When the future lies in the genes
Non-invasive prenatal tests and their consequences

Abridged version of the study «Wissen können, dürfen, wollen? Genetische Untersuchungen während der Schwangerschaft»
New methods in genetic analysis allow the detection of genetic abnormalities in a pregnant woman’s blood, making it relatively simple to make early statements about chromosomal anomalies and other genetic traits of the unborn child. Non-invasive prenatal tests (NIPT) that have been available for a few years are very reliable, and the risks to the fetus associated with invasive procedures such as amniocentesis are avoided.

With a broader application of NIPT and with an increasing number of diseases that can be investigated, open questions arise. Which tests are appropriate? How do the affected persons cope with the information? How is the consultation secured? In the interdisciplinary study, the opportunities and risks of prenatal genetic examinations are assessed. The study shows how the new tests could affect prenatal diagnosis, analyzes social, ethical, legal, and economic issues, and formulates recommendations.
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Non-invasive prenatal tests in brief

Children represent our future, and on them rests parents' hope that they will be able to perpetuate their family history. Babies should therefore benefit from the best possible starting conditions: one's desire for one's offspring is that they are healthy and strong.

Since the 1980s, pregnant women in Switzerland have been routinely offered tests to enable them to find out whether their baby is laying correctly and developing properly – and if need be to initiate therapeutic or other precautionary measures even before the birth. Although the current ultrasound tests provide relatively reliable results, their informative value is not absolute. Especially when they indicate that the embryo may possibly have a medical condition, a more detailed investigation will be recommended to the expectant mother. Until now, this has necessitated removing cells from the placenta or amniotic fluid. However, these invasive procedures increase the risk of a miscarriage.

More recently, so-called non-invasive prenatal tests (NIPT) have been available that only involve blood being taken from the pregnant woman. From this are extracted fragments of the embryonic genetic material, which is then tested for possible genetic defects.

Its opportunities...

These non-invasive prenatal tests are obviously much lower risk than procedures in which cells have to be removed from the placenta or the amniotic fluid has to be punctured. In addition, if there is a greater risk at the outset, NIPT make it possible to predict, with 99 percent certainty, Down's syndrome (trisomy 21) in particular. As a result, women are on the one hand less often stressed by false-positive test results, and on the other the need for invasive tests is reduced – and

The ultrasound test makes it possible, even in the early stages of the pregnancy, to look at the foetus and detect some characteristics. If there are signs of any malformation, further clarifications are necessary. It is important for the pregnant woman to receive comprehensive consultation about the benefits and risks of the tests.
hence also the number of miscarriages that are caused by such tests.

NIPT are therefore beneficial to the self-determination of pregnant women: they may opt for a prenatal test without fearing adverse consequences for the health of the foetus. The tests also reinforce the parents’ right to know, and provide criteria for making decisions if it comes to the question of whether the pregnancy should be continued or terminated.

…its risks …

Even the new prenatal tests cannot provide completely accurate results. The earlier such a test is done, the less precise it will be. In rare cases, it can also happen that the foetal chromosome set in the blood sample does not match the actual genome of the foetus. Accordingly, in one or two percent of cases this may lead to false-positive or false-negative results.

If low-risk tests are available, it is possible that social pressure will increase on pregnant women to undergo such tests as well. As a result, society could eventually be inclined to be less accepting of disabled people.

There is also a considerable risk here that NIPT could in future be offered as a matter of routine. This would again conflict with the self-determination of expectant mothers – especially if the new tests were introduced without the necessary consultation and information.

Rapid development in the field of genetics and the corresponding tests makes it difficult for experts to keep constantly up to date with the available knowledge. The task of informing expectant mothers correctly is correspondingly challenging.

Depending on the findings, genetic tests can affect not only the person actually being tested but also his or her blood relations. Nor can the possibility be ruled out of tests on genetic material also bringing to light incidental findings – e.g. indications that the mother is ill. The requirements with regard to data protection are correspondingly high.

… and some key recommendations

Appropriate, comprehensive consultation that goes beyond the purely medical, which allows the pregnant woman complete freedom of choice and places no pressure of any kind on her, is indispensable for the positive potential of the new prenatal tests to have an effect. Consideration must be given to training specialist genetic counsellors, as well as creating interdisciplinary points of contact.

Routinisation effects must be avoided. That is because pregnant women must continue to be able to exercise their right not to know. It should be left to them to say whether, and if so which, tests they wish to avail themselves of.

The new tests should logically be made part of the existing medical support facilities for pregnant women. In particular, it must be ensured that they do not replace the ultrasound; because if the latter were abandoned this would lead to a clear deterioration in the care of expectant mothers, as it can also detect other malformations and developmental setbacks.

