



The British Society for Human Genetics

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# Report on the Genetic Testing of Children 2010

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## Introduction

Genetic testing can play an important role in the care and treatment of children, for example, as part of the diagnostic process when children present with particular health problems, or to determine whether surveillance strategies might be beneficial. In such situations, genetic tests can offer immediate clinical benefits and should be utilised in the same way as any other investigation used to determine the best clinical management of a child.

Genetic tests can also generate information about children's health in the medium to long term future, rather than about current or imminent health problems. In this sense, genetic tests can be different from other investigations carried out during childhood, which are usually done primarily to investigate current health or disease status. Decisions about the optimum time to carry out a genetic test can raise difficult issues for health professionals, for parents and for children and young people themselves. Testing too late for childhood onset conditions may deprive them of care and advice that promotes their well-being. Testing too early may unnecessarily reduce a child's opportunity to decide for him or herself whether they wish to know about their genetic makeup; it may also produce information that many adults prefer not to know.

In 1994, a report from the Clinical Genetics Society (CGS) recommended that predictive genetic testing was appropriate where a medical intervention would be offered during childhood, but that such testing should not generally be undertaken for adult-onset disorders unless there were clear cut and unusual arguments in favour in any particular case. Much of the 1994 guidance was based on clinicians' and families' experiences with Huntington's disease (HD) - an adult onset condition for which there are still limited intervention or treatment options. Most adults at high risk of HD choose not to undergo predictive or presymptomatic testing; this includes individuals who have had detailed discussions about the possible sequelae of testing. Therefore testing a child for HD would remove the choice 'not to know' when there is evidence that many adults at risk prefer not to know, and when there are no clinical benefits in the years before children can make that choice for themselves.

The 1994 CGS report concluded that it was important to preserve or maximise children's future choices where no clear benefits would accrue during childhood. The report acknowledged that extrapolation from HD to other conditions might not always be appropriate, and called for more evidence about the potential harms and benefits of childhood testing for later onset conditions.

This report revisits the issues explored in 1994 in the light of subsequent developments. CGS is now part of the British Society for Human Genetics, which represents professionals working in human genetics in the UK and this report is written on behalf of the British Society for Human Genetics (BSHG). It is informed by research,<sup>1</sup> and takes into account developments including other guidelines published since 1994. We note that many clinicians have interpreted the 1994 guidance as more prohibitive of testing than was explicitly stated in the document.

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<sup>1</sup> We acknowledge that research into childhood testing for adult onset disorders has been limited, in part perhaps because the 1994 report has been interpreted as prohibiting such testing.

In this report, when discussing genetic tests we refer largely to physical tests of a person's DNA but we recognise that a genetic test result may also be achieved via other routes (for example, in part 3, case 7, we acknowledge that a renal ultrasound may be effective in diagnosing a genetic condition). Other clusters of clinical features may be so pathognomonic of a genetic condition that a DNA test is superfluous. A genetic diagnosis may also be reached by other techniques; for example, immunohistochemistry of tumour specimens may point to the existence of particular DNA mutations, as may tests of RNA transcription. We do not wish to limit the term genetic test to any particular technique but rather want to consider the potential problems of predicting a future disease or condition at some point before it can be medically managed or treated.

We also note that the term 'carrier' in relation to genetic test results has different usages. A carrier may refer to autosomal recessive disease, where a person who carries just one of the 2 mutant alleles required for disease status; for example a cystic fibrosis carrier. A carrier may refer to X-linked inheritance; a woman can be a carrier of the Haemophilia gene or of Duchenne Muscular dystrophy and may be an asymptomatic carrier or have some features of the disease (but usually in a milder form than the men in their family who have the mutant gene on their single X chromosome). However, the term carrier is also used for people who have balanced chromosomal translocations, or for autosomal dominant conditions: a woman with a BRCA1 gene mutation might be described as a 'BRCA1 carrier'

Part A of this report summarises our recommendations about genetic testing of children. Part B explains the legal and clinical rationale for those recommendations. Part C aims to assist professionals to use the recommendations through illustrative case studies.

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## Part A Recommendations/ Conclusions

1. Genetic testing in childhood often leads to better management of a child's condition. Where this is the case, for example where testing aids immediate medical management such as the initiation or cessation of surveillance or treatment, it is unlikely to be contentious. Nevertheless, the possible longer term consequences for the child and family should, where feasible, be discussed prior to testing.
2. Where genetic testing is primarily predictive of illness or impairment in the future, or is predictive of future reproductive risks, a cautious approach should be adopted. We recommend that in such circumstances testing should normally be delayed until the young person can decide for him/herself when, or whether, to be tested. The rationale for this recommendation is that testing in childhood removes the opportunity of the future young person to make their own choices about such decisions, and that opportunity should not be denied to them without good reason.
3. This does not mean that childhood testing for such conditions should never be done. For any particular child and family, the benefits of testing in childhood may outweigh the harms, but we believe that predictive genetic testing for a later onset condition should only happen when there are specific reasons not to wait until a child is older.
4. In each case where parents request genetic testing of a child when this is of no direct or immediate medical benefit, an assessment should be made of the balance of harms and benefits of such testing taking into account that decisions ought to be made in the child's best interests.
5. Even where a condition is likely to manifest during childhood, the principle of adopting a cautious approach still applies as there may be good reasons to defer testing until such time when surveillance might be implemented, including to enhance the opportunity for the child to participate in discussions. Where there is no realistic possibility of choice being exercised by the future young person before the condition might present clinically, the reasons to defer are weaker.
6. In many situations, therefore, an immediate decision about testing is unlikely to do justice to the complexity of the issues; ample time for discussion and consideration of the timing of a test with all relevant parties should be allowed. Health care professionals and parents should be enabled to spend time discussing the optimal timing of a predictive genetic test and facilitate, where appropriate, discussions within the family. Encouraging parents to talk to their children about their family history from a young age, so that they grow up knowing about it, will be integral to discussions about genetic testing.

## Part B Rationale

### *Legal considerations: consent, best interests and autonomy*

Like all medical tests (other than in an emergency where the necessity of immediate life saving treatment may override the requirement for consent), the genetic testing of children needs to be authorized by appropriate consent.<sup>2</sup> Health professionals are liable in law if they proceed without such a consent. They will also be accountable to their regulatory bodies for their practice and need to take into account ethical guidance to ensure that they act professionally. The principles set out in this document are intended to assist those who are asked to consider genetic testing in relation to children to meet both their legal and ethical obligations. While similar ethical issues arise in all countries, the particular context of UK law means that they may not necessarily be resolved in the same way.

As each professional remains individually accountable for their actions, the recommendations need to be used intelligently; i.e. to guide consideration and not to override professional judgements as to the best course of action. The circumstances of specific children will differ and sometimes the rationale that underpins the recommendation will not hold. In such cases, professionals should exercise their judgement as to whether there are reasons to outweigh the presumption against early testing.

In most cases, however, professionals will be able to follow the recommendations in the confidence that they will be acting in accordance with the considered views of colleagues and this will enable them to show that they are following accepted practice. This section explains the rationale behind the recommendations in order to allow professionals to satisfy themselves that they are applicable to the children whose care they are considering.

