A New Ethical Landscape of Prenatal Testing: Individualizing Choice to Serve Autonomy and Promote Public Health: A Radical Proposal

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Abstract
A new landscape of prenatal testing (PNT) is presently developing, including new techniques for risk-reducing, non-invasive sampling of foetal DNA and drastically enhanced possibilities of what may be rapidly and precisely analysed, surrounded by a growing commercial genetic testing industry and a general trend of individualisation in health care policies. This article applies a set of established ethical notions from debates on PNT of the past for analysing PNT *screening-programs* in this new situation. While some basic challenges of PNT stay untouched, the new development supports a radical individualisation of how PNT *screening* is organised. This reformation is, at the same time, difficult to reconcile with responsible spending of resources in a publicly funded health care context. Thus, while the ethical imperative of individualisation holds and applies to PNT, the new landscape of PNT provides reasons to start rolling back the type of mass-screening programs currently established in many countries. Instead, more limited offers, based on considerations of severity of conditions and optimised to simultaneously serve reproductive autonomy and public health within an acceptable frame of priorities, is suggested. The new landscape of PNT furthermore underscores the ethical importance of supporting and including people with disabilities. For the very same reason, no *ban* on what may be analysed using PNT in the new landscape should be applied, albeit private offers must, of course, conform to strict requirements of respecting reproductive autonomy and what that means in terms of counselling.

1. INTRODUCTION

The technological development of prenatal diagnosis or health risk assessment – prenatal testing (PNT), for short – has been considerable in the past few years, adding to ethical questions in this area (1, 2, 3, 4, 5, 6). The context of such clinical practices has simultaneously changed, due to the launch of general "preconception" tests of (mere) carrier status for a wide variety of conditions (7, 8, 9) and the emergence of a rather aggressive direct to consumer (DTC) genetic testing industry, offering "susceptibility" or carrier testing, as well as marketing non-invasive PNT (NIPT) online.[1] This development, takes place inside a broad health policy drive towards "personalisation", or "person-" or "consumer centeredness", striving to offer more "individualised" choice for patients (10, 11). Health services are increasingly outsourced to private contractors, thus transferring responsibility for health to individual citizens (cf. 12, 13).

In this paper, I will use a few largely uncontested premises to argue that these factors taken together create a broad ethical challenge for *the future organisation* of PNT services in the form of *mass-screening*

[1] See, for instance, the webpages of the companies *Natera*, promoting its "Panorama" NIPT product (http://www.panoramatest.com/) [accessed 2014-08-14] and the similar one of *Ariosa Diagnostics*, promoting "Harmony" (http://www.ariosadx.com/) [accessed 2013-08-14]. While this marketing targets also patients, the provision of the service will go through a a qualified doctor. In the longer time-perspective, however, one needs to consider possible developments in line with how other parts of the DTC genetic testing industry is moving to bypass health professionals and regulators (see further note 9 below), as well as trends of moving health care services into a more pronounced business context, with the opportunity to base online activities off-shore to escape national regulation.

programs. My topic is thus not the morality of PNT *as such*, albeit some arguments from debates on that issue will be used in places. I will propose that the new PNT landscape, first, weakens the ethical reasons for large, publicly funded PNT screening programs and, secondly, provides reasons for restricting access to publicly financed PNT on the basis of the severity of conditions. The argument for this conclusion is not due to any single key-factor or one knock-down argument, but rather arises out of how different reasons for organising PNT in different ways connect to each other in the new ethical landscape here envisioned.

I will first sketch, in section 2, more exactly what is *new* in this landscape in contrast to familiar ethical debates on PNT. On that basis, I will describe, in section 3, how a traditional tension with regard to what the practice of PNT is or should be *for* – the good of society or the emancipation of individuals – is deepened and complicated in the new landscape. In section 4, a vision of increased individualisation, designed to confront this situation, is sketched and found to be less sensitive to rebuttal. However, it poses challenges from a rationing perspective, difficult to get around without reintroducing ethical downsides. This leads to the conclusion, developed in section 5, that PNT *screening* should be scaled down in the new landscape and that PNT as a source of individual self-determination should be given less priority within publicly funded health care systems. These should concentrate on markedly severe conditions and resources should otherwise be

redirected to social reform to reduce inequality and prejudice in the face of human variation,

