

# Hjemmemonitorering

## Af gravide med komplikationer Erfaringer og perspektiver

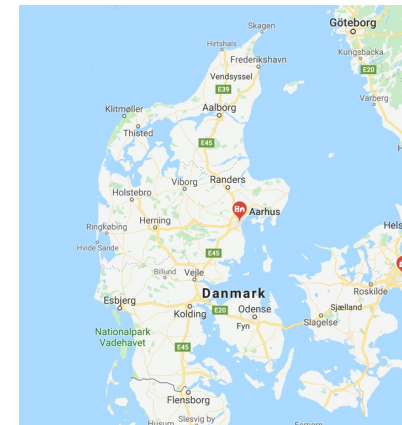


*Temadag:  
Digitale løsninger  
til fødsels- og  
graviditetsområdet*

Olav Bjørn Petersen, Klinisk professor, PhD  
Center for føtalmedicin, Obstetrisk afdeling  
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☎ 4033 1158

# Hjemmemonitorering

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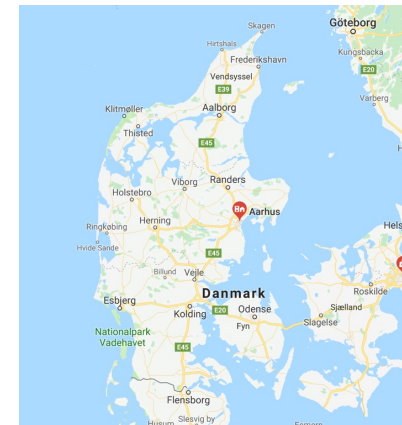
# Hjemmemonitorering

## Af gravide med komplikationer Erfaringer og perspektiver



AARHUS UNIVERSITET

midt  
regionmidtjylland



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# Baggrund

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## ”Tina”



- PPRROM Uge 20
- Mand og barn på 2 år
- Indlagt indtil uge 34 ?

# Monitorering af gravide med komplikationer

- Den gravide:
  - Symptomer
  - **CRP**, BT, puls, temp, (vægt, urin analyse)
- Fostret:
  - **Doptone/CTG**, Fosterbevægelser
  - **Ultralyd**



# Ny CTG pulsmåling: Foster & mor-EKG

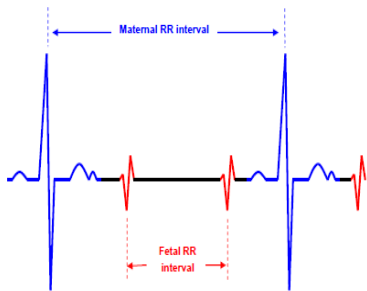
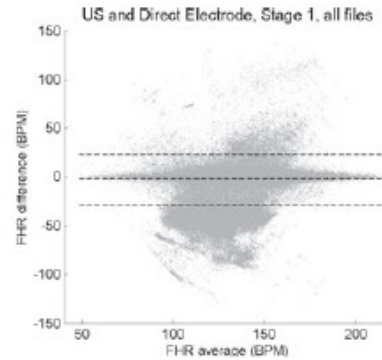
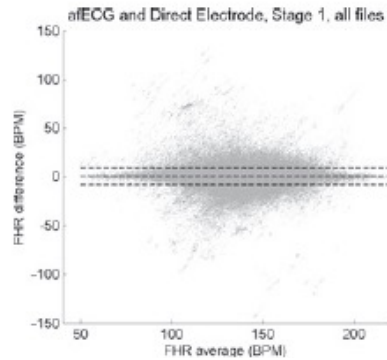
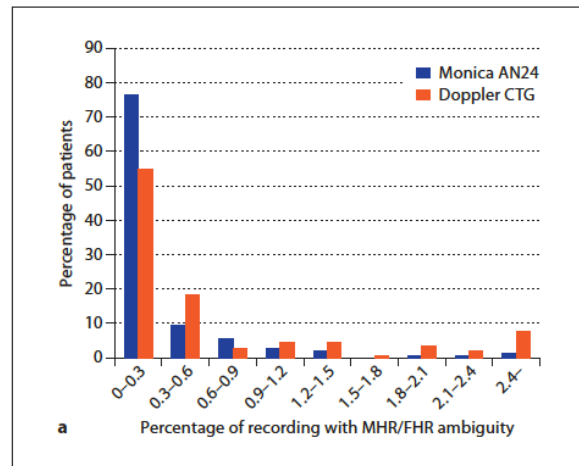