The present abridged version is based on the study on non-invasive genetic prenatal tests that was carried out by a project team led by Susanne Brauer and Jean-Daniel Strub for TA-SWISS. The Brauer & Strub research bureau in Zürich specialises in analysis in the fields of medicine, ethics and politics. Apart from TA-SWISS the study also received financial support from the Commission for Technology and Innovation (CTI), the National Advisory Commission on Biomedical Ethics (NCE) and the Swiss Academy of Medical Sciences (SAMS).
Starting a family usually involves careful thought beforehand. For several decades it has been possible to detect certain medical conditions in the unborn baby at an early stage. Now there are also tests on the market which trace genetic anomalies from analyses of the mother’s blood without harming the foetus in the process. The new analytical methods could mean profound changes in pregnancy support.

Around 85 000 babies are currently born in Switzerland every year. Every one of these births represents a small biological miracle: in just nine months a new human being matures in the pregnant woman’s uterus.

However, only about one in two fertilised eggs develops into a baby. In other cases, within the first weeks after fertilisation, even before the tiny bud has been able to implant itself in the uterus, early and mostly unnoticed spontaneous abortion occurs. It is often chromosomal defects which cause the abortion. Nature ensures that it is primarily healthy foetuses which continue to develop. It is ultimately only 3 to 4 percent of unborn babies who have any anomaly at all, and only one percent of those who present with genotype defects.

An initial test to determine any medical conditions

Once the fertilised egg has implanted itself in the uterus, pregnancies normally proceed without complications – apart from sometimes troublesome but harmless complaints. And medicine has developed methods of detecting possible risks to the health of the unborn child early on, so that if necessary therapies can be initiated even before birth.

Also circulating in the pregnant woman’s blood stream are fragments of the genetic material of the foetus. Her blood can therefore be used for tests on the foetal DNA.
The so-called first-trimester test includes an ultrasound scan, as well as an analysis of the pregnant woman’s blood. This “baby-TV” provides information including how far advanced the pregnancy actually is and when the birth will occur. It also identifies how vital the foetus is, how it is laying and whether multiple births are to be expected. Certain physical characteristics also indicate whether the child could suffer from defects of the abdominal wall or of the neural tube – i.e. from “spina bifida”. It is also possible to determine if there is an increased risk of Down’s syndrome (trisomy 21), a medical condition whose cause cannot be treated. For this so-called nuchal translucency in particular is assessed, because a thick fold in the nape of the child’s neck can be a sign of this disease. Trisomy 21 is one of the best known chromosomal disorders. It is caused by a genetic mutation that has the effect of the entire chromosome 21, or parts of it, being present in a set of three, rather than two. Trisomies can occur in principle in any of the total of 23 sets of chromosomes; however, beside those with trisomy 21, only children with trisomy 18 and trisomy 13 are viable, both of which involve very serious disabilities and mostly lead to death after a few months.

The biochemical blood analysis values complement the ultrasound images. The alpha-fetoprotein value is particularly significant here. An increased content of this protein compound in maternal blood indicates a defect in the neural tube, while a value that is too low can be an indication of trisomy 21.

**Certainty bought by risks**

The results of the first-trimester test are indeed relatively reliable. But they do not offer absolute security. In the case of trisomy 21, for instance, the test on 100 foetuses that suffer from this chromosomal defect detects 90 correctly, while in 10 the condition remains undetected. But the opposite can also occur, with 5 percent of those determined as positive, and therefore as affected, actually being healthy foetuses.

For pregnant women who are faced with an unfavourable test result, the physician will therefore suggest a more detailed analysis. This will entail either puncturing of the amniotic fluid (amniocentesis) or removing tissue from the placenta (chorionic villus sampling or placentalcentesis). In both procedures cells can be extracted that match those of the embryo and thus enable analysis of its genes. The disadvantage: these are so-called invasive, i.e. tissue damaging, procedures, which increase the risk of the pregnant woman suffering a miscarriage. Studies estimate the risk of miscarriage at 0.5 to 1 percent.

**A new, non-invasive test**

In pregnant women’s blood, roughly one cell in ten million is of foetal origin; otherwise there are also free swimming segments of genetic material, so-called cell-free DNA. Although 90 percent of this comes from the mother, the remaining 10 percent of the cell-free DNA is suitable for the new prenatal tests. That is because biomedical research has developed methods of reproducing the DNA, so that even a small amount of genetic material is enough for a genetic analysis. Foetal genetic material from the mother’s blood therefore enables the foetus to be examined for possible chromosomal defects.