2. The New and the Old PNT Ethical Landscape

The technical features of the new ethical landscape of PNT can be characterised thus:

1. Sampling of foetal issue or genetic material without need for any more invasive testing than a regular blood sample of the pregnant woman (current NIPT), or even less invasive methods in the future. The reliability of the final result far exceeds that of current non-invasive screening methods[2] and may come to approach that of presently used invasive methods, such as amniocentesis or chorionic villus sampling.
2. Fast and reliable analysis across the entire DNA of samples collected through 1. Currently, the standard here is the arrayCGH, used by many neonatal clinics when trying to find the right diagnosis to confusing symptoms or birth defects. In a near future looms the dream of so-called *whole genome sequencing* (WGS), allowing quick and accurate analysis of every base pair, as well as mitochondria.

NIPT is already here, albeit initially dazzling accuracy figures have been toned down when variations have been revealed between different

[2] That is, combined ultrasound-serum screening, or CUS (14).

conditions and, especially, less impressive positive predictive value figures, implying at least 20% of positive predictions to be wrong, in spite of otherwise excellent precision.[3] The second one is less developed, but at least one commercial party already markets NIPT with arrayCGH as the standard and most public units are opting for the same route. Professionals and ethicists have started to address the ethical implication of the preconception and prenatal screening hereby made possible (3-8, 15), several of which connect to developmental complications and uncertainties. My own further discussion will assume that both 1 and 2 will be fully functional with important technical uncertainties straightened out. The point of this assumption is mainly methodological – should, e.g., NIPT be *less* functional, the reasons in its favour will decrease and my sceptical argument with regard to screening programs will be strengthened even more. regarding WGS, my argument is moreover positively dependent on 2.

The ethical discussion of PNT is due to its typical use is for reproductive choice and family planning on the basis of information about probable health-related features of the foetus, with an opportunity to have an abortion when these features do not match desired outcomes.[4] This is

[3] The phenomenon is more pronounced the rarer conditions that are targetted, causing particular concern regarding monogenetic and less common chromosomal conditions. However, it has been picked up also in currently ongoing large-scale trials for routine screening for Down syndrome (16, 17).

[4] Regarding a very small minority of the conditions to which PNT is applied (such as the very worst of monogentic diseases and chomosomal cinditions, such as Tay Sachs or trisomy 18), it may be argued that aborting an affected fetus saves the child that would otherwise have been born from a life worse than never having exited in the first place. However, that argument would justify only a very small portion of actual PNT, likewise of most added applications within new PNT. In particular, typical sex

not to deny that PNT may sometimes lead to a woman or couple accepting a child with a disability, or to the birth and adoption of such a child, but the fact remains that termination remains the common choice following positive tests. In exceptional cases, PNT may be part of a plan to treat the detected condition and, most cases of PNT are followed by decisions to continue the pregnancy. But what has inspired the *ethical* scrutiny of PNT is its connection to the possible use of abortion to facilitate a choice of what future possible children that will be given the opportunity to exist on the basis of health related information about the foetus.[5] This core feature remains untouched in the new PNT landscape.

Familiar objections to PNT on the basis of moral opposition to abortion in general, or to the very idea of choosing future children on the basis of expected health (or other) features thus remain. However, their *relevance* or *force* may be affected by the new situation. I have argued elsewhere that the objection from abortion is rather weak (9, 18, 26), since PNT mostly motivates pregnant women to abstain from abortion. This might be changed by the new landscape, depending on how many conditions that will be included and how societal standards for what is counted as normal will be influenced. Arguments against PNT based on opposition to the very idea of selecting future offspring (20, 22, 23, 25) may have to be reappraised in several ways. In both cases, the nature and extent of influence of the new PNT landscape depends on how it is

chromosomal conditions and Down syndrome would clearly not be included and neither would the most common monogenetic conditions, such as Cystic fibrosis ((9, sect. 3.1.1), (18, ch 3)).

[5] Contributions to this debate include, but do not exhaust (18-25).

organised and regulated, with the presence of screening-like features, such as large and unprepared populations, being one particularly important consideration (9, 27).