Figure 2 Calculation of FHR and MHR from ECG



## Foster EKG:

- Mere præcis FHR
- Mindre risiko for FHR/MHR konfusion

### Intrapartum Heart Rate Ambiguity: A Comparison of Cardiotocogram and Abdominal Fetal Electrocardiogram with Maternal Electrocardiogram

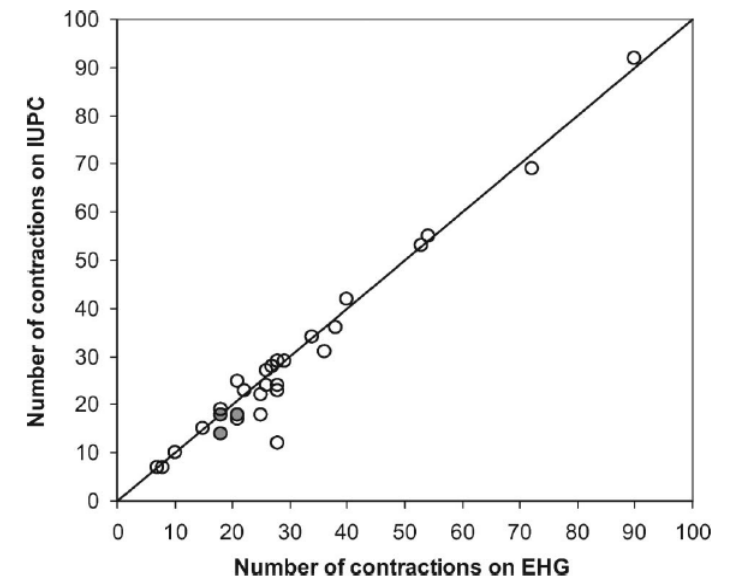
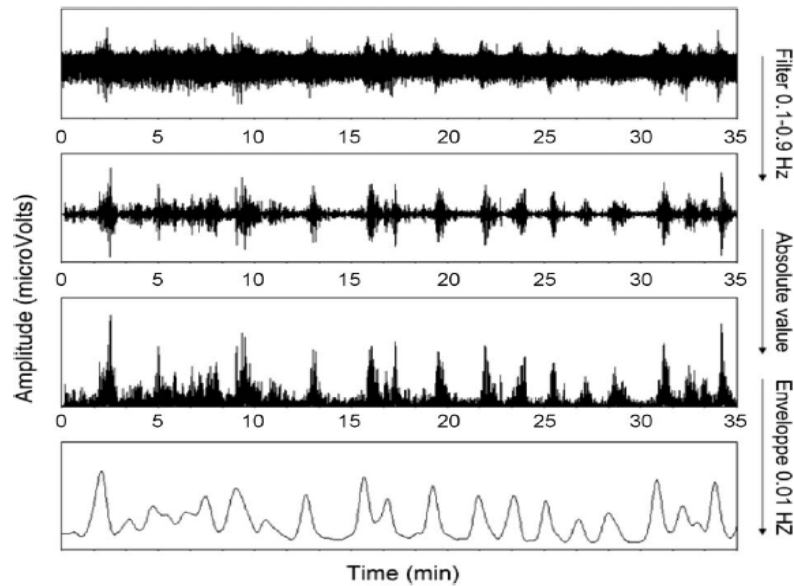
Joscha Reinhard<sup>1</sup>, Barrie R. Hayes-Gill<sup>2</sup>, Sven Schiermeier<sup>3</sup>, Hendrike Hatzmann<sup>4</sup>, Tomas M. Heinrich<sup>5</sup>, Frank Louwen<sup>6</sup>