In the UK, the rights of children to exercise autonomy are recognized separately to the claims of parents to determine what happens within their families. The Gillick decision in 1985 established that parental rights were held by parents to enable them to carry out their responsibilities to look after their children and should be exercised in their children's best interests.<sup>3</sup> A series of court hearings considered cases where there was a clash between parental views of their children's best interests and those of others concerned with the child. They have established that the courts are not bound to follow parental views (even if they are reasonably held)<sup>4</sup> but must make an objective assessment of what the children's best interests indicate should happen. In practice, courts have shown that they are likely to accept health professionals' views of such best interests rather than those of the family. Thus, it is clear that parental requests for early genetic testing need to be considered, to see whether the professionals agree that they are in the best interests of the child concerned.

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<sup>2</sup> Gillick v W Norfolk & Wisbech AHA [1985] 3 All ER 402. For the emergency exception, see pp 424 and 435 and also Re S [1994] 2 FLR 416, at 420.

<sup>3</sup> Gillick v W Norfolk & Wisbech AHA [1985] 3 All ER 402.

<sup>4</sup> Re C (HIV Test) [1999] 2 FLR 1004 clarifying that the decisions in Re T [1997] 1 All ER 193 should not be taken as suggesting that reasonable parental views should be accepted. See also Re MM [2000] 1 FLR 224 where professional views on the child's best interest were preferred even though the parents views were found to be rational and understandable.

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In the UK judges expect doctors to protect children from their parents in those rare cases where they fear that parental decisions will be contrary to the interests of the child. Doctors are only expected to offer parents the opportunity for care and treatment that they think is clinically indicated and ethically appropriate. Decisions over children's care are a matter of partnership between clinicians and parents, in the interests of the children. As Lord Donaldson put it:

No one can dictate the treatment to be given to any child, neither court, parents nor doctors... The doctors can recommend treatment A in preference to treatment B. They can also refuse to adopt treatment C on the grounds that it is medically contra-indicated or for some other reason is a treatment which they could not conscientiously administer. The court or parents for their part can refuse to consent to treatment A or B or both, but cannot insist on treatment C. The inevitable and desirable result is that choice of treatment is in some measure a joint decision of the doctors and the court or parents.<sup>5</sup>

It follows that the law expects professionals to assess whether it is appropriate to offer genetic tests before they are of medical benefit. They are not obliged to do so if they believe it would be inappropriate to carry them out. Even where a court considers that such tests might be in the best interest of a child, they have stated that they would not require the professional to perform such investigations against their judgment.<sup>6</sup>

The Gillick decision also identified the importance of children's autonomy rights, establishing that children who had sufficient understanding of the matter to be decided had the legal authority to consent to treatment.<sup>7</sup> While such competence is presumed from the age of 16, it may exist at a younger age depending on the capacity of the child to understand the matter in question. The fact that the child is competent to consent does not remove the right of parents to give a legally valid consent up until their child's 18th birthday. That consent is available to authorize tests in addition to the consent of the child. Consequently, it would be lawful for a test to go ahead on the basis of parental consent even when a child is competent to decide, a position that protects health professionals from the risk of being sued for mistakenly adjudging a child to be incompetent.<sup>8</sup> The Axon decision in 2006 confirmed that girls were entitled to confidentiality against their parents in respect of abortion decisions. This demonstrated that the law recognizes children's autonomy and privacy rights are distinct from best interests questions. In particular, that those rights are independent of their family's view of where their best interests lie.<sup>9</sup>

The recommendations in this report give weight to this legal recognition of the value of young people's autonomy rights by suggesting that, wherever possible, decisions on testing should be delayed until young people can be involved in the decision. In the absence of a strong reason to take the decision earlier, it should be left for the young person to decide whether they wish the test to go ahead. Even where the test may need to be done before the young person is competent to provide the necessary legal authorisation, there is value in delaying until they can participate in the discussions. This reflects the commitment in Article 12 of the United Nations Convention on the Rights of the Child that a 'child who is capable of forming his or her own views [has] the right to express those views freely in all matters affecting the child, the views of the child being given due weight in accordance with the age and maturity of the child.' This participation right provides an independent reason for delaying decisions on testing until later childhood in cases where it is not outweighed by a strong reason for an early test.

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<sup>5</sup> Re J [1991] 3 All ER 930, 934.

<sup>6</sup> Re J [1992] 4 All ER 615.

<sup>7</sup> This position has been codified in Scotland in the Age of Legal Capacity (Scotland) Act 1991.

<sup>8</sup> Re R. [1991] 4 All ER 177; Re W [1992] 4 All ER 627.

<sup>9</sup> R (Axon) v Sec State for Health [2006] EWHC 37 (Admin).

Nevertheless, competent children's views are not determinative of the best interests question and courts can override even the views of a competent child if they believe that their best interests require it.<sup>10</sup> This shows that, in children (unlike with adults), autonomy rights do not always trump best interests judgements. In the case of a competent adult who rejects a treatment, there is no scope for that decision to be overturned by any other person or by a court. The adult him or herself is the only person legally authorized to consent.<sup>11</sup> In the case of a young person under 18, it may be possible for an alternative consent to be given if a person with parental responsibility or a court believes it is in the best interests of the child to do so. Thus, the principle of deferral pending competence should be displaced if it is necessary to do so to prevent harm to the child. In cases where there is an immediate clinical need for the genetic information, then it would jeopardize the child's interests if the test was delayed. This is the basis for the first recommendation, that testing may go ahead where it is expected to provide an immediate aid to management or surveillance of the child's health issues.

The Guidelines from the European Society of Human Genetics suggest that the only type of benefit that might justify presymptomatic or predictive genetic testing of children for late onset disorders would be the opportunity for preventive actions (such as preventive surgery or early detection as a prelude to a therapeutic intervention). It is not clear that UK law would restrict evidence of best interests to a narrow clinical context. In one case concerning an adult without the capacity to consent, preservation of family relationships was thought to be sufficiently valuable to the patient to mean that it was in her interests to be a bone marrow donor.<sup>12</sup> The Children Act 1989 requires courts making best interests judgments to have regard to the child's 'physical, emotional and educational needs' and also 'the likely effect on him of any change in his circumstances'.<sup>13</sup> One judge, considering a dispute over life-sustaining treatment for a child suffering from spinal muscular atrophy has suggested that best interests has an extensive compass:

Best interests are used in the widest sense and include every kind of consideration capable of impacting on the decision. These include, non-exhaustively, medical, emotional, sensory (pleasure, pain and suffering) and instinctive (the human instinct to survive) considerations.<sup>14</sup>

As a result of this legal context, the recommendations refer to 'best interests' as the definition of the reasons that might outweigh the presumption that testing should be delayed. This may be a broader category than that used in the European Guidelines and therefore more difficult to assess. However, it remains important that the evidence of benefit is clear and strong enough to outweigh the need for caution.

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<sup>10</sup> Re R. [1991] 4 All ER 177; Re W [1992] 4 All ER 627.

<sup>11</sup> Re MB [1997] 2 FCR 541; Re B (Consent to Treatment: Capacity) [2002] 2 All ER 449.

<sup>12</sup> Re Y [1996] 2 FLR 787.

<sup>13</sup> S 1(3), part of the welfare checklist.

<sup>14</sup> Re MB [2006] para 16.