In some ways, the new landscape affects ethical analysis considerably. First, NIPT presents a promise of (at best) getting rid of the risk of miscarriage (0,5-1%) present when suspicions from earlier pregnancies, obstetric ultrasound or CUS are controlled invasively, or (at least) that the initial sorting of who is exposed to that risk becomes more selective. Given that PNT screening is on-going, this is an important gain. However, by itself it consists an argument for using NIPT only to the extent that such *screening* can *itself* be justified (9, 27).

The other side of losing or significantly decreasing the mentioned risk, is a parallel increased risk of people being more easily lured into PNT without serious reflection on the long-term consequences (e.g., possibly having to ponder abortion or the birth of a child with foreseen difficulties on the basis of a complex mass of information, and so on). Already patients in the "risk free" PNT practices of today (CUS and obstetric 2nd trimester ultrasound screening) have been found to be ill-informed about the implications of the tests, and the possibility of the new PNT strengthening such tendencies have been commented extensively (4, 6, 14, 16, 22, 23, 27-30). This is a sort of risk that may be expected to increase within a mass-screening setting (9).

PNT experts and practitioners currently discuss how NIPT should replace or be added to existing mass-screening programs and, just recently, the American College of Medical Genetics recommended a broadening of screening employing NIPT (31-32). CUS was once put into place due to concerns about false positives in recruitment to invasive PNT (involving the mentioned risk of miscarriage) on the basis of maternal age, although it has later come to be used also for other purposes, such as detecting pre-eclampsia (4). At the same time, CUS brings acknowledged and serious pre- and post-testing counselling difficulties (9, 14) due to the complex and unclear information output. In this respect, the increased precision of NIPT screening may look as a benefit, but if the existing programs are problematic to start with, that reason may be undermined.

A related change is the prospect of having a (more) precise test result much *earlier* than before (from week 6-8).[6] This may be seen as positive, since it implies a possible abortion to be performed earlier and thus thought to reduce the ethical seriousness of PNT,[7] as well as reducing medical risk for the woman and, for the couple, bringing less

[6] As mentioned, current NIPT seems to offer good, albeit somewhat variable, precision in terms of avoiding false positives and negatives, but still in many cases suffers from a weak predictive value compared to invasive tests. This is something that might be overcome in the future, but would presently appear to be a significant limitation for the notion of exchanging invasive PNT for NIPT altogether (16, 17).

[7] Contrary to what is hinted by de Jong and colleagues (4) that line of thought would not, however, be accepted by *everyone*, not even by everyone who supports legislative solutions where earlier abortions are made more available than later ones. Such support may rest on purely pragmatic considerations and ethical anti-abortion hardliners, whose views underly a number of very restrictive abortion legislations in Europe alone, would not see the fact that an abortion is performed at an earlier stage of fetal development as any kind of morally mitigating factor.

emotional burden. However, an earlier test will also imply less room for pretesting counselling, thereby possibly reinforcing the mentioned risk of unreflecting enrolment in PNT screening. At the same time, it may make more room for *post-testing* counselling, but then the upside of the possibility of an earlier abortion would have to be sacrificed to some extent. Obviously, there are complex trade-offs that need to be made between these aspects (9).

In view of these complexities, the mentioned enthusiasm for organising NIPT as a mass-screening and to quickly apply NIPT clinically on a broad basis is somewhat unsettling, as it has inspired discounting of pre-testing counselling concerns (28, 32). In addition, some studies reveal that clinical staff may become less inclined to care about patients' wants and desires by adopting NIPT (5, 6, 26, 33). Such results have been less clear in other studies (34), but general tendencies to have technology dictate clinical ethics is, at the same time, far from new in the history of PNT and related technologies (18-20, 22, 23, 25, 26). The presupposition of a consensus on PNT as a servant of patients (4) can therefore not be taken for granted when designing policies for the new PNT landscape. Rather, policies need to be shaped to *reinforce* that norm, as recognised in a recent statement by the American College of Medical Genetics (8).

The range and amount of (possible) conditions available for analysis through WGS are potentially immense, including a lot of uncertainty.