### AOGS MAIN RESEARCH ARTICLE

#### Accuracy and reliability of fetal heart rate monitoring using maternal abdominal surface electrodes

WAYNE R. COHEN<sup>1</sup>, SOPHIA OMMANI<sup>1</sup>, SARMINA HASSANI<sup>1</sup>, FADI G. MIRZAI<sup>1</sup>, MOLHAM SOLOMON<sup>1</sup>, RAYMOND BROWN<sup>2</sup>, BARRY S. SCHIFRIN<sup>3</sup>, JOHN M. HIMSWORTH<sup>4</sup> & BARRIE R. HAYES-GILL<sup>1</sup>  
 Departments of Obstetrics and Gynecology, <sup>1</sup>Queens Hospital Center, New York, NY; <sup>2</sup>Temple University Hospital, Philadelphia, PA; <sup>3</sup>Columbia University Medical Center, New York, NY; <sup>4</sup>Kaiser Permanente Los Angeles Medical Center, Los Angeles, CA, USA; and <sup>5</sup>Department of Electrical and Electronic Engineering, University of Nottingham, Nottingham, UK

# Ny CTG ve-registrering: EMG



A validation of electrohysterography for uterine activity monitoring during labour

BENOIT C. JACOD, ELISABETH MARGO GRAATSMA, ELINE VAN HAGEN, & GERARD H. A. VISSER

Department of Obstetrics, University Medical Centre, Utrecht, The Netherlands

(Received 23 February 2009; revised 18 May 2009; accepted 25 June 2009)

EMG korrelerer bedre med intrauterine tryk end alm CTG (tryktransducer)

# Flere fordele ved ny CTG teknologi

- Uafhængig af BMI
- Uafhængig af fosterbevægelser
- Fra GA 20
- Mere mobil (under fødsel)



Published in final edited form as:  
*J Matern Fetal Neonatal Med.* 2014 May ; 27(7): 714–718. doi:10.3109/14767058.2013.836485.

## Fetal heart rate patterns at 20 to 24 weeks gestation as recorded by fetal electrocardiography

F Hofmeyr<sup>1</sup>, CA Groenewald<sup>1</sup>, DG Nel<sup>2</sup>, MM Myers<sup>3</sup>, WP Fifer<sup>3</sup>, C Signore<sup>4</sup>, GDV Hankins<sup>5</sup>, and HJ Odendaal<sup>1</sup> for the PASS Network<sup>6</sup>

## Maternal Body Mass Index Does Not Affect Performance of Fetal Electrocardiography

E. Margo Graatsma, M.D.,<sup>1</sup> Jena Miller, M.D.,<sup>2</sup> Eduard J.H. Mulder, M.Sc., Ph.D.,<sup>1</sup> Christopher Harman, M.D.,<sup>2</sup> Ahmet A. Baschat, M.D.,<sup>2</sup> and Gerard H.A. Visser, M.D., Ph.D., F.R.C.O.G. (a.e.)<sup>1</sup>

### AOGS MAIN RESEARCH ARTICLE

## Influence of maternal body mass index on accuracy and reliability of external fetal monitoring techniques

WAYNE R. COHEN<sup>1</sup> & BARRIE HAYES-GILL<sup>2</sup>

<sup>1</sup>Department of Obstetrics and Gynecology, University of Arizona College of Medicine, Tucson, Arizona, USA, and  
<sup>2</sup>Department of Electrical and Electronic Engineering, University of Nottingham, Nottingham, UK



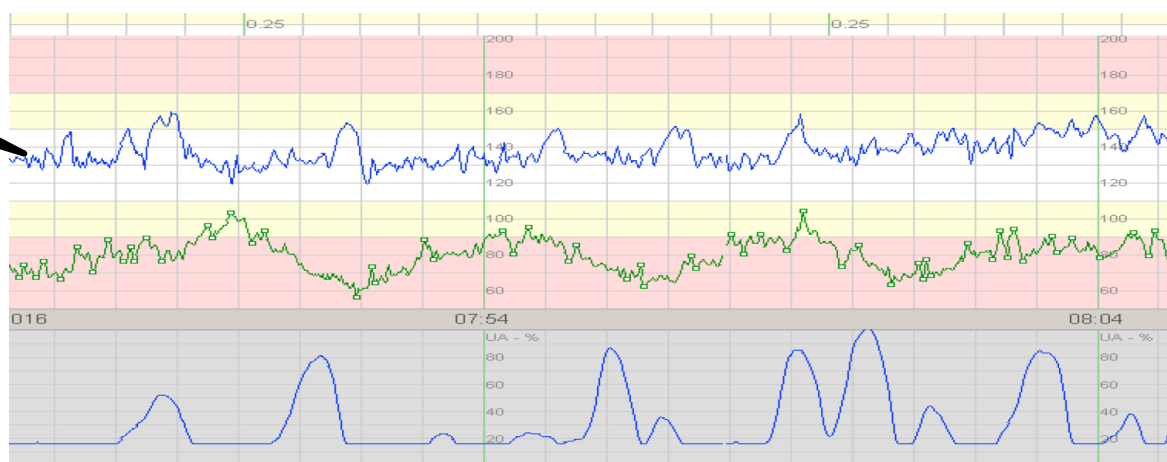
# CTG-Sammenligning: Standard vs EKG/EMG