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## Clinical considerations

### *Diagnostic testing*

As recognised in the introduction, genetic testing during childhood is appropriate in a range of contexts including situations where there is a diagnostic imperative. There can be value in achieving a diagnosis through genetic testing when this avoids a long series of medical investigations or invasive procedures. For example, a genetic test in a boy with a possible diagnosis of Duchenne Muscular Dystrophy might make a muscle biopsy unnecessary. In other situations, a genetic test may have management implications in a healthy child. For example, a child at risk of retinoblastoma can be spared repeated general anaesthetics to look for early signs, if a genetic test proves they have not inherited the condition.

There are also situations where genetic testing may be helpful to relieve familial anxiety. For example, parents of children at risk of Hereditary Motor and Sensory Neuropathy may be concerned that their child is showing early signs of the condition, and a genetic test may help resolve the significance of signs or symptoms. In such cases, although a genetic test would not be for immediate medical management, it is unlikely to affect the child's future autonomy because testing is likely anyway to take place in childhood before s/he would be able to play an active part in the decision making. Nevertheless, whilst the decision to do a genetic test may be relatively easy, the timing of it should still be considered carefully through discussions between professionals and the family. An example is where tests are requested on medical grounds in case a child ever requires emergency treatment and there may be value in knowing whether the child has a bleeding tendency, for example, a girl who might be a carrier of Haemophilia or is at risk of anaesthetic complications (e.g. a child at risk of myotonic dystrophy).

In other situations making a medical diagnosis may be the motive, but the decision to test may be more difficult. For example, a child at risk of Huntington's Disease (HD) may present with signs or symptoms that could be suggestive of the early stages of juvenile HD; a gene test may show s/he has the HD gene mutation but may not necessarily explain the child's clinical features. Another complex situation is where a test may generate a result but where there currently is no agreed or useful intervention. For example, a child with an adrenocortical tumour may be given a diagnosis of Li-Fraumeni syndrome through TP53 testing, but currently there is no medical intervention to offer and the condition has a poor prognosis.

In all of the above situations, a case could clearly be made to perform a test but the decision will be complex. A number of factors need to be taken into consideration and be part of the dialogue with parents, those with parental responsibility, or other health professionals who are requesting the testing. There will of course be other situations including carrier testing for autosomal recessive or X-linked recessive disorders where a child will almost certainly remain asymptomatic (even if they are carriers), and the major reason for testing would be for future reproductive planning. Requests may nevertheless be made for testing from those with parental responsibility.

## Parental decision-making and children's choices

Parental decision-making on behalf of their children and children's capacity to make choices can create challenges for genetics professionals. For both professionals and families there can be a considerable tension between recognising that parents have to make decisions on behalf of their children and protecting children's autonomy as future adults. In terms of parental requests for testing before it is of direct or medical benefit, we think it is important to be clear that saying "yes" or "no" at the outset is very unlikely to be helpful to either the family or to the professional(s). We recommend detailed discussions with the parents to discuss both their concerns and the reasons behind the professionals' views on the timings of any tests. Parents should be supported in communicating risk information to their children over time; using developmentally appropriate strategies would help to promote children's understanding of, and coping with, genetic information.<sup>15</sup>

We know that parents have a strong sense of a right to decide when to inform their children of their risk and when to have carrier testing done. We also know that parents feel a responsibility to help their children adjust to their genetic risk and to tell them of their carrier status prior to the possibility of reproduction.<sup>16,17</sup> However, even when parents claim such rights or express such a sense of responsibility, they may decide that they do not want their own child to be tested.<sup>18</sup> Children/young people often agree with their parents that genetic testing is important for reproductive decision-making and relationship-building; however, they also tend to favour testing at a later age and to express more concerns about the psychological risks associated with testing.<sup>19</sup>

It is difficult to determine the psychosocial harms and benefits of testing in childhood. Most discussions on this issue have focused on the right to make the decision and on the impact on the child's (future) autonomy. Opposition to genetic testing in childhood when there is no direct or medical benefit is rooted in concerns to protect the future autonomy of the child, i.e. preserving the right for the child to make her/his own decision.<sup>20,21</sup> On the other hand, it has been argued that parents have the right to make decisions on behalf of their children because they have primary responsibility for their child and they know their child best.<sup>22</sup> The lack of evidence to corroborate that testing young people would cause psychosocial harm and the fact that existing guidelines are based on assumptions rather than empirical evidence has also been highlighted.<sup>23</sup> Assumptions about harms have included possible lessened self esteem, distortion of the family's perception of the child, altered upbringing, discrimination and increased anxiety both of parent and child. Arguments in support of testing children/young people are that the untested child loses the opportunity to grow up with and adapt to genetic knowledge during his/her formative years and that not testing may cause harm if parents remain anxious and the young person finds uncertainty difficult.<sup>24,25</sup>

<sup>15</sup> Metcalfe A et al, Family communication between children and their parents about inherited genetic conditions: a meta-synthesis of the research, *Eur J Hum Genet*, 2008, 16:1193–1200.

<sup>16</sup> McConkie-Rosell A et al, Carrier testing in fragile X syndrome: When to tell and test. *Am J Med Genet*, 2002, 110:36–44.

<sup>17</sup> McConkie-Rosell A et al, Parental attitudes regarding carrier testing in children at-risk for fragile X syndrome. *Am J Med Genet*, 1999, 82: 206–211.

<sup>18</sup> Hamann H et al, Attitudes toward the genetic testing of children among adults in a Utah-based kindred tested for a BRCA1 mutation. *Am J Med Genet*, 2000, 92: 25–32.

<sup>19</sup> James CA et al, Perceptions of Reproductive Risk and Carrier Testing Among Adolescent Sisters of Males With Chronic Granulomatous Disease, *Am J Med Genet*, 2003, 119C:60–69.

<sup>20</sup> Working Party of the Clinical Genetics Society, 'Report on the Genetic Testing of Children', *Journal of Medical Genetics*, 1994, 31:785–797.

<sup>21</sup> Genetic Interest Group, GIG (now known as Genetic Alliance UK) Response to the Clinical Genetics Society Report: "The Genetic Testing of Children", GIG, London, 1994, 5–6.

<sup>22</sup> Robertson S and Savulescu J. Is there a case in favour of predictive genetic testing in young children? *Bioethics* 2001; 15: 2.

<sup>23</sup> Michie S, Marteau TM. Predictive genetic testing in children: the need for psychological research. *Br J Health Psychol* 1996;1:3–14.

<sup>24</sup> Elger BS and Harding TW. Testing Adolescents for a Hereditary Breast Cancer Gene (BRCA1). *Arch. Pediatr. Adolesc. Med.* 2000; 154:113–119.

<sup>25</sup> Clayton EW. Genetic Testing in Children. *J. Med. Philosophy* 1997; 22:233–51.

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Whilst these arguments are important, a focus on rights and autonomy has the potential to force parents and professionals into polarised positions. We feel it is more productive to encourage open communication and to discuss with the parents (and the child) what they have identified as the benefits/risks of testing.<sup>26</sup> We recommend that discussions with parents (and their children) should be framed around finding the best timing for the test, rather than whether or not it should take place. This will often lead to an agreement to defer the decision, especially if an offer is made to review the parents' request at a later date. On some occasions it may be appropriate to see children separately from their parents as well as with them. This is especially important to consider when children who are Gillick competent or young people over 16 request tests for adult-onset conditions or some types of carrier status.

