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W Gyselaers, V Storms & L Grieten

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Editorial

New technologies to reduce medicalization of prenatal care : a contradiction with realistic perspectives.

Gyselaers W [1,2], Storms V [3], Grieten L [3]

Wilfried Gyselaers: Author for correspondence

[1] Dept. Physiology, Hasselt University, Hasselt Belgium

[2] Dept. Obstetrics and Gynaecology, Ziekenhuis Oost Limburg, Schiepse Bos 6, B3600 Genk Belgium

0032-89-327524

Wilfried.gyselaers@uhasselt.be

Valerie Storms: [3] Mobile Health Unit UHasselt

Hasselt University, Agoralaan Building D, 3590 Diepenbeek, Belgium

0032-89-268533

Valerie.storms@uhasselt.be

Lars Grieten: [3] Mobile Health Unit UHasselt

Ziekenhuis Oost Limburg, Schiepse Bos 6, B3600 Genk Belgium

0032-89-321512

Lars.grieten@uhasselt.be

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During the last decades - mainly since the introduction of obstetric ultrasonography - prenatal care in most industrialized countries has evolved from a mother-targeted paramedical discipline to fetus-targeted medical care [1]. With this, clinical decision making and practical skills have been replaced by technical assessments and measurements. As a consequence, prenatal care has moved – and still is today - from the physiologic field of midwife-led care at home, to the technical area of medicine led by obstetricians and neonatologists in hospitals. This evolution was accompanied with a marked reduction of maternal and perinatal mortality in most developed countries, however with persisting inequalities to access of care [2]. To achieve this positive evolution, nearly all pregnant women and their unborns – even those at very low risk for adverse outcome - are encouraged to participate in a cascade of technical assessments throughout the course of pregnancy, several of which are evidence based beneficial, but others of no reported or proven relevance [3]. There are many aspects which can be considered responsible for this evolution. There is the technical revolution in health care itself, where digitalization, internet communication, automatization,… have been introduced even more swiftly than in public life. There is also a gradually reducing health condition of pregnant women over generations, with increasing rates of maternal obesity, advanced age, comorbidities, … and with intergenerational impact on population health [4]. In many countries, there is well organized private medical care, with reported higher intervention rates than in public health care [5]. Overall, there is also an ever growing psychological need for patients and health care workers to be in control - even more accentuated by social pressure - which induces fear for a natural event as childbirth, or for delivering or raising a disabled child [6]. This very much lowers the threshold for medicolegal litigation [7]. It is of no surprise that this technological revolution has raised the costs for public health care in most industrialized countries, with interregional differences not always well understood [8].

Fortunately, technological improvements sometimes also deliver more simplified tests, easily accessible to all patients at acceptable costs. One of the most striking examples in current prenatal care is the recent introduction of Non Invasive Prenatal Testing (NIPT) in screening for fetal Down

Syndrome [9]. The application of NIPT in a selected high risk population allows reducing strongly the rate of invasive prenatal procedures (amniocentesis or chorionic villus sampling), with intrinsic risk for iatrogenic miscarriage or hospital admission for bleeding or leakage of amniotic fluid. The cost per NIPT has reduced markedly since its introduction a few years ago, and when this evolution would continue, it will soon be possible to offer NIPT to every pregnant women requesting prenatal fetal aneuploidy screening [9]. Another prenatal screening process in evolution today involves the algorithms to screen for gestational proteinuric hypertension or preeclampsia, which mostly use combinations of ultrasound and/or Doppler measurements with maternal serum parameters [10]. Most of these algorithms require access to obstetric scanning performed by skilled sonographers, and therefore are not always readily available to all pregnant women. One strategy to potentially tackle this problem is a rationalized exploration of the performance of new, very simple non-invasive technologies to measure cardiovascular function in pregnant women. It is well known that gestational hypertensive disorders and premature birth, with or without fetal growth restriction, are related to gestational maladaptation of the maternal cardiovascular system [11], and link maternal hemodynamic dysfunction to cardiovascular diseases in later life [12]. It is also well known that adults, who were born dysmature or premature, are at higher risk for hemodynamic complications during their own pregnancies, and as such for transmitting this risk to their offspring [13]. Up till recently, hemodynamic assessments in pregnant women were technically difficult because of their invasive nature requiring monitoring at intensive care units, and usually were reserved for the exceptional case where the mothers' life was at risk [14]. Whether or not related, there has also been a very slow evolution during the last decades in management of gestational hypertensive diseases, which is illustrated by the older types of drugs and treatments still used today for these conditions [15]. A new generation of non-invasive methods for hemodynamic assessment is emerging now, which have outgrown their childhood diseases: impedance cardiography, bio-reactance, bio-conductance, … [16]. Several research groups are currently exploring the possibilities and limitations of these technologies and mostly conclude that reliabilities are high enough for