Standard (UL)  
CTG



Foster  
HR

Moder  
HR



EKG/EMG  
CTG

# BMI 50 – standard CTG



# BMI 50, EKG/EMG CTG

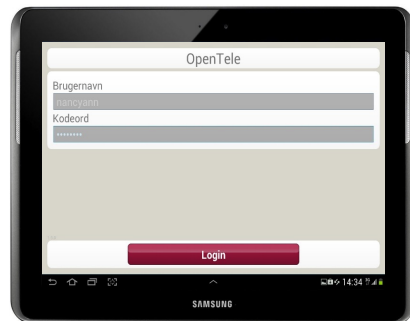
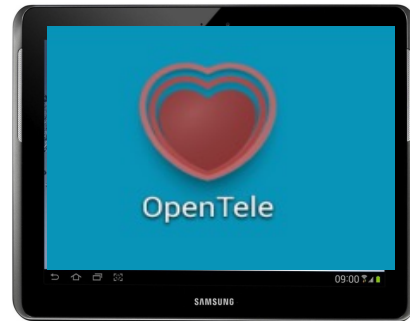


# ”Micro laboratorier” – POC/hjemmeanalyser

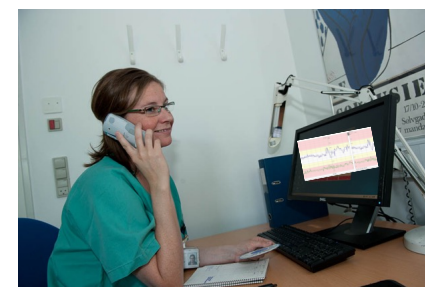
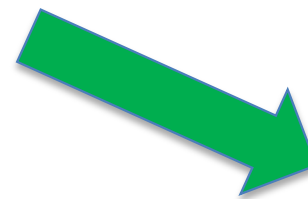
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# Platform til spørgeskema & dataoverførsel



# CTG Teknologi & POC udstyr = Hjemmemonitorering



# Evidens for hjemmemonitorering?

Forventningsafstemning

Preterm Premature Rupture of Membrane Management–Inpatient versus Outpatient: A Retrospective Review

Sarah C. Ellestad, M.D.,<sup>1</sup> Geeta K. Swamy, M.D.,<sup>1</sup> Tammy Sinclair, R.N.,<sup>1</sup> Andra H. James, M.D., M.P.H.,<sup>1</sup> R. Phillips Heine, M.D.,<sup>1</sup> and Amy P. Murtha, M.D.<sup>1</sup>

Registrere ”alt”