Therefore, aspect 2 of the new PNT landscape (mentioned above) implies increasing uncertainty as to what conditions should be targeted in PNT and what organisational needs are implied (15). Solutions common today that test for only a predetermined selection of conditions[8] will probably be abandoned (4) and that can be seen as an upside from a patient autonomy standpoint (since what is tested for is not decided by others by default). It may also be valued from a disability advocacy standpoint, as less of predefined lists of what to test for means less of an implied official message that certain types of people are undesirable (9, 18, 20, 22). The issue of *who to test for what* – i.e. what information made available through WGS should be sought in PNT for different individual patients – will remain, however. At the same time, a lot of the obtainable information is highly uncertain and difficult to evaluate. This, of course, feeds into the mentioned counselling challenge connected to PNT screening.

Surrounding these aspects is the new context of DTC services, currently obviously bent on securing a large slice of an envisioned market and take on regulators' possible restrictions retrospectively (in the future possibly escaping them by off-shore online solutions). It would be prudent to expect industry to quickly apply WGS as soon as it can. People who buy such products and find out susceptibilities, carrier status, vague health risks or foetal polymorphisms will then approach

[8] This includes so-called Rapid Aneuploidy Detection (RAD), such as QF-PCR, concentrating on chromosomal disorders (4), but also other typer of restrictive, ready-made biochip kits that facilitate testing for a small number of other sorts of conditions which have been preselected by health care rather than patients.

publicly funded health services for further assistance: PNT, associated counselling, abortion or other, further complicating the organisation of screening efforts.[9]

3. Serving Society, Serving the Patient or Serving the Service Provider?[10]

The history of PNT demonstrates an on-going tension between, on the one hand, viewing the practice as primarily a reproductive public health project serving societal goals or, on the other, as a patient empowerment project based on ideals about promoting reproductive autonomy (18, 19). While it is not impossible for these tendencies to come together in harmony (23), in most developed PNT settings they are, as mentioned, less than perfectly aligned. This is most salient in the strong drive to organise PNT as a mass-screening, in spite of the mentioned known problems from an autonomy-standpoint.

[9] It is instructive, in this respect, to inspect how DTC services package their offerings of carrier, risk or "susceptibility" testing. A fresh example of the former is *Genepeeks*, a commercial offering of preconception carrier screening of a large number recessive single-gene disorders combined with donor or partner matching (see http://www.genepeeks.com/). Earlier examples include the susceptibility health test package offered by *23andme* before the FDA ordered the closing down of this operation in 2013 (see the official letter at http://www.fda.gov/ICECI/EnforcementActions/WarningLetters/2013/ucm376296.htm). A very similar service is currently offered by the *Map My Gene* operation (see www.mapmygene.com/). The basic sales trick is to offer testing for carefully designed bundles of factors, in relation to which impressive risk figures may be given (for the whole bundle), while each part of the bundle in most cases is associated with extremely small and/or uncertain and for most people insignificant risk. While this strategy to attract customers is not as flawed and unethical as the mixing of relative and absolute risk figures that has in the past been employed, e.g. by *Myriad Genetics* in its sale of tests for cancer susceptibility mutations (36), it is still obviously rigged to create an appearance of having much more to worry about than would otherwise have been the case.

[10] This section emulates a number of different points and arguments deveoped further in (9), especially sections 3.1.1, 3.3, 4.2, 5.1 and 6.5.1.

Part of the story behind this tendency is the historical eugenic roots of PNT, echoed by recurring calls already since the 1960's for PNT *screening* to reduce the number of otherwise costly people in society (18, 20, 22).[11] There is also a general institutional pull towards screening as an organisational form, due to the substantial benefits of having society fund a screening effort (9) and, in addition, there is the private industry producing testing kits, patented methods and so on, pressing on to expand its markets, a pressure augmented by the DTC genetic testing industry.[12] In PNT, setting up screening programs is also unusually easy from a practical standpoint. There is normally an existing health care infrastructure to piggyback on and the target population is readily assembled and available for recruitment (9).

The reasons against organising PNT as a mass-screening and thus resisting the just mentioned forces all have to do with what is special about a *screening program*. In the normal health care situation, procedures are on offer insofar as patients approach health care on their own initiative with a particular problem or worry. In contrast, screening programs mean that society or health care institutions take

[11] Such policy thinking is eugenic in the classic sense of focusing on shaping reproductive patterns to achieve a particular composition of the population, deemed desirable from a societal point of view – in this case the national economy. Here, individuals are valued primarily as potential resources of burdens for society and a focus on individual autonomy thus has scant room (18).