### ***Predictive testing for Gillick competent children and young people age 16-17***

With regard to requests for predictive testing for adult onset conditions from Gillick competent children or young people age 16 and 17, we know that some young people are mature enough to make such decisions. When considering/assessing a young person's competence, we think the focus should be on the process by which a decision is made, rather than on the decision itself, because there is often not a right or wrong decision in such cases.<sup>27</sup> We recognise that not allowing young people to undergo predictive testing may be detrimental to the development of their autonomy,<sup>28</sup> and that there can be benefits of testing at this stage such as: incorporating the result into self-concept; the opportunity to make more realistic life planning; a reduction in uncertainty and anxiety; and, facilitation of openness in the family.<sup>29,30,31</sup> It is just as important to engage the young person as it would be the parents of a young child in a consideration of the 'pros and cons', rather than simply accepting the request for a test at face value.

We recommend using the following questions, as previously proposed by Binedell et al,<sup>32</sup> to form the basis of an assessment of the young person's competence to make a decision about predictive testing:

- Does the person show the necessary factual understanding of the nature and limitations of the test?
- Does the person show appreciation of the potential costs and benefits of the procedure and the test result, both personally and for his/her family?
- Is there consistency and stability of the decision over time?
- Does the person show a fairly stable set of values that will continue into the future?
- Is the adolescent the primary decision maker?
- Are there third party pressures evident in the request?
- Does the person understand the moral and family issues involved?
- What are the individual and family functions of the request?
- What is the family's way of discussing information and of sharing and making decisions?
- How much decision making responsibility has the person had within his/her family?
- Has the family structure and functioning enhanced opportunities for developing decision making competence?

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<sup>26</sup> McConkie-Rosell A and Spiridigliozzi GA, "Family Matters": A Conceptual Framework for Genetic Testing in Children, *J Genet Couns*, 2004, 13:9-29.

<sup>27</sup> Binedell J, Soldan JR, Scourfield J and Harper PS, Huntington's disease predictive testing: the case for an assessment approach to requests from adolescents *JMed Genet* 1996;33:912-918.

<sup>28</sup> Duncan RE, Predictive genetic testing in young people: When is it appropriate? *J Paediatr. Child Health* (2004) 40: 593-595.

<sup>29</sup> Duncan RE et al, "Holding your breath": Interviews with young people who have undergone predictive genetic testing for Huntington disease. *Am J Med Genet*, 2007, 143A:1984-1989.

<sup>30</sup> Ross LF, Moon MR. Ethical issues in genetic testing of children. *Arch. Pediatr. Adolesc. Med.*2000;154:873-9.

<sup>31</sup> Savulescu J. Predictive genetic testing in children. *Med. J. Aust.*2001;175: 379-81.

<sup>32</sup> Binedell J, Soldan JR, Scourfield J and Harper PS, Huntington's disease predictive testing: the case for an assessment approach to requests from adolescents *JMed Genet* 1996;33:912-918.

## Potential anomalies after prenatal diagnosis and newborn screening

Following prenatal diagnosis (PND), preimplantation genetic diagnosis (PGD) or newborn screening, parents may have genetic information about one (or more) but not all of their children. PND/PGD can lead to the identification of carrier/disease status in a pregnancy. If a couple seeks PND for a later onset condition but then decides against terminating an affected pregnancy, it will be known that the child will (very likely) develop the condition. If a couple request PND, the test may exclude the condition but identify the baby as a carrier. In PGD, unaffected embryos with good morphology are transferred for implantation, and the most suitable embryo may also be known to be an unaffected carrier. In this case, the resulting child's carrier status will be known.

Newborn screening aims to identify babies affected by a number of early onset conditions e.g cystic fibrosis, MCADD (Medium Chain Acyl CoA Dehydrogenase Deficiency) and sickle cell disease. However, screening also identifies some babies who are carriers. Concerns have been raised about how/whether to inform parents of their child's carrier status.<sup>33</sup> Knowing a child's carrier status means s/he can grow up knowing this (or be told about it when of reproductive age). One possible concern is that parents may not pass on the information accurately but, on the other hand, there would be significant logistical problems to ensure that genetic/other professionals pass the information on to a child at an appropriate age, and so it has been argued that withholding carrier status from parents is not justified.<sup>34</sup> We support the Human Genetics Commission's stance in their report 'Making Babies'<sup>35</sup> that this information should not be withheld from parents who indicate that they wish to receive it. One solution could be to develop screening techniques that do not reveal carrier status unless this would compromise the reliability of the test, or if information about carrier status is clinically important to the child's health; but the advent of high throughput genomic technologies means that this is unlikely to materialise. If carrier status is important to the child's health and its management, then recommendation 1 (p4) applies.

**We also recommend that the policy of routine disclosure of carrier test results which carry no medical implications for the child should be re-examined.** We acknowledge that this approach differs from that of the UK's National Screening Committee, which argues that parents should be routinely informed if a child is identified as a carrier, whether or not this has any implications for the child's health.

Parents who know that their baby is likely to develop a late-onset condition, and those told that their baby is a carrier following newborn screening, may have older children whose genetic status is unknown. Some parents are uncomfortable with this disparity and request carrier testing for their other children; they can find it difficult to understand why genetics professionals are sometimes reluctant to test their other children.<sup>36</sup> We see a difference between incidental and intentional carrier detection, but can understand parents' discomfort at the anomalous situation. In such circumstances, rather than simply testing for carrier status, it is important to consider the best way in which the other child(ren) could (i) learn about the possibility of being a carrier, and (ii) find out for certain whether or not this is the case.

Although the genetics professionals' preference may be not to test a child for carrier status, it is not appropriate to refuse all such parental requests automatically. It is important that the strength of professional resistance to such requests is proportionate to what is at stake in any particular case. Adamant and intransigent refusal to test can lead to confrontations and to a breakdown in the relationship with the family. Professionals should use (and document) informal or formal discussions with colleagues locally, supra-regionally, nationally (e.g. at the Genetics Club: [www.geneticsclub.org](http://www.geneticsclub.org)) or at clinical ethics committees for advice and support about difficult situations.

<sup>33</sup> La Pean A, and Darrell MH: Initially misleading communication of carrier results after newborn genetic screening. *Pediatrics* 2005, 116(6):1499-1505.

<sup>34</sup> Laird L, Dezateux C, and Anionwu EN: Fortnightly Review: Neonatal screening for sickle cell disorders: what about the carrier infants? *BMJ* 1996, 313(7054):407-411.

<sup>35</sup> Human Genetics Commission, *Making Babies: reproductive decisions and genetic technologies*, 2006, 3.48-3.50. <http://www.hgc.gov.uk/UploadDocs/DocPub/Document/Making%20Babies%20Report%20-%20final%20pdf.pdf>

<sup>36</sup> Parsons EP, Clarke A and Bradley D, Implications of carrier identification in newborn screening for cystic fibrosis, *Arch Dis Child Fetal Neonatal Ed*, 2003;88:F467-F471.

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## Adoption

The 1994 guidance recommended that genetic testing should only be carried out on a child being considered for adoption when this would also be done (at that stage) if the child was with his/her birth family. It was suggested, however, that this may not hold for predictive tests if it proves difficult to place a child for adoption because of the uncertainty of her/his genetic status; in this scenario, it was felt that the decision to put the child forward for adoption or to undertake genetic testing would need to be reconsidered. The BMA,<sup>37</sup> GIG (now known as Genetic Alliance UK)<sup>38</sup> and the American Society for Human Genetics<sup>39</sup> have a somewhat different opinion about this issue, and hold that the same approach should apply as does for children with their birth families.

