table 4 provides a summary of the risk of tumor development according to diagnosis and recommendations for management.

Cultural and Social Factors

DSD may carry a stigma. Social and cultural factors, as well as hormonal effects, seem to influence gender role in 5αRD2 deficiency. Gender-role change occurs at different rates in different societies, suggesting that social factors may also be important modifiers of gender-role change.

In some societies, female infertility precludes marriage, which also affects employment prospects and creates economic dependence. Religious and philosophical views may influence how parents respond to the birth of an infant with a medical condition. Fatalism and guilt feelings in relation to congenital malformations or genetic conditions have an influence, whereas poverty and illiteracy negatively affect access to health care.[87]

FUTURE STUDIES

Establishing a precise diagnosis in DSD is just as important as in other chronic medical conditions that have lifelong consequences. Considerable progress has been achieved with molecular studies, as illustrated in Table 5, which summarizes the genes known to be involved in DSD. Use of tissue-specific animal knock-out models, comparative genomic hybridization, and microarray screens of the mouse urogenital ridge will provide benefits in identifying new genes causing DSD.[88] It is essential that the momentum for an international collaborative approach to this task be maintained.

Much remains to be clarified about the determinants of gender identity in DSD. Future studies require representative sampling to carefully conceptualize and measure gender identity, recognizing that there are multiple determinants to consider, and gender identity may change into adulthood. In terms of psychological management, studies are needed to evaluate the effectiveness of information management with regard to timing and content. The pattern of surgical practice in DSD is changing with respect to the timing of surgery and the techniques used. It is essential to evaluate the effects of early versus later surgery in a holistic manner, recognizing the difficulties posed by an ever-evolving clinical practice.

The consensus has clearly identified a major shortfall in information about long-term outcome. Future studies should use appropriate instruments that assess outcomes in a standard manner[68,69] and take cognizance of guidelines relevant to all chronic conditions (see www.who.int/classifications/icf/en). These studies would preferably be prospective in nature and designed to avoid selection bias. A number of countries already have registers of DSD cases, but there could be added benefit from pooling such resources to enable prospective, multicenter studies to be undertaken on a larger number of cases that are clearly defined. Allied to this should be an educational program to ensure that multiprofessionals tasked with providing care to families with a child with DSD are suitably trained to discharge their responsibilities.

APPENDIX 1: ROLE OF SUPPORT GROUPS

The value of peer and parent support for many chronic medical conditions is widely accepted, and DSD, being lifelong conditions that affect developmental tasks at many stages of life, are no exception.

Those affected by DSD and parent members value the following:

- Peer support ends isolation and stigma, providing a context in which conditions are put into perspective and intimate issues of concern can be discussed safely with someone who has "been there."

- Children who form relationships with peers and affected adults early in their lives benefit from a feeling of normalcy early on, with support in place well before adolescence. Adolescents often resist attempts to introduce them to peer support.

- Support groups can help families and consumers find the best quality care.

Although clinical practice may focus on gender and genital appearance as key outcomes, stigma and experiences associated with having a DSD (both within and outside the medical environment) are more salient issues for many affected people.

Support groups complement the work of the health care team and, together, can help improve services. Initiatives by support groups have led to improvements in

management of DSD and research directed toward clinically relevant issues. Dialogue between health care professionals and support groups and collaboration as partners is to be encouraged.

APPENDIX 2: LEGAL ISSUES

Basic principles of medical law will remain even as research and clinical experience evolve in etiology, diagnosis, and treatment. This Appendix draws on practice in 3 countries on standards of medical negligence and patient informed consent. In the United States, the medical profession sets standards of care on the basis of prevailing medical custom.[89] However, a treatment may also be that used by a respected minority of practitioners.

Informed consent in the United States was founded on the principle of battery, whereby it is an offense to violate another person's bodily integrity without consent. Nowadays, most states are concerned with negligent nondisclosure to the patient. The standard of adequate disclosure may be physician based, requiring conduct of a reasonable practitioner, or it may be patient based, asking what a reasonable patient would find material. Physician-based disclosure must include information about risks, alternatives, outcomes, and prognosis, with or without treatment.

US courts assume that parents know what is best for their child when parental authority applies to consent for the child (substituted judgment). Parental decisions are deferred to except in situations in which potentially life-saving treatment is withheld. Consent to treatment by a child depends on an understanding of its nature and consequences.