[12] The existence of large PNT screening programs substantially increases the value in terms of potential demand of the products sold by the DTC genetic testing industry. This since having preconception carrier or susceptibility testing can be motivated by wanting to prepare for PNT screening, especially in the new PNT landscape. Converesely, the producers of products (lab services, testing kits, etc.) used in the new PNT efforts, have an interest in the existence of said preconception testing activities, since they are likely to boost demand for PNT.

the initiative and proactively propose testing to a large group of people, who are typically previously unaware of the details of what this proposal involves and implies. The effect of the program is then not to clarify a person's initial worry, but to select from this larger group those where there is special reason to offer of some sort of follow-up procedure[13] – in the case of standard PNT-screening, the option of having further tests – thereby creating more specific worries (possibly laid to rest later on).

All of these aspects imply particular problems from the perspective of autonomy – in the simple and, within bioethics, generally condoned sense of having people making choices and direct their lives in line with their own considered wants and plans (9, sect. 2.3 and ch. 4). Already the fact that the initiative comes from authoritative and powerful societal institutions means that initial pressure is applied to women and couples to consider PNT – the more suggestive the offer and the less clear the opportunity to freely decline it (e.g. through a routinisation of the offer), the more heavy this pressure is. Also contextual factors, like the general situation of disabled people or abortion laws making abortion in case of disability more readily available than otherwise, may contribute to pressure and bias (9, 18, 20, 22, 23). The sheer mass of people handled by the program implies well-known practical obstacles to handling informed consent and counselling well. This regards, for instance, the just mentioned aspect of

[13] See the conceptual discussion and suggested definition in (9), sect. 1.3.

clarifying the voluntariness of PNT, and to have people understand what the offer and eventual test result imply, as many people are unprepared to assess these. In all, therefore, organising the offer of PNT in the form of a screening program can be expected to make PNT substantially more difficult to justify from the perspective of reproductive liberty and autonomy (9).

The new PNT landscape adds to these difficulties. First, there is the lure created by the absence of a risk of miscarriage. This absence is, of course, a great benefit in the case where PNT is offered in a way conducive to autonomy. If PNT is performed in a way that tends to jeopardize rather than promote autonomy (such as mass-screening), less riskiness may still be held out as a pragmatic upside. However, this ignores the central ethical issue of whether or not PNT should be offered *at all* on such a premise. That is, the absence of the risk of miscarriage is indeed a benefit when NIPT is compared to CUS or invasive PNT. But it is not a benefit that, from the perspective of patient autonomy and liberty, can justify PNT *screening*. Bearing in mind the mentioned risk that NIPT turns into "an offer you cannot refuse" (29), what is new about the new PNT mainly adds to what already tells against PNT *screening* (9, 27, 30). The activities of the DTC genetic testing industry add to these challenges, as these increase the incentives of people to seek PNT for more vague reasons and distort their expectations of the service. For a PNT screening program, it will be difficult to separate the cases when people have acquired good

reason through prior "susceptibility" or preconception tests from those where the situation is the opposite, without rather ambitious pretesting counselling procedures, which are less likely to be realised the more mass-screening-like the organisation of the new PNT becomes (9).

Already arrayCGH, but most far-reaching, WGS, delivers a promise of getting rid of the current practice of "directive" PNT through testing-kit solutions that target particular conditions, predetermined by health care professionals (see note 8). Such solutions are obviously problematic from an autonomy standpoint, since the range of choice is out of the control of individual patient. The resulting "directedness" makes public PNT screening programs signal a special will of society to avoid having particular sorts people (namely those with conditions in the predetermined kit) around, thereby bringing risks of undue bias and pressure. In addition, since this is a proactive suggestion from societal institutions, such programs appear to press a specific official societal view on the value of these types of disabled people. There is a well-established body of PNT criticism based on the possible resulting influence on public attitudes and, not least, the reactions to this of the targeted disabled people themselves (9, 18, 20, 22, 23, 25).[14]

Preselective testing-kit solutions have nevertheless been accepted, partly due to the upside of facilitating rapid analysis, partly due to a

[14] Some versions of such "disability-" or "eugenics-based" criticism have been questioned (19, 21). However, broader analysis regarding PNT in general (22), as well as regarding PNT *screening* in particular (9, pp. 36-40) support the interpretations of this critique formulated in the present context.