Studies up to now confirm that certain trisomies are identified with high reliability by the new non-invasive prenatal tests (NIPT). The results for trisomy 21 are particularly reliable. Out of one hundred cases of Down’s syndrome 99 are detected, and the rate of false-positive results is less than 1 percent.

Although NIPT have only been on the market since 2012, there is already high demand for them. In the Swiss laboratories officially licensed to carry them out, 4,366 of these analyses were reported for the year 2013; the actual number could, however, be considerably higher. The tests have therefore already led to shifts in prenatal tests: since their introduction, at the University Hospital of Basel, for instance, invasive diagnostics has fallen by 67 percent. On the basis of simulations, it must therefore be assumed that in future, non-invasive prenatal tests will reduce the number of amniocenteses and chorionic villus sampling by 95 percent. There could therefore also be a concomitant fall in the number of miscarriages to be expected.

**No absolute guarantee, despite high reliability**

Even if the non-invasive tests give reliable results for certain medical conditions, they do not provide any guarantee whatsoever that the child will be healthy. The high hit rate for trisomy 21 is in any case not achieved for other trisomies; for a trisomy 13, the figure is about 90 percent, and it could be even lower in respect of other genetic anomalies.

There is also the fact that information about the genetic defect does not as such allow any conclusions on the severity of the health impairment. In the case of Down’s syndrome, for instance, there are people who have relied on help all of their lives, while others manage a school-leaving qualification and are able to cope with everyday life independently. With other abnormalities of the genotype, too, it is often difficult...
or even impossible to estimate what limitations they will actually entail.

Furthermore, it also has to be borne in mind that NIPT only investigate genetic conditions, and therefore cover a relatively narrow segment of conditions which may affect a child. A good test result must therefore not be misunderstood as a guarantee of a healthy child. And even if all prenatal – including non-genetic – analyses prove the integrity of the foetus, the birth process itself involves certain risks. Seen in this light, a healthy child is a gift that fate generally blesses us with, but without any guarantees about favourable test results.

**Further surge in development likely**

Over the next five years, there will be further developments in non-invasive prenatal tests: they will become even cheaper and more reliable. Technical advances, too, will lead in future to the detection of even more chromosomal anomalies; it will therefore be possible to investigate and to research hitherto unknown malformation syndromes mostly prenatally. It is also conceivable that more and more parents will undergo a genetic risk analysis even before a planned pregnancy, if they have to face the fear of being the carrier of a genetic disorder.

In ten years’ time, NIPT will deliver information in even sharper resolution: in technically sophisticated form, the tests will be able to deliver information on the sequence as well as on the number of copies of any region of the DNA or of the entire genome. But even with this high quality, serious diagnoses are not expected for even longer, because in many cases it is not clear what clinical picture will result from the individual gene mutation. Such knowledge can only be developed gradually by the systematic collection and analysis of all data. It is also true that many conditions do not manifest themselves until later in a person’s life, and the course of the condition will be influenced by other factors; a lot more research will have to be done to decode the complex connections. That is also the case with regard to inheritable positive characteristics such as beauty and intelligence. In the foreseeable future, too, we will barely be able to prenatally diagnose such features reliably, because we do not know the many genetic variants that would enable a reliable prognosis.
Pregnancy in the focus of society and economy

Parents wish for healthy children, and the community is also building on a young generation that is in a position to meet the expectations of society and economy. Non-invasive prenatal tests are therefore of major social and economic significance.

When it comes to assessing a particular issue, the question that arises immediately is the perspective from which the assessment should be based. The study by TA-SWISS weighs up the advantages and disadvantages of the new prenatal tests from the point of view of pregnant women. Every other standpoint would be either speculative – because if the argumentation is based on the unborn and possibly severely disabled child – or patronising, if, for instance, family or social interests are placed before the personal concerns and values of the mother-to-be.

There's a lot that a lot of people don't know

Pregnancy is a time that is full of expectation, but also a time fraught with worries, when what many pregnant women wish for is security. Thanks to the prenatal test, they want to be able to rule out the possibility of their child suffering from one of the diagnosable disabilities. The test helps others to decide whether they should give birth to their child at home, in a birth centre or in hospital. However, a not insubstantial number of mothers-to-be deliberately decide not to take a test, because they want to accept their child as it is: in Switzerland, for instance, 30 to 40 percent of pregnant women forego a first-trimester test. Nevertheless, there are differences between the regions, with expectant mothers in French-speaking Switzerland being much more inclined to undergo prenatal tests than those in German-speaking Switzerland. Also, prenatal tests are more commonly used in towns and cities than in rural areas. And finally, women from a migrant background likewise take up prenatal checks less frequently than the average; the assumption being that language barriers prevent them from getting the information, or that they decline prenatal investigations on cultural or religious grounds.