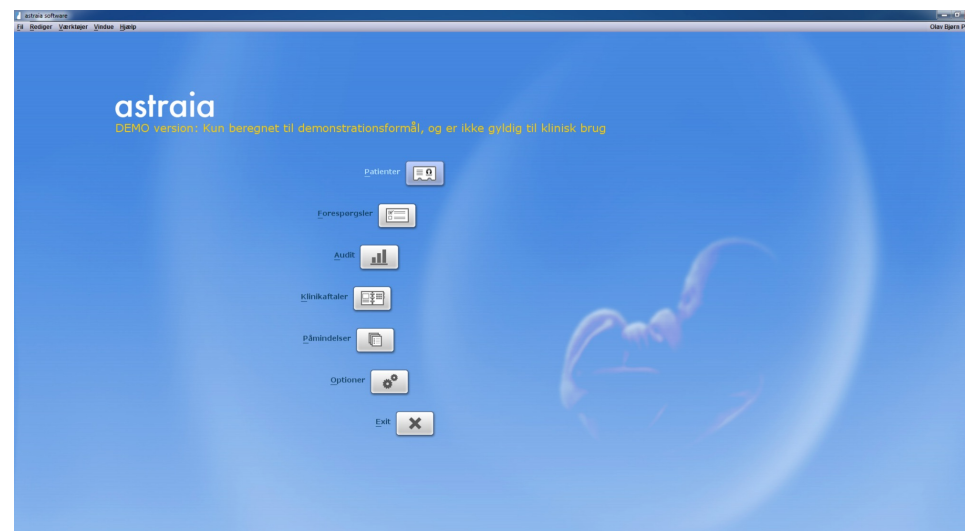
Carlan SJ, O'Brien WF, Parsons MT, Lense JJ. Preterm premature rupture of membranes: a randomized study of home versus hospital management. *Obstet Gynecol.* 1993 Jan;81(1):61-4.

Non-inferiority

Ryan G, Oskamp M, Seaward PG et al. Randomized controlled trial of inpatient vs outpatient management of PPRM. *Am J Obstet Gynecol* 1999; 180, No 1; Part 2: S95, SMFM Abstract 314.

# Registrering af alle variabler i Astraia

PID	A.pH
Mor cpr	A-BE
Selvmonitorering-gruppe	V-pH
termin efter ultralyd	V-BE
Inklusionsdato i projekt 1	Forløsningsmetode
Ophørsdato i projekt 1	Indikation (2)
Inklusionsdato i projekt 2	Forløsningsmåde
Ophørsdato i projekt 2	Indikation (2) (2)
Inklusionsdato i projekt 3	Præeklampsi
Ophørsdato i projekt 3	debut
Inklusionsdato i projekt 4	PPROM
Ophørsdato i projekt 4	Dato for PPR0M
GA inkl_diff	Gestationsalder
GA_inkl_d	PPROM_GA_days
GA_inkl_u	GA_PPR0M_d
Inkl_d_tot	GA_PPR0M_u
Monitoreret antal dage i projekt	Delta_d
Indlagt antal gange under projekt	Delta_u
outcome	Barn CPR
Død den	Flerlinger, afkryds
date.birth	Fødselskomplikationer
ga.birth.w	Graviditetskomplikationer
ga.birth.d	Kommentarer (2) (2)
GA-fød_d	bmi
GA-fød_u	pariety
birth.dept	Cervix længde ved inklusion
Barnets køn	Selvmonitorering-lokalisation
Birth weight	Antal UL-skanninger under projekt
Z-scoreFV	Antal kontroller i KfG under projekt
Apgar-1	Kontroller i Akutmodt. undet projekt
Apgar-5	
Apgar-10	





# Patientgrupper tilbudt hjemmemonitorering

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- For tidlig vandafgang (PPROM)
- Let-moderat præeklampsi (PE)
- Diabetes
- Øget *risiko* for PE
  - Medicinsk sygdom(Thrombofili, nyresygdom etc)
  - Tidligere graviditet m/alvorlig PE/HELLP
  - Svært væksthæmmet foster ( <-33%)
- Komplex anamnese, ex. tidligere dødt foster/nyfødt barn
- Anden obstetrisk komplikation, ex. For meget fostervand, nedsatte fosterbevægelser

I stedet for / supplement til:  
-Indlæggelse  
-Hyppig ambulant kontrol

# Patientgrupper, singletons

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• PPRM	85
• Risiko for PE	151
• FGR	27
• PE	67
• Diabetes (DM/GDM)	23
• Andre / kompleks historie	47

Received: 25 June 2021 | Revised: 15 October 2021 | Accepted: 2 November 2021

DOI: 10.1111/aogs.14294

ORIGINAL RESEARCH ARTICLE



Home management by remote self-monitoring in intermediate- and high-risk pregnancies: A retrospective study of 400 consecutive women

n=400

Anne Rahbek Zizzo<sup>1</sup> | Lone Hvidman<sup>1</sup> | Jannie Dalby Salvig<sup>1</sup> | Lone Holst<sup>1</sup> | Morten Kyng<sup>2,3</sup> | Olav Bjørn Petersen<sup>1,4,5</sup>