restricted range of possible outcomes making counselling less difficult. Both these advantages disappear when WGS works in the way here assumed. However, if *no preselection at all* is done, WGS will result in an output containing many different aspects and dimensions, and large portions of uncertainty and indeterminacy regarding the implications for the person tested. This brings salient risks of confusing people rather than supporting their autonomous decision-making and self-determination. If WGS is to promote patient autonomy and reproductive liberty in the new PNT landscape, it therefore seems necessary to make some sort of restricted selection of what to test for. The upside compared to current preselective solutions thereby diminishes, but even more important is that the PNT practice is faced with the question of *what* selection to make and *how* it should be done (15). This issue would thus have to be added to formerly mentioned considerations regarding to what extent the new PNT should be organised as screening.

If population health related reasons are given priority over patient autonomy and reproductive liberty, it may be argued that, although PNT in general does not help curing or preventing anyone's disease or disability, it may be used as a public health tool to reduce the statistical incidence of disease and disability by making more probable that potentially ill or disabled people are being identified and eliminated at the foetal stage by means of PNT and abortion. This aim, which brings the idea of PNT close to shunned eugenic policies of the past, has been

saliently present in the history of PNT, for instance, through the notion of having PNT for the purpose of saving society the money it takes to adequately care for the children that would otherwise have been born (9, 18, 20, 22). From such a perspective, although not ideal, it would not be a minor problem if people were lured into the program, since its point is in this case to have as many people as possible enrol in order to have as many potentially disabled children as possible detected at the foetal stage and aborted. The issue of selecting what to look for with WGS also would resolve itself easily: that, whatever it is, which would cost society a great deal to take good care of.

In contrast, I will in the following favour a view of PNT as justified primarily to the extent that it serves reproductive autonomy and liberty. This does not mean that a public health perspective can be dismissed altogether, as we will see,[15] but it does project a problem for NIPT having been so uncritically embraced as fit for mass-screening already when CUS was introduced in the 1990's. Even then, researchers pointed to the need for extra ambitious counselling resources – way beyond what has ever been made available (14). In effect, reports about the inadequacy of these programs from a counselling and autonomy perspective have kept coming (4, 37, 38). This leads over to the question of what is possible to achieve from an autonomy standpoint

[15] I accept (9, pp. 41-42), with some cautionary qualifications, that, in some specific socio-economic conditions of a society, reproductive policy solutions, among those PNT, that are directed primarily by public health concerns somewhat akin to eugenic policies of the past, may be acceptable, in spite of their lack of concern for individual autonomy. This acceptance, however, is not applicable to the societies capable of making the sort of organised health care offers discussed in this article.

with regard to the new PNT landscape. This regards what to test for, how to decide this and how to organise offers to patients.

4. Individualisation and Personalisation in the New PNT Landscape

The objections against PNT *screening* presented in the former section are of a practical or pragmatic nature. If PNT screening could be reformed in order to harmonise the aims of serving long-term population health, promoting and protecting reproductive autonomy and liberty and avoiding official eugenic pointers to what sort of people there should be, these objections would dissolve (23). On paper this is easy: avoid "directive" preselection of what to test for and beef up the counselling organisation so that it can actually meet the real challenges of a new PNT mass-screening. At least in reasonably accommodated social settings (where society supports and adapts itself to the needs of disabled people, and where directedness is absent also elsewhere in social policy, such as abortion legislation), then the public health, the individual reproductive autonomy aspects and the requests for non-discrimination of PNT may come together.[16]

[16] The more that societal structures are geared to the opposite, the more potential parents will be pressed to seek PNT and pregnant woman to opt for abortion in the case of a positive result and, thus, the more reason to suggest that individual choices will not be autonomous and free, however well informed they are. Moreover, the more the practice of PNT will as a whole deliver an official eugenic message. Cf. (18, 20, 22, 23, 25, 26)