What pregnant women know about prenatal testing depends very much on their level of education. In a survey conducted in Germany in 2004, about half of the women taking part in weeks 20 to 40 of pregnancy were unable to explain or gave a wrong explanation for the expression «prenatal testing» – despite the fact that 85 percent of those surveyed had already undergone at least one such test. Studies from Switzerland indicate that the level of knowledge is not much higher in this country. Accordingly, fewest of the mothers-to-be, even before the test, are thinking about what they want to do if the result indicates that there is something wrong with their baby.

In many cases, non-invasive prenatal tests are being taken up on a relatively impartial basis and few questions being asked – because the foetus is not endangered as a result. The situation seems different with an invasive test, if the couples concerned have to weigh the likelihood of a disability against the risk of a miscarriage being caused by the intervention. Many of those affected feel this decision to be serious and stressful. Women also generally think carefully about foregoing a prenatal test. The availability of NIPT still has some impact on the experience of pregnancy: experts observe the phenomenon of «pregnancy on approval», in that mothers-to-be only commit themselves to their future role and form a relationship with the unborn child after the initial tests have not revealed any kind of anomalies.

Focus on trisomy 21

The idea of having a disabled child who will have to be cared for the whole of its life horrifies many parents. They fear not only the disability itself, but also the fact that caring for the disabled child will be at the expense of its siblings. In discussions with the members of families affected, however, it is apparent that someone who has experience of disabled people regards everyday life with them as much less stressful than persons who do not have any dealings with such people.

Nevertheless, non-invasive prenatal tests could still have an impact in particular on the future number of births of children with trisomy 21. Because most women whose prenatal test confirms that their child has this genetic defect terminate their pregnancy. The first-trimester test however is able to detect fewer cases than an NIPT. A simulation shows that of the 300 or so foetuses expected with Down’s syndrome from the first-trimester test, the outcome is 166 pregnancy terminations, whereas in the case of the NIPT there are 177 or 183, depending on how the test is used.

Family situation and social values influence the decision

Whether a woman will decide to continue her pregnancy after a positive test result depends very much on her environment. A partner who shares her values and whose support she can depend on, family members who accept disabled people, medical contacts who have positive attitude to life, exchange and support from people similarly affected in self-help groups – these are factors that encourage a pregnant woman to carry even a disabled child to full term.
The DNA code is read and the DNA segments of the foetus are identified.
Mothers-to-be also wonder about the future of a possibly disabled baby. In a society that integrates handicapped people, encourages them as they develop and regards them as part of a diverse and humane community, it is easier for pregnant women to bring such a child into the world. By contrast, women who discern an atmosphere of animosity towards disabled people are more inclined to terminate the pregnancy after an odd test result. At present, in view of attitudes towards disabled people in our society, contrasting trends can be identified: on the one hand the pressure to perform is steadily increasing, which goes against the acceptance of people with limited potential. On the other hand, efforts to integrate sick and disabled people have been stepped up, and the trend to emphasising one’s own individuality is also putting a positive value on «being different».

**Pregnancy support as a market**

Apart from the gynaecologists who support pregnant women directly, health insurance companies, consultation centres, licensing authorities and not least the providers of genetic tests also have considerable vested interests in pregnancy support.

As a rule, it is the physicians who maintain the most intensive contact with a pregnant woman, and consultation is also their responsibility. The fact that this leaves something to be desired is due to a variety of factors: it takes a lot of time and is financially unattractive for the physicians. Anyone who aims to provide comprehensive consultation has to be up to date not only with medical, but also with technical, psychological and social issues; a single person will hardly be able to meet such requirements. Finally, genetic prenatal diagnostics is continuing to develop rapidly, and it is hardly possible for physicians to be constantly up to speed. Moreover, medical specialists in single practices are often poorly networked, and therefore heavily reliant on information from the test providers. They are therefore more receptive to the marketing activities of the providers, and also give in to the demands of their patients. If one of them asks for a test many physicians will comply with this request – only so as not to lose the patient. In any case, it is conceivable that for medical personnel there are powerful incentives for giving preference to non-invasive tests over other testing methods.