Applying the same approach for adoptive children may not recognise the importance of matching the child and the prospective parents.<sup>40</sup> It is crucial that children should be placed with parents willing and able to care for them in order to minimise the risk of the relationship breaking down. Most parents-to-be would prefer to have a healthy child, and it would seem reasonable to assume this is the case for adoptive parents. However, almost 50% of children needing placement with a family have health problems.<sup>41</sup> These include physical disabilities, developmental delay, learning difficulties, behaviour problems and genetic conditions (including being at risk of an inherited disorder). The evidence suggests that children with these problems can be successfully adopted, particularly when the adopting parents are aware of what they will be facing as a family.<sup>42,43</sup>

A family willing to adopt a child at risk of an inherited disorder and to find out about their genetic status over time, as in the biological family, appears preferable to a family that sets genetic conditions upon accepting a child. On the other hand, adopting parents face multiple uncertainties about any child they adopt, and the desire to reduce uncertainty, when this is possible, is understandable. We think that there may be special circumstances which mean that genetic tests are undertaken for adoptive children, although they would not be carried out at that stage for children in the care of their birth families. Even so, we recommend caution for carrier testing (of future reproductive significance only) and even more so for predictive testing for later onset conditions (with no useful medical interventions in childhood).

One approach to genetic testing prior to adoption is to recommend that genetics professionals have an open discussion with the prospective parents. Testing then would not occur before prospective parents had met the child or while the child was being 'advertised'. This would create the opportunity for the specific genetic risks to the child being placed in the context of the background risks faced by any child and parent, and the additional potential risks to the child which may result from genetic testing. Such open discussions often resolve the difficulties without the need for genetic testing of a young child being considered for adoption. In the event of a persisting disagreement between the clinical genetics team and social services, it may be helpful to involve the relevant Trust's legal team. We have heard of cases where courts have ordered the genetic testing of children before it would have been of medical benefit and believe that improved discussions between the different teams involved might avoid such situations (see also page 6 para 3). Helpful advice is also available from the British Association of Adoption and Fostering.<sup>44</sup>

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<sup>37</sup> British Medical Association, *Human Genetics: Choice and Responsibility*, Oxford University Press, Oxford, 1998, 98-99.

<sup>38</sup> Genetic Interest Group, *GIG Response to the Clinical Genetics Society Report: "The Genetic Testing of Children"*, GIG, London, 1994.

<sup>39</sup> The American Society of Human Genetics Social Issues Committee and the American College of Medical Genetics Social, Ethical and Legal issues Committee, 'ASHG/ACMG Statement: Genetic Testing in Adoption', *American Journal of Human Genetics*, 2000, 66:761-767.

<sup>40</sup> Jansen LA and Friedman Ross L, 'The Ethics of Preadoption Genetic Testing', *American Journal of Medical Genetics*, 2001, 104:214-220.

<sup>41</sup> Turnpenny P (Ed), *Secrets in the Genes, Adoption, Inheritance and Genetic Disorders*, British Society for Adoption and Fostering, 1995.

<sup>42</sup> Holloway JS, 'Outcome of Placements for Adoption or Long-term Fostering', *Archives of Diseases in Childhood*, 1997, 76:227-230.

<sup>43</sup> Glidden LM and Cahill BM, 'Successful Adoption of Children with Down Syndrome and Other Developmental Disabilities', *Adoption Quarterly*, 1998, 1:27-43.

<sup>44</sup> <http://www.baaf.org.uk/>

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## Technological innovations

New genetic testing technologies, e.g. sequencing and microarrays, can generate substantial amounts of information, some of which will not have been anticipated when consent for testing was obtained. This is particularly true when undertaking genomic screening rather than targeted testing for a specific mutation. Careful prior consideration is needed about the information that might be generated (including, for example, incidental findings of adult risk of disease through array CGH), how this can best be covered in the consent process, and how it will be interpreted and fed back to the family.

## Re-contact of families at a later date

We recognise that policies towards following up or re-contacting families vary between different regional genetics services and may also depend on whether a particular disease register is active. Registers often review or re-contact family members around the time at which individuals at potential risk could benefit most from information related to family planning. Even where registers are not active we believe that consideration should be given to how a family might be contacted in the future, particularly if genetic testing is being deferred until a child can decide for themselves. The CGS Clinical Governance Committee<sup>45</sup> addressed the related issue of the re-contact of discharged families if new information were to become available (for example through new technologies) and recognised that this type of follow-up may become impossible to implement as the availability of new information outstrips the resources available to implement reliable re-call practice. They concluded that clinical geneticists and families together must share any perceived obligation to re-contact. However, we believe that if a request to test a young child is deferred until they are older, then plans should be discussed as to how this might best be reconsidered at a future date.

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<sup>45</sup> CGS Clinical Governance sub-committee 2001: <http://www.clingensoc.org/Docs/Standards/CGSFollowUp.PDF>

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## Part C: Clinical case examples

### *Case one: APC testing in a young child*

Peter has familial adenomatous polyposis (FAP) with a known mutation in the *APC* gene. Both he and his father have had bowel surgery in their 20s. He has a 1 year old son, Ethan, and would like him to be tested so that the family can prepare him early for hospital visits if he has inherited the condition. Ethan is unlikely to be affected before his late teens, although bowel screening for tumours would be recommended from 9-12 years. Peter and his wife are persistent in their request for testing now and cannot see why it should be delayed until Ethan is older.

The Clinical Genetics professionals explain that they would like to find the best time for testing Ethan and suggest that this may not be until he is older, when he could take part in discussions about his risk of inheriting FAP and the decision about testing. His parents do not understand why there might be any reason to defer testing. They agree to think about things but return in a few months saying they would like Ethan tested now. When the clinicians question their reasoning, they say they want the test now and will go elsewhere if it is not provided. They will call other genetics centres around the country, to see if anyone else will do the test and, failing that, they will seek to obtain it privately.

### *Discussion*

It seems that the contrasting approaches of parents and professionals have led to an unhelpful confrontation. The professionals are concerned to respect the future autonomy of the child but the parents feel it would be intolerable to remain in ignorance of their child's genetic status for so long and for so little purpose.

There are three ways that this situation could be handled:

(i) Adopting a position that the child's autonomy is paramount and so no genetic testing should occur until Ethan is competent to make the decision himself (when he is 16 years or Gillick competent). Until then, he should have annual colonoscopy from the age that bowel screening usually commences, although this might subsequently be shown to have been unnecessary.

(ii) It could be argued that testing should occur by the time that bowel screening 'should' commence, perhaps at 9-10 years. The timing should be decided upon so as to maximise Ethan's potential involvement in the discussion, although he might be too young to play much part in making the decision. Testing would accordingly be deferred until just before bowel screening would commence.

(iii) Deciding that testing should occur by 9-10 years of age and that the timing should be decided upon by the parents in discussion with the clinical genetics team. Ethan's involvement will be minimal whenever testing is performed in that period from 0-9 years, and any delay in testing during this period would seem unlikely to result in any appreciable increase to Ethan's autonomy. The key question might well be how his parents feel they would react to an adverse test result (or a good result) and whether the test result may have an impact upon other at-risk children in the family. The genetics team can raise these questions to help the parents make the best decision they can but it would, in essence, be their decision.