# Udkomme – PPROM

PPROM @	Avg. (min-max)	
	<24 w	>=24 w
N	23	62
<b>GA @ PPROM (week)</b>	<b>21.8 (15.4-23.9)</b>	<b>29.1 (24.0-33.3)</b>
GA @ Inclusion (week)	24.6 (20.7-27.7)	29.9 (24.3-33.9)
Cx length @inclusion (mm)	35 (8.0-50.0)	28.8 (5.7-57.0)
Included (days)	32 (2-98)	14 (1-62)
Number of controls @home	28 (3-96)	14 (2-62)
Interval PPROM to delivery (days)	52 (7-158)	20 (3-69)
<b>GA @ delivery (week)</b>	<b>29.2 (24-38)</b>	<b>32.0 (26-38)</b>
BW Z-score	-0.7 (-3.8 - 0.7)	0.6 (-3.0 - +2.2)
Alive	<b>18/23 (78.3%)</b>	<b>60/62 (96.8%)</b>

# Litt: Udkomme – GA @PPROM < 24

Kun AUH var hjemmemonit.

De andre var indlagte

Parameter	AUH	Soylu (2010-CAN) Case-ctrl	Dinsmoor (2004-USA)	Linehan (2016-IRL)
N	23	29	46 (57 børn)	42
<b>GA @ PPRM (week)</b>	<b>21.8 (15.4-23.9)</b>	<b>21 (19-23)</b>	<b>22,0 (16,9-24)</b>	<b>18 (14-24)</b>
Interval PPRM to delivery (days)	52 (7-158)	45 (15-75)	13 (0-96)	13
<b>GA @ delivery (week)</b>	<b>29.2 (24-38)</b>	<b>27 (25-29)</b>	<b>25,8</b>	<b>20,7</b>
Alive	18 (78.3%)	22 (76%)	27 (47%)	2 (4,8%)

(Mean +- 2SD)

all other mean (min-max)

# Udkomme – Ikke PPR0M

	Avg. (min-max)
n	315
<b>GA @ Inclusion (week)</b>	<b>31.3 (12-39)</b>
Included (days)	36.1 (1-193)
Number of controls @home	14 (1-72)
<b>GA @ delivery (week)</b>	<b>36.9 (27-41)</b>
BW Z-score	-0.6 (-4.8 to +4.6)
Alive	<b>313*/315 (99.4%)</b>

# Hvad siger de danske gravide?

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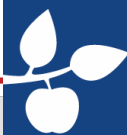
- ***”Understøtter egne muligheder”***
- ***”Mere i (egen)kontrol”***
- ***”Øget frihed og fleksibilitet”***
  
- ***”Fysisk på afstand men i tættere kontakt med personalet!”***

FONDEN FOR  
VELFÆRDSTEKNOLOGI

Klinisk Integreret Hjemmemonitorering  
(KIH)

Slutrapportering til Fonden for Velfærdsteknologi

August 2015



# Hvad siger de gravide i udlandet?



## Empowerment

Archives of Gynecology and Obstetrics (2018) 298:1085–1093  
<https://doi.org/10.1007/s00404-018-4918-y>

MATERNAL-FETAL MEDICINE



Acceptance of a new non-invasive fetal monitoring system and attitude for telemedicine approaches in obstetrics: a case-control study

Katharina Schramm<sup>1</sup> · Florian Lapert<sup>1</sup> · Juliane Nees<sup>1</sup> · Carlijn Lempers<sup>2</sup> · S. Guid Oei<sup>2,3</sup> · Markus W. Haun<sup>4</sup> · Imad Maatouk<sup>4</sup> · Thomas Bruckner<sup>4</sup> · Christof Sohn<sup>1</sup> · Sarah Schott<sup>1</sup>

Archives of Gynecology and Obstetrics  
<https://doi.org/10.1007/s00404-022-06705-y>

MATERNAL-FETAL MEDICINE



Wearable technology for health monitoring during pregnancy: an observational cross-sectional survey study