So far, there are only two Swiss laboratories offering the new tests: one is Genetica AG, a spin-off of the University of Zürich, which has obtained the licence to carry out a US NIPT. Also active on the market is Genesupport, a Swiss company that has developed its own NIPT. Observers of the scene are predicting huge market potential for the new tests; but at the same time these are threatening invasive diagnostics, which until recently generated a substantial proportion of turnover for the laboratories concerned. It is therefore important for the survival of these laboratories to get into the NIPT business, and it is likely that even more laboratories will acquire licences to be able to offer non-invasive tests, in addition to Genetica AG. Providers of genetic tests are also reporting the willingness of many women to pay for the test out of their own pockets – especially if the risk of them having a child with a chromosomal disorder is not increased and the health insurance companies do not therefore cover the cost of the test. Providers are reacting to this demand by also aiming the information on their websites directly at women.

Finally, the health insurance companies are also key actors on the prenatal testing market. Individual companies assumed a large part of the costs soon after the market launch of the NIPT among pregnant women from the age of 35 – and have therefore possibly gained a lead for themselves in the market among younger people who are still at the phase of starting a family. However, the insurers are prohibited by law from demanding to perform such a test if a couple also wish to take out a supplementary insurance even before the child’s birth. The new tests cannot therefore be used to exclude babies from insurance benefits.

**Financial participation in prenatal tests**

In pregnancies that progress normally, compulsory health insurers accept seven medical examinations; with risky pregnancies additional examinations are arranged at medical discretion and paid for by the insurer. In addition, the health insurers reimburse the cost of two routine ultrasound scans, including the first-trimester test referred to above. Furthermore, if there is an increased risk of a chromosomal disorder, invasive examinations, i.e. amniocentesis and chorionic villus biopsy, are taken care of by the insurer. The price of a first-trimester test in this case is CHF 140, and for an invasive diagnosis around CHF 1600.

Since 15 July 2015 the cost of the new non-invasive prenatal test is also reimbursed – but only if a preceding first-trimester test has identified an increased likelihood of a trisomy. This financial regulation applies on a time limited basis up to 30 June 2017. It is also a condition that the test is carried out in Switzerland. In various statements and surveys, disability organisations and associations critical of gene technology are sceptical about the new practice of reimbursement. Because, they say, this expresses governmental recognition of the new tests, and in a benefit-obsessed society might be seen as an invitation to make use of all means of preventing undesirable impairment.
Admittedly, the funds’ practice of reimbursement is not entirely coherent, because while they partially accept prenatal genetic tests, they refuse to reimburse the cost of the relevant tests if the child has already been born and a diagnosis of any genetic anomalies should have been carried out.

The prices of the new tests have already fallen substantially since their introduction; in Switzerland in the summer of 2015 the costs for analyses of trisomies 13, 18 and 21 were between CHF 880 and CHF 950. In other countries, however, the tests were available much more cheaply, with prices around EUR 550.

**NIPT and their consequence for health costs**

In order to estimate the costs that the new tests entail for compulsory health insurers, three possible developments were simulated. The first (or base scenario) assumed pregnancy support as it was established before the introduction of the NIPT: all pregnant women are offered a first-trimester test; if this shows an increased risk of trisomy 13, 18 or 21, it will be supplemented by an invasive examination. That is the case for about 10 percent of women. The cost of the first-trimester test is voluntarily reimbursed by the health insurance companies, while the invasive diagnostics is one of the standard benefits.

In the second scenario, the pregnant women among whom the first-trimester test indicates a possible trisomy firstly avail themselves of an NIPT. Only then, if the latter confirms the anomaly, will an invasive examination be carried out. All examinations are financed by the health insurance company. The third scenario assumes that all women are firstly offered an ultrasound and an NIPT; in the event of a positive result from the NIPT an invasive examination follows.

Compared to the procedure up to now, without NIPT—i.e. the base scenario – the costs in the second scenario, which provides for the new test as a second examination, have slightly increased. Nevertheless, they are still much lower than for the third scenario, where an NIPT is applied at the same time as the first examination; scenario three with the non-invasive tests as initial screening would only be more economical if the costs for them were to fall to around the price level for a first-trimester test, i.e. to about CHF 150. In this case, in the second and in the third scenario practically the same number of trisomies are detected. The risk of a miscarriage brought on by the examination is identical in both scenarios: because no invasive diagnostics is carried out unless and until an NIPT has confirmed the suspicion of a trisomy. Measured against the overall costs of compulsory health insurance, CHF 30 billion annually, the additional costs for NIPT are in the permille range; they amount to CHF two million in scenario two and CHF 43 million in scenario three.