Medical negligence in the United Kingdom defines treatment that falls below the standard expected of a reasonably competent practitioner. The standard of proof in court is whether negligence is demonstrated on the balance of probabilities. It is incumbent on the practitioner to demonstrate that treatment was consistent with a rationally defensible body of medical opinion. A shift in parental prerogative to consent to treatment was reflected in the Children Act 1989 in which parental rights were replaced by parental responsibilities. United Kingdom courts can intervene with orders made requiring or preventing a specific action related to the child. Age is not a barrier to informed consent, providing that a minor demonstrates an understanding of the issues sufficient to have the capacity to consent.

Colombian law is noted for a reasoned set of guidelines advanced by the highest court in cases of DSD.[90] A protocol was formulated for parental and physician intervention. The process of consent requires "qualified and persistent informed consent" over an extended period of time. Authorization is given in stages to allow time for the parents to come to terms with their child's condition. The court aimed to strike a balance between parental autonomy for those who did and those who did not want early surgery for their child until there was clear evidence of harm in deferring surgery until the child was competent to decide. Parents cannot consent for children over 5 years of age, because by then, children are deemed to have identified with a gender and, thus, are considered to be autonomous.

REFERENCES

1. Frader J, Alderson P, Asch A, et al. Health care professionals and intersex conditions. *Arch Pediatr Adolesc Med.* 2004;158: 426–429

2. Conn J, Gillam L, Conway G. Revealing the diagnosis of androgen insensitivity syndrome in adulthood. *BMJ.* 2005;331: 628–630

3. Dreger AD, Chase C, Sousa A, Grupposo PA, Frader J. Changing the nomenclature/taxonomy for intersex: a scientific and clinical rationale. *J Pediatr Endocrinol Metab.* 2005;18:729–733

4. Brown J, Warne G. Practical management of the intersex infant. *J Pediatr Endocrinol Metab.* 2005;18:3–23

5. Cohen-Kettenis PT. Gender change in 46,XY persons with 5-alpha-reductase-2 deficiency and 17-beta-hydroxysteroid dehydrogenase-3 deficiency. *Arch Sex Behav.* 2005;34:399–410

6. Meyer-Bahlburg HF. Gender identity outcome in female-raised 46,XY persons with penile agenesis, cloacal exstrophy of the bladder, or penile ablation. *Arch Sex Behav.* 2005;34:423–438

7. Zucker KJ. Intersexuality and gender identity differentiation. *Annu Rev Sex Res.* 1999;10:1–69

8. Cohen-Bendahan CCC, van de Beek C, Berenbaum SA. Prenatal sex hormone effects on child and adult sex-typed behavior: methods and findings. *Neurosci Biobehav Rev.* 2005; 29:353–384

9. Meyer-Bahlburg HF. Gender and sexuality in congenital adrenal hyperplasia. *Endocrinol Metab Clin North Am.* 2001;30: 155–171, viii

10. Nordenström A, Servin A, Bohlin G, Larsson A, Wedell A. Sex-typed toy play behavior correlates with the degree of prenatal androgen exposure assessed by CYP21 genotype in girls with congenital adrenal hyperplasia. *J Clin Endocrinol Metab.* 2002;87:5119–5124

11. Goy RW, Bercovitch FB, McBrair MC. Behavioral masculinization is independent of genital masculinization in prenatally androgenized female rhesus macaques. *Horm Behav.* 1988;22: 552–571

12. Wallen K. Hormonal influences on sexually differentiated behavior in nonhuman primates. *Front Neuroendocrinol.* 2005;26: 7–26

13. Moore CL. The role of maternal stimulation in the development of sexual behavior and its neural basis. *Ann N Y Acad Sci.* 1992;662:160–177

14. Wallen K. Nature needs nurture: the interaction of hormonal and social influences on the development of behavioral sex differences in rhesus monkeys. *Horm Behav.* 1996;30:364–378

15. De Vries GJ, Rissman EF, Simerly RB, et al. A model system for study of sex chromosome effects on sexually dimorphic neural and behavioral traits. *J Neurosci.* 2002;22:9005–9014

16. Skuse DH, James RS, Bishop DVM, et al. Evidence from Turner's syndrome of an imprinted X-linked locus affecting cognitive function. *Nature.* 1997;387:705–708

17. Hines M, Ahmed F, Hughes IA. Psychological outcomes and gender-related development in complete androgen insensitivity syndrome. *Arch Sex Behav.* 2003;32:93–101

18. Arnold AP, Rissman EF, De Vries GJ. Two perspectives on the origin of sex differences in the brain. *Ann N Y Acad Sci.* 2003; 1007:176–188