To achieve this, the following seems to be required.[17] First, to ensure equal access and basic knowledge about PNT, a standard of informing everyone concerned about the nature, presence and availability of PNT services needs to be in operation.[18] Second, further initiative to seek out PNT services or requesting further information is left to people themselves. From the point of view of autonomy and reproductive liberty, it is of equal value whatever the responses of people are, as long as they are in line with genuine wants, values and plans. The point of the procedure is not to have people enrol in a program or decide in certain ways, but to help them decide whatever it is that fits them best in a non-coercive, unbiased way. Third, when people do decide to approach PNT services, there has to be appropriate pre- and post-testing counselling resources available, shaped to handle not only previously known needs and difficulties, but also new complexities brought by the lures of NIPT, the potentially manipulative effects of the DTC genetic testing industry and the special complexities of WGS. As mentioned, this may require that the advantage of having PNT earlier is sacrificed to ensure that people who initiate or decline the procedure do this for what are truly good reasons. Proper post-testing counselling may imply that the early abortion advantage is further reduced and if

[17] The following sketch accommodates the "liberal eugenics" notion of Agar (39), but also supercedes it, as my suggestions take into account the professional responsibilities of health services, beyond that of mere commercial providers, as well as structural factors of importance to safeguard reproductive autonomy and liberty.

[18] What more exact practical action may be necessary to realise this aim may vary between societies, as successful communication of the information may in some settings require more active measures (such as seeking out subpopulations otherwise isolated from mainstream communication) or especially adapted forms of communication to handle barriers created by weak litteracy, language plurality and so on.

known counselling shortcomings in CUS are to be taken into account, it may disappear altogether.

On top of these rudiments, the new PNT landscape necessitates additions regarding the need for preselecting what to test for in a scenario of WGS. WGS, as we saw, makes possible a different approach to harvesting the advantages of early and predictable test-results, built on individual choice rather than set health care directedness, more in line with a person-centred organisation. On the basis of a structured initial classification[19] of what types of information WGS may deliver, the patient herself decides what features to test for. In order to insure against such self-designed testing-kits being inferior from an autonomy perspective (e.g. kits targeting areas of the DNA with very unclear implications), restrictions built on known perils of genetic testing and counselling may assist the design, somewhat restricting the initial range of free choice. For instance, the more of uncertain and equivocal information a patient wants to include, the fewer targets may be allowed for testing, or the setup may exclude too uncertain or equivocal information altogether for the reason of upholding a certain clinical standard of promoting patient autonomy.[20]

[19] For instance, with regard to types of health or other states, degrees of certainty or variability of the conditions, etc.

[20] The connection between the quality of the information on which decisions are based and the prospects of these decisions to promote and protect autonomy have been analysed in-depth in the context of reproductive genetics in (26), pp. 175-178, 188-201.

This individualised opportunity for women to devise their own testing-kits on the basis of partly restricting autonomy concerns may also meet the potential threat of having a person-centred approach to PNT undermine professional responsibility by sliding into pure consumerism (11, 13). In addition, this way of restricting what to test for avoids the repeated objection to predefined lists of conditions in terms of stigmatising people with such conditions as undesirable in the eyes of health care and society (1, 4, 18, 20, 22, 23, 26).

5. A Radical Proposal: The End of PNT as We Know It?

The vision of implementing the new PNT in a mass-screening organisation fit to harmonise societal interests and the promotion of reproductive autonomy described in section 4 has one obvious shortcoming. It will be very expensive to uphold the required adaptability of testing-kits, as well as sufficient standards of counselling. Mere promotion of reproductive autonomy will hardly serve to justify such costs in a public priority-setting context.[21] Focusing on the new PNT as a source of liberation and self-determination thus rather drives a notion of it as a reproductive information technology to be used by people outside of publicly funded services. If offered to honour reproductive autonomy and liberty without creating additional drawbacks, the new PNT signals a time to end the mass-screening efforts of national health services, which have

[21] Remember that trying to justify these costs with reference to the potential of avoiding the future existence of costly people is at least practically or pragmatically incompatible with offering PNT for the sake of patient autonomy.

made up the chief organisational form of PNT since the end of the 1970's.

The new PNT may, of course, be offered for such purposes by commercial parties and the arguments above provide no reason for society to disallow that. However, since the same ethical standards of quality of services apply to these,[22] the high costs will there be reflected in high prices. This will, unfortunately, create an inequality between those who have disabled children due to lack of access to commercial PNT and those who can afford it. The remedy to that situation is, however, certainly not for commercial providers to offer PNT (new or old) in an unethical way. Rather, what would seem to transpire is the following.