application into research programs and clinical practice [17]. The main advantages of these technologies are their low cost and methodological simplicity: the application of electricity-based devices measuring impedance, reactance or conductance, do hardly require any training and can easily be performed by technicians, nurses, midwives and family doctors. As such, these techniques become very accessible to most pregnant women, which opens perspectives to explore their potential role in improving access to population screening for proteinuric and non-proteinuric gestational hypertensive disorders.

The most fundamental problem to solve in any screening program for gestational hypertensive disease is : “What to do with those women, identified with maladapted cardiovascular functionality and classified in the high risk group?”. A large European multicenter study to explore the role of aspirin in the prevention of preeclampsia was aborted prematurely for practical difficulties [18]. The administration of calcium to women at high risk is reported beneficial, but still requires confirmation in a large multicenter trial [19]. Even when both strategies should turn out to improve obstetric and neonatal outcome significantly, they are likely associated with more intensified prenatal follow up and increased number of technical assessments in the high risk group. Again, another technological evolution can be explored towards reversal of this increasing medicalization of care: remote monitoring of cardiovascular parameters in pregnant women at risk [20]. In their normal life situation at home, women with high-risk pregnancies use digital enabled blood pressure monitors to self-measure their systolic and diastolic pressures and have wearable sensors to track their physical activity on a daily basis. These data are transferred automatically via modern digital communication systems (smart phone, wifi, blue tooth, …) to a clinical observation post at the hospital. Here, a team of midwife-researchers evaluate these data online, discuss abnormal measurements and evolutions with the responsible obstetricians or perinatologists, and close the loop by providing structured feedback on management options to the patients at home. This approach not only allows for a timely diagnosis of onset of gestational hypertensive disease, it may also avoid extra outpatient antenatal visits and/or hospital admissions for presumed hypertension [21], an effect debated by others, as this

strongly depends on the organization of health care [22]. Next to this, remote monitoring also opens the perspective to timely initiate and monitor antihypertensive treatments for gestational hypertensive disease, which is currently a grand-challenge. Today, the remote observations are limited to parameters of hypertension, but many aim to expand with clinical grade wearable sensors to measure uterine and fetal activity, enabling the obstetrician to look beyond the in-office visits and unlock a revolutionary eagle-eye view over the most important gestational complications [23].

The alternative organization of health care as explained above is very realistic and feasible in its set-up today, because most currently available non-invasive hemodynamic technologies and remote monitoring devices are cheap, and their simplicity is similar to using a mobile phone or tablet computer. This also opens perspectives to reverse the current evolution of antenatal interventions leading to more interventions and as such to ever increasing medicalized antenatal care. Offering remote home monitoring of obstetric parameters to a high risk group, associated with offering routine antenatal care by midwifes to the low risk group, allows timely identification of most cases of abnormal pregnancies without increasing ambulatory or in-hospital interventions. The authors strongly believe that time has come now for health organizations to facilitate research on a structured and organized medical implementation of today's simple technological innovations, which worldwide may offer accessible and individualized prenatal care to all pregnant women, without the need for increasing costs for public health care through reduction of interventions or hospitalizations for presumed or missed diagnoses.

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Declaration of Interest

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

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