19. Luders E, Narr K, Thompson PM, et al. Gender differences in cortical complexity. *Nat Neurosci.* 2004;7:799–800

20. Paus T. Mapping brain maturation and cognitive development during adolescence. *Trends Cogn Sci.* 2005;9:60–68

21. Consortium on the Management of Disorders of Sex Differentiation. Clinical guidelines for the management of disorders of sex development in childhood. Available at: www. dsdguidelines.org/htdocs/clinical/index.html. Accessed May 30, 2006

22. Lee PA. A perspective on the approach to the intersex child born with genital ambiguity. *J Pediatr Endocrinol Metab.* 2004; 17:133–140

23. American Academy of Pediatrics, Council on Children With Disabilities. Care coordination in the medical home: integrating health and related systems of care for children with special health care needs. *Pediatrics.* 2005;116:1238–1244

24. Cashman S, Reidy P, Cody K, Lemay C. Developing and measuring progress toward collaborative, integrated, interdisciplinary health teams. *J Interprof Care.* 2004;18:183–196

25. Warne G. Support groups for CAH and AIS. *Endocrinologist.* 2003;13:175–178

26. Feldman KW, Smith DW. Fetal phallic growth and penile standards for newborn male infants. *J Pediatr.* 1975;86: 395–398

27. Schonfield WA, Beebe GW. Normal growth and variation in the male genitalia from birth to maturity. *J Urol.* 1942;48: 759–777

28. Fujieda K, Matsuura N. Growth and maturation in the male genitalia from birth to adolescence. II Change of penile length. *Acta Paediatr Jpn.* 1987;29:220–223

29. Tuladhar R, Davis PG, Batch J, Doyle LW. Establishment of a normal range of penile length in preterm infants. *J Paediatr Child Health.* 1998;34:471–473

30. Cheng PK, Chanoine JP. Should the definition of micropenis vary according to ethnicity? *Horm Res.* 2001;55:278–281

31. Zachmann M, Prader A, Kind HP, Häfliger H, Budlinger H. Testicular volume during adolescence: cross-sectional and longitudinal studies. *Helv Paediatr Acta.* 1974;29:61–72

32. Oberfield SE, Mondok, A, Shahrivar F, Klein JF, Levine LS. Clitoral size in full-term infants. *Am J Perinatol.* 1989;6: 453–454

33. Verkauf BS, Von Thron J, O'Brien WF. Clitoral size in normal women. *Obstet Gynecol.* 1992;80:41–44

34. Lloyd J, Crouch NS, Minto CL, Liao L-M, Creighton SM. Female genital appearance: "normality" unfolds. *BJOG.* 2005; 112:643–646

35. Grumbach MM, Hughes IA, Conte FA. Disorders of sex differentiation. In: Larsen PR, Kronenberg HM, Melmed S, Polonsky KS, eds. *Williams Textbook of Endocrinology.* 10th ed. Heidelberg, Germany: Saunders; 2003:842–1002

36. Ahmed SF, Cheng A, Dovey L, et al. Phenotypic features, androgen receptor binding, and mutational analysis in 278 clinical cases reported as androgen insensitivity syndrome. *J Clin Endocrinol Metab.* 2000;85:658–665

37. Morel Y, Rey R, Teinturier C, et al. Aetiological diagnosis of male sex ambiguity: a collaborative study. *Eur J Pediatr.* 2002; 161:49–59

38. Ogilvy-Stuart AL, Brain CE. Early assessment of ambiguous genitalia. *Arch Dis Child.* 2004;89:401–407

39. Quillin JM, Jackson-Cook C, Bodurtha J. The link between providers and patients: how laboratories can ensure quality results with genetic testing. *Clin Leadersh Manag Rev.* 2003;17: 351–357

40. Pagon RA, Tarczy-Hornoch P, Baskin PK, et al. GeneTests-Gene Clinics: genetic testing information for a growing audience. *Hum Mut.* 2002;19:501–509

41. Dessens AB, Slijper FM, Drop SL. Gender dysphoria and gender change in chromosomal females with congenital adrenal hyperplasia. *Arch Sex Behav.* 2005;32:389–397

42. Mazur T. Gender dysphoria and gender change in androgen insensitivity or micropenis. *Arch Sex Behav.* 2005;34:411–421

43. Clayton PE, Miller WL, Oberfield SE, et al. Consensus statement on 21-hydroxylase deficiency from the European Society for Paediatric Endocrinology and the Lawson Wilkins Pediatric Endocrine Society. *Horm Res.* 2002;58:188–195

44. Nicolino M, Bendelac N, Jay N, Forest MG, David M. Clinical and biological assessments of the undervirilized male. *BJU Int.* 2004;93(suppl 3):20–25