The working group considers that it is inappropriate in these circumstances to give much weight to Ethan's future autonomy. Furthermore, we recommend that Ethan has testing by the time he is ~10 years old. In practice, as almost all at-risk adults do choose to have the test to confirm their diagnosis, safeguarding Ethan's autonomy offers little tangible advantage.

Approach (i) leads to unnecessary procedures in many children that are of an unpleasant nature and not without risk and for which there is no compensating advantage.

Approach (ii) could be a valid approach if the recommended age for commencing tumour surveillance were somewhat later. This might arise in attenuated FAP, for example, with a likely age of onset in adult life and with no bowel screening recommended until >20 years.

In the case discussed here, we would favour approach (iii), in which the professionals support the family in coming to their decision about the timing of the test but do not argue for one time rather than another.

### *Case two: pre-adoption HD testing*

Carla is 2 years old and in foster care awaiting adoption. Her mother has a clinical diagnosis of symptomatic Huntington's disease (HD) and has been detained in a psychiatric institution. The identity and whereabouts of her father are not known. Adoption workers request a genetic test for HD for Carla, saying that she is already hard to place because of her family history, including violence and criminal behaviour in affected individuals. They argue that, without testing, Carla will probably not be placed. They also argue that if she is found not to carry the HD mutation (and there is a 50% chance of this) she will have a greater chance of being placed.

### *Discussion*

This case history relates to a child being considered for adoption, in which the weight of the presumption against early testing will be more substantial because of the pattern of decisions actually made by adults at risk of HD. Many never come forward for genetic counselling or testing; of those who do come forward to discuss their predicament and the question of predictive testing, many choose not to proceed. In all, about 20% of adults at risk of HD actually proceed with a predictive genetic test. There are two possible courses of action:

- (i) Advise the adoption agencies that testing should be delayed until Carla is in a position to make up her own mind about how to proceed;
- (ii) Proceed with testing on the basis that this might increase the chances of making a favourable adoption placement

The Working Party strongly supports option (i) in this case. Unless clear and compelling reasons exist to remove the opportunity for Carla to make her own decision, which would need to amount to exceptional circumstances, this possibility should be preserved. There is no medical benefit for testing during childhood or later and we believe that the argument put forward by the adoption workers would need to be challenged as it seems to make at least two unwarranted assumptions:

- (1) that the future for Carla, if she had an unfavourable test result, would be likely to be little or no worse than if she remained at risk, untested.
- (2) that the likely quality of placement available to Carla if she remained at risk of HD would be poorer than the likely quality of placement made available to her upon the condition of a favourable test result.

We would argue that the interests of the child with an unfavourable test result should not be sacrificed to her more fortunate sibling – and of course there may well be several children at risk in the same family – and an adopting family willing to accept a child of uncertain genetic status may be especially well suited to looking after a child in such circumstances. It is of course likely, although not certain, that the onset of disease in Carla – if she has the mutant HD gene – would be a long time in the future, so we would hope that this would not deter too many potential adopters from considering her. The additional family problems of violence and criminality will not be altered by the decision about HD gene testing.

Given the weight of the presumption against testing in this case, there would need to be compelling grounds for selecting option (ii) and performing a test now. We assert that such testing should not be requested by the adoption agency. If approach (ii) was being considered by an already identified potential adopter, for whom the test would make a major difference, then the appropriate professional response would be discussion with these prospective adopters to explain the importance of preserving the child's future choice, the lack of any intervention during childhood that could assist Carla before she would be able to decide for herself about predictive testing, and reassurance that HD symptoms are unlikely to manifest during the period of their parental responsibility. Potential adopters could be assured that the presumption against testing would be reconsidered if Carla was to develop symptoms of HD (i.e. develop a juvenile form of the disease) at a later stage in her childhood, and if testing was then regarded as being important for managing her symptoms more effectively. It is possible that some potential adopters might be dissuaded from adopting Carla in these circumstances but others will not be. It is also possible that the request from adoption workers comes from the belief that prospective adopters would want to have as much information as possible about a child's potential future, as well as from possible misinformation about the usual timings of such testing, rather than because they have evidence that prospective adopters are less likely to adopt an untested child.

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### *Case three: pre-adoption MEN1 testing*

Shane is 6 months old and in foster care awaiting adoption. His mother has drug and alcohol dependency. His father has Multiple Endocrine Neoplasia type 1 (MEN1). Social workers have requested that the clinical genetics team arrange for Shane to have a predictive test for MEN1, so that prospective adopters are better informed. Shane would not usually be offered any biochemical screening for the condition until 5 years of age. The genetics service thinks that testing would not be of immediate medical benefit and that Shane should not be treated differently from other children simply because he was being considered for adoption.

A Court Order was produced requesting that testing be performed without delay.

### *Discussion*

This case differs from the previous one in a number of ways. Firstly testing is often initiated around 5 years old before the child can contribute much to the discussion and certainly before they can make an autonomous decision. Secondly, in this case the Court has already made an order that testing should proceed.

Here the options include:

- (i) Delaying testing until Shane reaches the age at which testing becomes medically justified (around 5 years of age at the earliest),
- (ii) Testing without delay at the request of the social services (and the court),
- (iii) Testing after a process of discussion with (serious) prospective adoptive parents.

Factors in favour of option (ii) or (iii) include the consideration that the scope for Shane to be involved in the decision about testing, or even the discussion, will be very limited at 5 years of age. Deferring the test until near the time at which screening for tumours would start does not result in any substantial enhancement of autonomy. Whereas competence to decide is specific to each child and each decision, this factor is not likely to carry much weight as a reason to defer testing when it could well be performed for clinical reasons by the age of five years.

By analogy with Case One, we would suggest that the timing of this test should usually be decided in open discussion between the child's parents and the clinical genetics team. In this context, however, we suggest that it would be better for the clinical team to have these discussions with the child's potential adoptive parents rather than with Social Services or the Court. There is no immediate benefit of knowing the genetic information and therefore no clinical urgency to embark upon the testing before the child is part of his new family unit. We therefore favour option (iii) over option (ii). We would be open to a serious request to test Shane under option (iii) as long as the reasoning for doing so included a careful consideration of Shane's best interests by his prospective parents.

The adoption professionals seem likely to have pressed for option (ii) - immediate testing - and to have applied for a Court Order in the belief, often held amongst adoption professionals, that it is best to make available to prospective adopters as much information about the child as possible. Prospective adopters who are well informed, it is argued, are in a better position to successfully parent the child as they are able to anticipate and seek help and support for that child's problems. There is often a dearth of information about a child being considered for adoption and, as adopting parents usually have much less background knowledge about such a child than the biological parents possess, it may be helpful to resolve this uncertainty about the child's genetic constitution rather than adding to the uncertainty. However, consideration should also be given to potential adverse consequences of testing Shane now: genetic professionals would need to be satisfied that the benefits from earlier testing would be sufficient to justify deviating from usual practice. It is sometimes suggested that a test result might help the adoption agency to match prospective adopters and adoptees, although it is unclear whether this claim is justified; either whether it has ever been demonstrated that information about genetic status is helpful, or whether an adverse genetic test result (of which there is a 50% chance) might reduce the chances of successful placement. Testing should be done in Shane's best interests and not because it would make the process appear 'tidier' from the bureaucratic perspective.