**How expensive is disability?**

If one wishes to assess the economic consequences of non-invasive prenatal tests comprehensively, it is not enough simply to consider the price that has to be paid for these tests. In fact, the social consequences must also be included in the overall balance. It is significant here, firstly, that thanks to the new tests, the risk of complications and miscarriages that are associated with invasive examinations is reduced. Secondly, thanks to NIPT, more trisomies are detected, and thus fewer children are born with Down’s syndrome, whose care also has a cost.

Various US scientists have tried to determine the social costs of the birth of a child with trisomy 21. A Californian study, now over 20 years old, estimated the costs for a person with Down’s syndrome at just under half a million US Dollars per case. More recently, however, it is more the loss of quality of life for the mother that has been the focus for research. In this case, it became apparent that the loss of quality of life is greater if the woman bore the child on the basis of a false-negative test result. By contrast, mothers who were already aware of the diagnosis before the birth feel less affected in terms of their quality of life. But women who have aborted a healthy foetus on the basis of a false-positive diagnosis also experience a diminished quality of life. Viewed overall, it is extremely difficult to develop convincing economic concepts for balancing the social costs as a whole and the benefits of prenatal tests. From an ethical point of view, it seems in any case insensitive to convert human destiny into a monetary value.
Balancing act between values

Prenatal genetic tests affect central social values such as reproductive autonomy and protection from discrimination against people on the grounds of their genetic make-up. What sounds plausible and unproblematic as a general setting can in individual cases lead to difficult weighing of interests.

If an embryo is aborted on the basis of a diagnosed chromosomal disorder, one occasionally hears the argument that the child’s quality of life would in any case have been so bad that it was in its own interest not to have been born at all. Under the heading «wrongful life», it is precisely the sort of problems and arguments that are dealt with by ethics, and they also extend into the legal domain: hence in various countries in recent years there have been more and more cases fought against physicians who had not recognised a chromosomal defect in the embryo, thereby denying the parents-to-be the opportunity to have an abortion. The ethical evaluation of prenatal diagnostics in the present study is based on the applicable Swiss law, which with the regulated time limit for abortions in the first twelve weeks of pregnancy permits abortion in an emergency situation.

Joy for life is not bound to perfection

From an ethical point of view, an abortion which refers to the wellbeing of the child is difficult to justify. Firstly there is the fact that many disabilities are socially constructed. For example, a person in a wheelchair can lead a fulfilling life and contribute to society, provided he or she is not discriminated against and no building obstacles restrict his or her mobility. In other words: it is society’s reaction to disabilities that makes them a problem for those concerned. Secondly, the same chromosomal defect can manifest itself in very different ways and cause a range of symptoms; the actual
suffering of such a child is something that cannot be reliably predicted before its birth.

It is also disputed whether it is in any case possible to measure quality of life objectively, or whether it is solely the sense of wellbeing felt personally by the persons concerned that is the deciding factor. If that is the case, many disabled persons who are perceived as such by society cannot be denied a good quality of life. Finally, it would be highly problematic to want to draw up a catalogue of objective criteria by means of which quality of life could be measured – because certain forms of life would then be debased and classified as «unworthy of life». And where that leads is a lesson to us from European history in the 1940s with the National Socialists’ false doctrine of eugenics.

Another line of argument questions what it means if it becomes increasingly possible to plan reproduction, making it a technical process. Apart from the fact that parents are becoming increasingly dependent on medical staff, it might also reinforce their impression that they are obliged to «make» the best possible children for themselves. There is no agreement among the experts in the assessment of this so-called perfectionist model. Thus there are philosophers who take the view that parents would always want the best for their child, and it is irresponsible if they fail to make every effort to create ideal starting conditions for it. From this point of view, NIPR represent an instrument for ensuring one’s offspring the optimal opportunities for their start in life. Other ethics experts take a critical view of this urge for perfection. For them, life is a gift that has to be accepted, together with all its imponderables, with a certain humility. Because in the end it is part of the «condition humaine», which removes complete predictability and control from our own lives and those of our children.

If too much DNA is found in a chromosome, that is an indication of a trisomy, e.g. trisomy 21 (Down’s syndrome).

More autonomy from more knowledge?
Reproductive independence means that every woman, or every couple, should determine for themselves whether they want a child. But this also includes the freedom to terminate a pregnancy if necessary. The more parents know about the consequences of the birth and about the life of the child they are expecting, the more independently can such a difficult decision be made. That, anyway, is what many philosophers and even some ethics committees believe.