As argued by many contributors to past PNT debates (e.g., 18-20, 22, 23, 25), the downsides that may befall people who have disabled or sick children is foremost an argument to have society apply more decent, fair, including and supporting policies with regard to the abilities and conditions of all people – thus making the need to avoid having certain sort of children less acute. Some potential parents may, of course, still harbour *desires* to select what children to have on a broad selection of grounds, but the presence of such a desire is, by itself, no reason to

[22] This is in line with the conclusions of a recent Nuffield Coucil of Bioethics report (40), and also in an even more recent policy statement of the American College of Medical Genetics with specific regard to prenatal and preconception carrier screening, as well as NIPT screening (8, 31).

spend public resources, any more than other types of consumer demand. Again, focusing on the new PNT mainly as a source of self-determination would move it alongside other types of medical services which society tolerates (within requirements) without actively supporting or being involved in, such as cosmetic plastic surgery.

At the same time, it is both unrealistic and implausible to think that a reshuffling of societal resources in line with what has just been described would eradicate all need (beyond mere desire) of PNT worthy of societal consideration. First, nations differ with regard to available resources and the weight of autonomy may not apply with full force when balanced against public health considerations unless basic standards of population health and equality are secured (41). When such standards are not met, then, temporary acceptance of screening solutions using the new PNT might seem justified, in spite of their downsides from an autonomy perspective, at least to the extent that they promote a progress towards a situation where public health concerns can no longer outweigh reasons of reproductive autonomy and liberty (9).[23] Second, also in more affluent settings, there will no doubt remain conditions where no conceivable extent of societal adaption or support will significantly reduce the burdens for parents in order to make access to PNT into a mere luxury product. These, then,

[23] There are reasons, therefore, to be wary of the very real risk that this organisation of PNT lingers on also after it has lost its justification. See (9), pp. 40-42.

may be included in a justifiable publicly funded new PNT offer, in the form sketched in section 4.

Already the individualised, person-centred form of organising new PNT would make such a publicly run program very different from today's proactively pursued mass-screening setups. Moreover, if the range of conditions "on the menu" of the program (from which patients may devise suitable testing-kits) is restricted according to what was described in the preceding paragraph, even more radical differences result. Many publicly run PNT programs include conditions with either rather mild clinical expression or conditions where available effective therapies ensure such an end-result, and the use of arrayCGH or WGS would make possible many more such inclusions. It is far from clear, however, that sex-chromosomal conditions often included today (e.g., Klinefelter or Turner syndromes), cognitive-behavioural difficulties (such as Fragile-X) or moderately intellectually disabling conditions (such as Down's syndrome) would be part of a justifiable public new PNT offer package. One may even ask if, in affluent societies which (as they should) meet the condition of including and supporting people with disabilities and diseases, it would be justified to include medically serious conditions, where best treatments provide reasonable life-spans approaching with decent quality of life and autonomy (such as cystic fibrosis). While resources to test for such conditions would be better spent on further social inclusion and support measures (benefitting those who would prefer PNT but cannot afford commercial

alternatives), there remain, of course, a great number of more serious conditions (with less promising treatment prospects) where inclusion in a publicly run PNT program is beyond questioning, but that the reasoning of section 4 still motivates the more person-centred individualised organisation described there.

My final conclusion, therefore, is that the main ethical implication of the new PNT landscape (approaching already in the form of NIPT with arrayCGH, but mostly when fully discharged with WGS) is that it heralds the end of its role in large, proactive public health oriented screening efforts. This to the benefit of improved societal efforts to include and support the sick and disabled. To the extent that PNT is organised in accordance with the ethical requirements set out in section 4, there may be commercial offers with no restrictions on conditions tested for. For a national health service, however, arguments additionally support a drastic downscaling of PNT to target a much more narrowly selected range of particularly severe conditions, Since society thereby focus only on severity, not selecting conditions on grounds of prejudicial attitudes or socio-economic criteria, while legally allowing any condition to be targeted by PNT, and using freed resources to benefit sick and disabled people, such a policy will not communicate any sort of discriminatory or stigmatising message.[24]

[24] This article was initiated by a kind invitation to speak at the Brocher Foundation symposium *Individualized choice: a new approach to reproductive autonomy in prenatal screening*, Geneva, April 4-5, 2013 and the initial draft presnted there profitted much from the comments received and the other presentations and discussions on that occassion. The further comments of two anonymous refrees made

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