Our suggestion would be to invite prospective adopting parents to meet with the clinical genetics team at an early stage, particularly if a request for genetic testing were made at a time when it would not usually be performed in other family settings. A decision can then emerge from these discussions. As noted above, the courts cannot insist that health professionals give care that they cannot conscientiously administer. (Re J [1991] 3 All ER 930, 934). This suggests that judges will be sympathetic to professionals declining to carry out tests even where a court has decided that the tests would be helpful. However, the court might then instruct an adoption agency to contact other professionals to see if they would be prepared to carry out a test.

A Radio 4 programme [[http://www.bbc.co.uk/radio4/science/ethicscommittee\\_20080820.shtml](http://www.bbc.co.uk/radio4/science/ethicscommittee_20080820.shtml)] examined the issues in a detailed debate of this case. Interestingly, the panel of experts decided unanimously not to test the child at this stage.

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### **Case four: neonatal testing for BRCA1**

Beverley's husband is known to have a BRCA1 mutation. During Beverley's pregnancy, her midwife mentions a prenatal diagnostic test, which Beverley declines on the basis that she would not want to terminate the pregnancy. Once her daughter is born she asks for a genetic test but is told that, because the disease is highly unlikely to manifest before adulthood, testing should be deferred. Beverley cannot understand why the test was offered during pregnancy but declined after birth.

### **Discussion**

While a woman is pregnant, the law does not recognize an independent status for the unborn child. On this basis prenatal diagnosis is permissible, especially where the woman might modify her reproductive plans on the basis of the test results. Once a child has been born, however, the legal context is dramatically different since the law requires that the interests of the child are considered independently of the parents' wishes. Those interests include protection against the restriction of her future autonomy unless there is a clear and specific reason to do so, relating to the current welfare and interests of the child. In this case, therefore, it would have been technically feasible, although unusual and perhaps controversial, to offer invasive, prenatal genetic diagnosis for a BRCA1 mutation in pregnancy although perhaps rather less controversial to offer PGD for this condition. By rejecting prenatal diagnosis, Beverley has implicitly decided to accept the risk that her daughter may carry the BRCA1 mutation.

In this case, however, the relevant question is whether or not to carry out a predictive test for a condition that is only likely to manifest in adulthood. The predictive testing of a young child for this adult onset condition is controversial. Two options are available:

- (i) Test for the BRCA1 mutation as a baby or young child
- (ii) Delay testing until the daughter can decide for herself.

Testing after birth cannot alter the risk to the daughter and so no benefit would accrue to her as a child. Testing would however, deprive the daughter of the opportunity to decide for herself whether and when she wished to know the genetic information. We know that when adults are offered such a choice, they do - after appropriate counselling - reach different conclusions. This strongly suggests that the choice is a valuable one, which should not be removed without good cause. This is why there is a presumption that testing should be deferred until the person to be tested can make her own decision; that, in turn, accounts for why this consideration carries very considerable weight. In this case, no reason has been identified to displace that presumption, and if one were offered it would need to be clear and precise to justify removing the daughter's future autonomy at this early age. Accordingly, we support option (ii).

### **Case five: carrier testing after newborn screening**

Richard and Jane have recently had a baby who was tested through a newborn screening programme for cystic fibrosis (CF) (an autosomal recessive condition in which affected children carry two altered copies of the CF gene). After a series of investigations, Richard and the baby are found to be carriers, whilst Jane is not. The couple have two older children aged 6 and 8 and request that these children are tested to determine whether they are also carriers. They do not want to distress their young children with an invasive test and therefore ask for this to be done with mouth brush kits. Both parents are interested to know what genetic endowment their children carry. Since the baby was tested routinely, they question why the older children cannot also be tested.

### **Discussion**

One approach would be to explain to the parents that newborn screening for cystic fibrosis is aimed at the identification of children affected by CF, (i.e. identifying children who have two altered copies of the CF gene) and does not have the goal of identifying healthy carriers (who have only one altered copy). Carriers are not identified intentionally but only 'inadvertently', as part of the overall process of excluding their being affected. Affected infants are given a range of treatments to limit the ill-effects of the condition. Once we are confident that a child is not affected, the question of their carrier status is of much less weight, at least until they are of reproductive age. This family has therefore been placed in an anomalous situation, with one child identified as a carrier of CF as part of that process of excluding the possibility that she might be affected by the disease, and with the other children untested, because there has been nothing to suggest that they might be affected.

There is a range of possible responses by professionals to this situation:

- (i) Test any child who may be affected by the disease, in order to diagnose and treat any child who is affected. This could be performed through genetic testing and/or a sweat test.
- (ii) Test all children on the basis that children who inherit one copy of the CF gene, and are therefore carriers, might use that information in the future to make reproductive decisions.
- (iii) Defer carrier testing until the children can at least participate in the discussion and the decision.

Approach (i) might be appropriate if there were any lingering doubts as to whether the older children might be affected. If there is no suggestion that the children are symptomatic, then testing might be performed to determine their carrier status, which might inform their future reproductive choices (option (ii)). However, reproductive choices are likely to be some years in the future and since carrier status will have no medical implications for the children in the intervening years option (iii) should be considered carefully. However, whilst the preservation of the children's autonomy is real and substantial – not to be brushed to one side – many families may approach this from a different perspective: with 1 in 20-25 of the population carrying a single mutant copy of the CF gene without serious adverse effects, parents may simply feel that it is inappropriate to be too restrictive (too 'precious') about such testing.<sup>46</sup>

It should be borne in mind that not all 'carrier testing' requests are equivalent even in a biological sense, so that testing for carriers of sex-linked and chromosomal disorders is often a weightier matter than for autosomal recessive disease. In sex-linked and chromosomal disorders, 'carriers' may themselves be affected by the disorder, to a variable extent. Furthermore, they may have more severely affected children regardless of the genetic constitution of their partner. For both reasons, it is appropriate for professionals to consider the timing of testing for carrier status of sex-linked and chromosomal disorders rather more carefully than for most autosomal recessive conditions. Where more is at stake, it is important that the young person is adequately informed about their reproductive risks and we believe this is more likely to be the case if they themselves are closely involved in any decision about genetic testing.

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<sup>46</sup> For example, the BMA Medical Ethics Committee amended their guidelines in 2009 to reflect this view.

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It can be argued that parents are the best people to raise the issue of carrier status for discussion with their children but this does not pre-determine when testing should take place. Early testing might ensure that such testing is not missed if the child is lost to follow-up but on the other hand, genetic testing of a young child in this context can offer no guarantee that the children will be told their results when older, nor that they would have independent support to assess its implications for them. We argue that the parents' primary responsibility lies in raising the topic for discussion with the child in an age-appropriate fashion. The possibility that the child may be a carrier is then incorporated gradually over time. The precise point at which testing occurs is then of lesser importance and can be determined in open discussion between parents, professionals and (when appropriate) the child.

Whether or not testing is performed in young children, there will be a need in many families for support in discussing the situation – the technical aspects and the more personal, emotional dimensions – with the child as they grow older and become adolescents and then young adults. The danger of glossing over these aspects of communication within the family, when testing has been performed in young children, may add to the factors that encourage professionals to challenge a parental request for carrier testing. On the other hand, these considerations should not weigh so heavily as to prohibit carrier testing.