However, not all experts endorse this idea without reserve. There is some doubt in particular that more information will automatically lead to more autonomy. For the growth in knowledge can also be perceived as pressure to choose from a range of possibilities and thereafter to have to justify this choice to oneself and to others. From this point of view the increase in options will become a burden that in the event of a pregnancy termination will affect the people involved, perhaps for the rest of their lives. Most experts in philosophy are therefore in agreement that regardless of the possibilities of the new prenatal tests, the right
of the mother-to-be not to know must be upheld and defended.

Law in flux

The handling of prenatal testing and genetic analyses is regulated by a series of legal guidelines, both international and specific to Switzerland. The Convention on Biomedicine, which was ratified by Switzerland in 2008, stipulates that medical interventions must only be undertaken once the persons involved have been fully informed about the consequences of the treatment. The convention permits genetic testing as part of a medical treatment and after the persons concerned have been fully informed, but prohibits discrimination against persons on the basis of their genotype. It also protects the dignity, identity and right to self-determination of the pregnant woman, especially her right both to know and not to know. Diagnostics on an embryo is not, however, covered by the convention; in that respect this complies with the prevailing legal opinion in Switzerland, whereby under civil law one’s status as a human being only begins at birth, and the foetus therefore has no legal personality.

Under Article 119, the Swiss Federal Constitution addresses reproductive medicine and gene technology in the human domain, and refers to the regulations that the Confederation adopts for dealing with human reproductive cells and genetic material. Of special relevance here are the Federal Act on Medically Assisted Reproduction (Reproductive Medicine Act, RMA) and the Federal Act on Human Genetic Testing HGTA.

These three key legal safeguards are currently being revised.

In the case of the revision of the Federal Constitution, and also that of the RMA, the central issue is on the one hand the number of embryos that may be developed as part of a medically assisted reproductive procedure. Physicians now no longer have to limit themselves to a number which can be implanted into the woman immediately, but a maximum of 12 embryos may be produced. On the other hand, the ban on pre-implantation diagnostics PID that has applied up to now has been lifted and replaced by a more liberal regulation. Nevertheless, opponents have collected signatures against the RMA, so that a national referendum on the issue will probably be held in the summer of 2016.

Inconsistencies and lack of clarity

The HGTA is also currently being revised. Its third section deals with prenatal tests, as well as genetic analyses. However, at present it is unclear what status the HGTA intends to allocate to NIPT: certain passages in the explanatory notes on the revised Act lead to the conclusion that non-invasive prenatal tests should be more correctly grouped with the risk clarifications, whereas the actual wording of the new Act allocates them to genetic testing. This distinction is relevant – because in the case of a risk clarification the results must be verified by a more detailed analysis as a second step. Or put another way: prenatal risk clarifications, in view of their diagnostic accuracy and also with regard to informing those concerned, have to satisfy less strict requirements than prenatal tests. In any case, the question that must be clarified is whether the distinction between diagnostic prenatal testing and mere clarification of risk is still justified at all and where exactly NIPT should be allocated to.

In its general approach, the HGTA aims to protect human dignity and personality, and to prevent genetic data being collected and used improperly. In particular, no-one must be discriminated against on the basis of their genotype. With regard to the conducting of genetic tests, Article 11 of the HGTA lists ex negativo everything that must not be investigated in prenatal tests; these are specifically characteristics that have no direct connection with health. The revised Act does, certainly, avoid listing predispositions that should be investigated, as does the existing Act. However, it does provide here for a tightening up, in that it stipulates that now only those characteristics that directly and materially impair the health of the unborn child may be investigated. What that means is, admittedly, not specified anywhere, or the interpretation is delegated to the National Advisory Commission on Biomedical Ethics. Because in the background there is a note of conviction that only certain genetic findings justify the termination of a pregnancy, this is like saying that certain lives are more worthy of life than others. The aim of prenatal diagnostics should, however, not be to pick out people with certain genetic characteristics by law, but to allow pregnant women to make decisions that are fully informed and properly thought through – and then individually and based on their specific life situation.
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Being able to know a lot doesn’t mean having to know a lot

In order to reap the benefits of prenatal genetic testing, sound advice is essential. The new tests must also be integrated into the established pregnancy support procedures in such a way that medical care for expectant mothers is no worse than it is today.

The major benefit of prenatal genetic clarification is that it can encourage people in their reproductive autonomy. For this benefit to bring results, however, it is essential that the parents-to-be, and especially the future mothers, are also able actually to make their own decisions and do not slip almost automatically into a pattern of behaviour. This could, however, be the case if NIPT were to become one of the routine components of pregnancy support. Comprehensive information and individual consultation counteract this risk. It would in this case also have to be expressly explained to the pregnant women that they are under no obligation to undergo prenatal tests. Because the wish not to know everything is also part of reproductive autonomy. In addition, social acceptance of people with disabilities must be promoted, in order not to put women under pressure to bear healthy children. Such acceptance is manifest not only in efforts to integrate disabled people into society. The State should rather avoid making judgements on which growing human life is more worthy of protection than another.