45. Mendonca BB, Inacio M, Costa EMF, et al. Male pseudohermaphroditism due to 5 alpha-reductase 2 deficiency: outcome of a Brazilian Cohort. *Endocrinologist.* 2003;13:202–204

46. Migeon CJ, Wisniewski AB, Gearhart JP, et al. Ambiguous genitalia with perineoscrotal hypospadias in 46,XY individuals: long-term medical, surgical, and psychosexual outcome. *Pediatrics.* 2002;110(3). Available at: www.pediatrics.org/cgi/content/full/110/3/e31

47. Lee PA, Witchel SF. Genital surgery among females with congenital adrenal hyperplasias: changes over the past five decades. *J Pediatr Endocrinol Metab.* 2002;15:1473–1477

48. Rink RC, Adams MC. Feminizing genitoplasty: state of the art. *World J Urol.* 1998;16:212–218

49. Farkas A, Chertin B, Hadas-Halpren I. 1-Stage feminizing genitoplasty: 8 years of experience with 49 cases. *J Urol.* 2001; 165:2341–2346

50. Baskin LS. Anatomical studies of the female genitalia: surgical reconstructive implications. *J Pediatr Endocrinol Metab.* 2004;17: 581–587

51. Crouch NS, Minto CL, Laio LM, Woodhouse CR, Creighton SM. Genital sensation after feminizing genitoplasty for congenital adrenal hyperplasia: a pilot study. *BJU Int.* 2004;93: 135–138

52. Meyer-Bahlburg HF, Migeon CJ, Berkovitz GD, et al. Attitudes of adult 46,XY intersex persons to clinical management policies. *J Urol.* 2004;171:1615–1619

53. American Academy of Pediatrics, Section on Urology. Timing of elective surgery on the genitalia of male children with particular reference to the risks, benefits, and psychological effects of surgery and anesthesia. *Pediatrics* 1996;97:590–594

54. Eroglu E, Tekant G, Gundogdu G, et al. Feminizing surgical management of intersex patients. *Pediatr Surg Int.* 2004;20: 543–547

55. Alizai N, Thomas DFM, Lilford RJ, Batchelor AGG, Johnson N. Feminizing genitoplasty for congenital adrenal hyperplasia: what happens at puberty? *J Urol.* 1999;161: 1588–1591

56. Bailez MM, Gearhart JP, Migeon CG, Rock JA. Vaginal reconstruction after initial construction of the external genitalia in girls with salt wasting adrenal hyperplasia. *J Urol.* 1992;148: 680–684

57. Mouriquand PD, Mure PY. Current concepts in hypospadiology. *BJU Int.* 2004;93(suppl 3):26–34

58. Bettocchi C, Ralph DJ, Pryor JP. Pedicled phalloplasty in females with gender dysphoria. *BJU Int.* 2005;95:120–124

59. Hurt WG, Bodurtha JN, McCall JB, Ali MM. Seminoma in pubertal patient with androgen insensitivity syndrome. *Am J Obstet Gynecol.* 1989;161:530–531

60. Rorth M, Rajpert-De Meyts E, Andersson L, et al. Carcinoma in situ in the testis. *Scand J Urol Nephrol Suppl.* 2000;205:166–186

61. Nihoul-Fékété C. The Isabel Forshall Lecture: surgical management of the intersex patient—an overview in 2003. *J Pediatr Surg.* 2004;39:144–145

62. Warne GL, Grover S, Zajac JD. Hormonal therapies for individuals with intersex conditions: protocol for use. *Treat Endocrinol.* 2005;4:19–29

63. Rogol AD. New facets of androgen replacement therapy during childhood and adolescence. *Expert Opin Pharmacother.* 2005;6: 1319–1336

64. Ahmed SF, Tucker P, Mayo A, Wallace AM, Hughes IA. Randomized, crossover comparison study of the short-term effect of oral testosterone undecanoate and intramuscular testosterone depot on linear growth and serum bone alkaline phosphatase. *J Pediatr Endocrinol Metab.* 2004;17:941–950

65. Mayo A, Macintyre H, Wallace AM, Ahmed SF. Transdermal testosterone application: pharmacokinetics and effects on pubertal status, short-term growth, and bone turnover. *J Clin Endocrinol Metab.* 2004;89:681–687

66. Weidemann W, Peters B, Romalo G, Spidler KD, Schweikert HU. Response to androgen treatment in a patient with partial androgen insensitivity and a mutation in the deoxyribonucleic acid binding domain of the androgen receptor. *J Clin Endocrinol Metab.* 2000;83:1173–1181