### **Case six: predictive testing for Li Fraumeni syndrome**

Daniel is 5 years old. His father has just died from an aggressive sarcoma at the age of 35. There is a strong family history of breast cancer and sarcoma on his paternal side. A TP53 gene mutation has been identified and there is a 50% chance that Daniel has inherited it. There are no evidence based interventions such as tumour surveillance or treatments that Daniel can have but there is a chance he might develop a cancer during childhood. Although his mother realizes that no established interventions are available if Daniel has inherited this mutation, she is desperate to know whether he has inherited this cancer risk from his father.

### **Discussion**

This a very difficult set of circumstances for the family to cope with. In general, the decision about whether to proceed with a test depends upon a combination of the severity of the condition, the likely age of onset, the availability of useful surveillance or prophylactic treatment and thus a package of overall risks and benefits associated with proceeding with the test. The two possible approaches in this case are:

- (i) To decline/ defer testing for the TP53 mutation
- (ii) To agree to mutation testing in the near future.

Arguments in support of option (i) are that there is no medical or other intervention that would provide a clinical justification for testing, to outweigh concerns about the loss of Daniel's future autonomy (to preserve the possibility of him making his own decision in the future about whether to find out if he carries the mutation). If the disorder were only rarely of childhood-onset, then this would strengthen the argument against genetic testing in a 5 year old boy. Even if there is a possibility of the cancer manifesting itself in childhood, this would not necessarily indicate that testing should take place in the absence of protective measures that could be taken. In this condition however, while only a minority develops problems in childhood, this happens with sufficient frequency (~20%) that a case can be made for testing children, who are known to be at risk, especially if the family group is supportive. Another reason for adopting this approach might be if the family's anxiety levels were enormously high to the extent that their concerns were crippling.

If there is specific evidence that this boy's mother is so anxious that it may be adversely affecting his well-being, then it would be necessary to assess whether her anxieties are sufficient to outweigh the presumption against early testing. This would require evidence that, in Daniel's case, knowledge that he was unaffected would lead to changes in parenting that would be sufficiently beneficial to displace the presumption against testing. This might include clear evidence that the mother's understandable anxieties could not be managed without testing. It would also be necessary to consider how his mother would respond if the test result were unfavourable; would she find this even less tolerable and more anxiety-provoking than his current position of being at 50% risk?

There is no clear and simple position that will be applicable in all circumstances.<sup>47</sup>

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<sup>47</sup> See also: Ainsley J Newson Clinical Ethics Committee Case 8: Should we carry out a predictive genetic test in our young patient? Clin Ethics 4(4): 173—175.

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### **Case seven: screening vs predictive testing for polycystic kidney disease**

Mark aged 6 and Stella aged 2 were referred by a paediatrician for consideration of genetic testing for autosomal dominant polycystic kidney disease (ADPKD). Michael, their 32 year old father, has just been diagnosed following presentation with hypertension. Michael's father had died of renal failure at the age of 62. Michael had not known the cause of his father's renal failure but it is now presumed that this may have been ADPKD. Once the diagnosis had been made in Michael, his physician had suggested to the GP that his children be referred to a paediatrician for screening. The paediatrician had offered to see the children annually for blood pressure (BP) checks, urinalysis for evidence of silent infection and assessment of renal function but did not think that regular renal ultrasound scans would be worthwhile in the absence of urinary tract infection (UTI) or other evidence of renal problems.

It was explained that each child has a 50% chance of inheriting the disorder but the chance of developing symptoms in childhood was low. If the causative mutation could be identified in Michael, genetic testing could be offered to Mark and Stella and if either did not carry the gene they would not require regular follow-up. If the mutation was not known, then a renal ultrasound scan could be arranged if evidence of UTI or renal problems is found or once the children/ young people were old enough to seek information for themselves. While the finding of bilateral cysts would indicate a diagnosis of ADPKD, the absence of cysts does not exclude such a diagnosis until 30 years or so.

Michael and his wife do not want to pursue gene testing as they do not want to know definitively if their children are affected, though they are happy to take them along for BP checks. Furthermore, they indicate that they do not want to tell their children about the disorder in the family as they do not want to worry them or affect their future ability to obtain life insurance. The paediatrician suggested referral for genetic counselling to help clarify the issues about communicating genetic information within the family.

### **Discussion**

This case contrasts with the previous cases in that the parents do not want genetic testing of their children, yet genetic services are asked to help with communicating risk information. In this case a renal ultrasound may provide the result of a genetic test, though as noted a normal ultrasound in young children would not exclude the presence of a polycystic kidney disease gene mutation.

Three broad approaches to managing the uncertainties exist:

- (i) Monitor the children for evidence of ADPKD through clinical surveillance as outlined, deferring renal ultrasound until clinically indicated and a decision about genetic testing until each child can make their own decision;
- (ii) Proceed with genetic testing on the basis that it can be used to assess which other screening tests might be necessary to manage the condition;
- (iii) Do nothing until either child presents with possible symptoms or signs from ADPKD, such as urinary infection.

In a condition like ADPKD there is no substantial risk to the child's physical health through providing non-invasive screening to detect complications. In the longer term, health problems may result if young adults remain unaware of their risk. It is therefore common for paediatricians and clinical geneticists to recommend that a child at risk of ADPKD should begin annual checks of blood pressure and urinalysis for infection at any age but certainly by the late teenage years.

Arguments in favour of approach (ii) may be more compelling in the context of other diseases, where both the risk from the disease and the risk from the procedures used in surveillance in childhood are potentially greater - such as retinoblastoma, where repeated general anaesthetics may be required.

Approach (iii) carries some risks, even in a condition such as ADPKD, since hypertension may be the first manifestation of the disease and, if untreated, it may worsen the risk of stroke, of coronary artery disease and of chronic renal failure. This may be especially important in young women, as renal complications may arise in, or be exacerbated in the course of, a pregnancy.

Approach (i) is least controversial since this is the stated wish of the parents but we believe that informing children of their risk is an important consideration in this family. This is because, if the children are engaged in the process, particularly as young adults, then they can be involved by promptly following up any symptoms that arise through appropriate investigation, perhaps by renal ultrasound scan in early adult life, as well as by monitoring for hypertension and silent urinary infections. Failure to inform the child or young person of his or her risk may result in an inadequate response to symptoms once he or she leaves home and takes responsibility for his or her own health. This can clearly lead to worse health outcomes if, for example, persistent hypertension remains undiagnosed and neglected for years. In addition, such persisting ignorance will affect the autonomy and opportunity for choice of young adults in relation to health screening and reproduction. If parents withhold information about the condition throughout the teenage years, they may find it increasingly difficult to find “the right time” both to pass on the information and to justify the reasons for the delay.

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## Appendix A:

Attendees at symposium held at Wolfson College Oxford March 2008 to discuss practical, ethical and legal issues in genetic testing of children:

1. Bruce Castle
2. Tara Clancy
3. Angus Clarke
4. Gareth Evans
5. Veronica English
6. Angela Fenwick
7. Frances Flinter
8. Alan Fryer
9. David Gokhale
10. Chris Goard
11. Alison Hall
12. Barbara Judge
13. Anneke Lucassen
14. Carole McKeown
15. Shehla Mohammed
16. Jonathan Montgomery
17. Ruth Newbury-Ecob
18. Michael Parker
19. Chris Patch
20. Graham Shortland
21. Helen Stewart



The British Society for Human Genetics

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# Report on the Genetic Testing of Children 2010

**BupaFoundation**  
*The Medical Research Charity*

**welcome**trust

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