Extend consultation and set standards

A detailed conversation without time pressure makes high demands. It is hardly possible for physicians to invoice their costs for comprehensive consultation in a reasonable way – especially as they have to do further study and stay informed in order to keep themselves up to date, in view of the rapid development of genetic tests. Added to that is the fact that consultation with pregnant women is not restricted to medical aspects, but should also take social and ethical, as well as individual, circumstances into account. In future, consultation could therefore be increasingly delegated to specialised experts. Consideration must therefore be given to training and certifying specialised «genetic counsellors». Setting up central interdisciplinary drop-in facilities at university centres could also ensure high quality consultation.

Medical professional organisations should also draw up fact sheets on good practice in genetic consultation and set standards which not only physicians, but also midwives and all other professionals who come into contact with pregnant women could model themselves on.

Comprehensive consultation means that independent specialists support the pregnant woman. If, however, the woman gets the test directly from the provider, impartial and proper information is not guaranteed. Marketing that is aimed directly at women and parent couples must therefore be viewed extremely critically. In any case, firms should refer to the necessity of consultation, and depending how the marketing strategies of the companies concerned are developed, a ban on direct advertising would also have to be considered. Obtaining tests from the internet should if possible be prevented.

Ultrasound remains indispensable

Ultrasound not only indicates a possible trisomy 21, but also enables conclusions to be drawn on vital features of the embryo that are not connected to its genetic make-up. If an NIPT is carried out early on, this might tempt one to forego the ultrasound. This would therefore obviously make the medical care of the pregnant woman worse than it is today – especially as non-invasive prenatal tests are less reliable early in the pregnancy than in later phases.

Procedures in pregnancy care should in any case be optimised so that pregnant women do not have to wait long for test results, and the new tests can be integrated well into established and proven structures. Nevertheless, rapid processing should not be at the cost of the explanation. Non-invasive prenatal tests open up the greatest benefits when they are used as a second test together with an ultrasound in the event of an abnormal finding.

No abandonment of invasive testing

Even if prenatal genetic tests are comparatively reliable, their success rate is not one hundred percent. Even in the case of trisomy 21 they can occasionally give false-positive results; other genetic anomalies probably lead to even higher rates of error. In case of an abnormal finding, the pregnant woman must, as before, be recommended an invasive test as a matter of urgency, in order to be able to exclude the possibility of a healthy child being aborted by mistake.

Meeting the costs of genetic tests, including after birth

If the first-trimester test gives indications of an afflicted child, the health insurance funds meet the cost of a non-invasive genetic test for detailed clarification. They do not, however, share in the costs if genetic tests have to be carried out on a new-born child in order to corroborate a diagnosis.

Genetic tests that are paid for by health insurance funds before the birth should also be met after the
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Birth if they serve to confirm a diagnosis or to secure treatment and life planning.

Guarantee accompanying research

Prenatal genetic tests are continuing to develop rapidly. They must therefore be monitored to determine how they actually benefit pregnancy support, what surplus and unintended findings they produce, and what the significance of their results is.

The Expert Commission on Human Genetic Testing GUMEK has the task of tracking the development of genetic testing, making recommendations on it and identifying legal loopholes. It is therefore the ideal body to make recommendations for accompanying research on prenatal genetic tests as well. Moreover, the planned evaluation of NIPT funding by the Federal Office of Public Health FOPH is also to be welcomed, particularly because there is still a substantial lack of studies on the performance of the new tests.

Beware of an unclear legal position

The revision of the Federal Act on Human Genetic Testing HGTA provides for a tightening up, whereby in future only those characteristics that «directly and materially» affect the health of the embryo may be identified. That should ensure that only foetuses with a severe medical condition will be rejected. This approach is questionable. On the one hand it is not clear for whom the health impairment has to be material; arguments from the point of view of the unborn child are highly speculative and neither ethically nor legally tenable. On the other, there is a lack of objective criteria for establishing what would constitute a «material» impairment of a human life. «Materiality» would therefore have to be described precisely from the perspective of the pregnant woman. But because «materiality» cannot in any case be an objective value, this legal tightening up must be abandoned. In general the scope of the testing should not be restricted by law, because only the woman can judge what information she needs in order to be able to fulfil her responsibility and duty of care as a mother.
Study «Wissen können, dürfen, wollen? Genetische Untersuchungen während der Schwangerschaft»

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