67. Kazak AE, Cant MC, Jensen MM, et al. Identifying psychosocial risk indicative of subsequent resource use in families of newly diagnosed pediatric oncology patients. *J Clin Oncol.* 2003; 21:3220–3225

68. Martin CL, Ruble DN, Szkrybalo J. Cognitive theories of early gender development. *Psychol Bull.* 2002;128:903–933

69. Zucker KJ. Measurement of psychosexual differentiation. *Arch Sex Behav.* 2005;34:375–388

70. Carmichael P, Ransley P. Telling children about a physical intersex condition. *Dialogues Pediatr Urol.* 2002;25:7–8

71. American Academy of Pediatrics, Committee on Pediatrics AIDS. Disclosure of illness status to children and adolescents with HIV infection. *Pediatrics.* 1999;103:164–166

72. Money J. *Sex Errors of the Body and Related Syndromes: A Guide to Counseling Children, Adolescents, and Their Families.* 2nd ed. Baltimore, MD: Paul H. Brookes Publishing Co; 1994

73. Basson R, Leiblum S, Brotto L, et al. Definitions of women's sexual dysfunction reconsidered: advocating expansion and revision. *J Psychosom Obstet Gynaecol.* 2003;24:221–229

74. Creighton S, Alderson J, Brown S, Minto CL. Medical photography: ethics, consent and the intersex patient. *BJU Int.* 2002;89:67–71

75. Ursano RJ, Bell C, Eth S, et al. Practice guidelines for the treatment of patients with acute stress disorder and post-traumatic stress disorder. *Am J Psychiatry.* 2004;161(11 suppl):3–31

76. Kuhnle U, Bullinger M. Outcome of congenital adrenal hyperplasia. *Pediatr Surg Int.* 1997;12:511–515

77. Warne G, Grover S, Hutson J, et al. A long-term outcome study of intersex conditions. *J Pediatr Endocrinol Metab.* 2005;18: 555–567

78. Creighton SM. Long-term outcome of feminization surgery: the London experience. *BJU Int.* 2004;93(suppl 3):44–46

79. Steiner E, Woernie F. Carcinoma of the neovagina: case report and review of the literature. *Gynecol Oncol.* 2002;84: 171–175

80. Schober JM. Long-term outcomes of feminizing genitoplasty for intersex. In: *Pediatric Surgery and Urology: Long-term Outcomes.* London, United Kingdom: WB Saunders; In press

81. Wisniewski AB, Migeon CJ, Meyer-Bahlburg HF, et al. Complete androgen insensitivity syndrome: long-term medical, surgical, and psychosexual outcome. *J Clin Endocrinol Metab.* 2000; 85:2664–2669

82. Honecker F, Stoop H, de Krijger RR, Chris Lau YF, Bokemeyer C, Looijenga LH. Pathobiological implications of the expression of markers of testicular carcinoma in situ by fetal germ cells. *J Pathol.* 2004;203:849–857

83. Cools M, Van Aerde K, Kersemaekers AM, et al. Morphological and immunohistochemical differences between gonadal maturation delay and early germ cell neoplasia in patients with undervirilization syndromes. *J Clin Endocrinol Metab.* 2005;90: 5295–5303

84. Cools M, Honecker F, Stoop H, et al. Maturation delay of germ cells in trisomy 21 fetuses results in increased risk for the development of testicular germ cell tumors. *Hum Pathol.* 2006; 37:101–111

85. Ramani P, Yeung CK, Habeebu SS. Testicular intratubular germ cell neoplasia in children and adults with intersex. *Am J Surg Pathol.* 1993;17:1124–1133

86. Hannema SE, Scott IS, Rajperts-De Meyts E, Skakkebaek NE, Coleman N, Hughes IA. Testicular development in the complete androgen insensitivity syndrome. *J Pathol.* 2006;208: 518–527

87. Warne GL, Bhatia V. Intersex, East and West. In: Sytsma S, ed. *Ethics and Intersex*. New York, NY: Springer; 2006:183–205

88. Small CL, Shima JE, Uzumcu M, Skinner MK, Griswold MD. Profiling gene expression during the differentiation and development of the murine embryonic gonad. *Biol Reprod.* 2005;72: 492–501

89. Martin PL. Moving toward an international standard in informed consent: the impact of intersexuality and the Internet on the standard of care. *Duke J Gend Law Policy.* 2002;9: 135–169

90. Sentencia SU-337/99, May 12, 1999; T-551/99, Aug 2, 1999 [Supreme Court decision, Colombia]

Consensus Statement on Management of Intersex Disorders

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