Colin Wakefield<sup>1</sup> · Lena Yao<sup>2</sup> · Steve Self<sup>2</sup> · Martin G. Frasch<sup>1,2</sup>

Received: 26 January 2022 / Accepted: 3 July 2022  
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Midwifery 29 (2013) 325–331



Contents lists available at SciVerse ScienceDirect

Midwifery

journal homepage: [www.elsevier.com/elsevier](http://www.elsevier.com/elsevier)



Women's experiences of outpatient induction of labour with remote continuous monitoring

Ediri O'Brien, BSc Hons (Research Assistant)<sup>a,\*</sup>, Zubair Rauf, MB, BS (Clinical Research Fellow)<sup>b</sup>, Zarko Alfirevic, PhD, FRCOG (Professor of Fetal and Maternal Medicine)<sup>b</sup>, Tina Lavender, PhD, MSc, RM, RGN (Professor of Midwifery)<sup>a</sup>

<sup>a</sup> School of Nursing, Midwifery & Social Work, University of Manchester, Manchester M13 9PL, UK

<sup>b</sup> Department of Women & Children's Health, University of Liverpool, Liverpool Women's Hospital, Liverpool L8 7SS, UK

AOGS  
Acta Obstetrica et Gynecologica Scandinavica

AOGS SYSTEMATIC REVIEW

Women's experiences of continuous fetal monitoring – a mixed-methods systematic review

ALEXANDRA CRAWFORD<sup>1</sup>, DEXTER HAYES<sup>1</sup> · EDWARD D JOHNSTONE<sup>1,2</sup> · ALEXANDER E.P. HEAZELL<sup>1,2</sup>

# Hvad siger personalet (i Tyskland)?

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244 Obstetriske sundhedspersonaler  
(sygeplejersker, jordemødre, læger)

Telemedicin indenfor obstetrikken:

- 73% Var skeptiske
- 56% Anerkendte at der var et potentiale

Gravides brug af apps til selvregistrering

- Læger: 72% var optimistiske
- Ikke-læger: 36% var optimistiske

JMIR MHEALTH AND UHEALTH

Grassl et al

Original Paper

A Web-Based Survey Assessing the Attitudes of Health Care Professionals in Germany Toward the Use of Telemedicine in Pregnancy Monitoring: Cross-Sectional Study

Niklas Grassl<sup>1</sup>, MS; Juliane Nees<sup>1</sup>, MD; Katharina Schramm<sup>1</sup>; Julia Spratte<sup>1</sup>, MD; Christof Sohn<sup>1</sup>, MD, PhD; Timm C Schott<sup>2</sup>, DMD, PhD; Sarah Schott<sup>1</sup>, MD, PhD

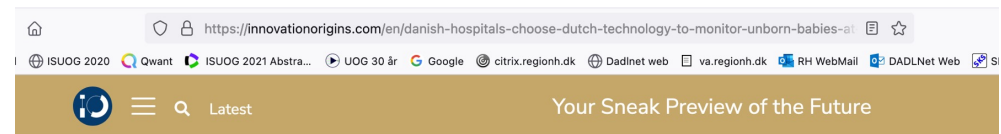
<sup>1</sup>Department of Gynecology and Obstetrics, University Women's Clinic Heidelberg, Heidelberg, Germany

<sup>2</sup>Centre of Dentistry, Department of Orthodontics and Orofacial Orthopedics, University of Tuebingen, Tuebingen, Germany



# Monica/GE = ikke til hjemmemonitorering ☹️

## Nationalt udbud 2019-2021



HEALTH

### Danish hospitals choose Dutch technology to monitor unborn babies at home

Hospitals in Denmark are going to use a Dutch monitoring system on a large scale for unborn children. This is a major commercial breakthrough for the medtech company Nemo Healthcare.

25 March 2021

LINDA BAK



Safe and comfortable fetal monitoring is what mother and child deserve



REGION

Rigshospitalet

AVNS  
SITET

# Potentiale for ny CTG (EKG/EMG)?

Flere med FGR/IUGR (væksthæmning)?

Under fødsel? STAN??

Risiko for præterm fødsel?

Tvillinger?

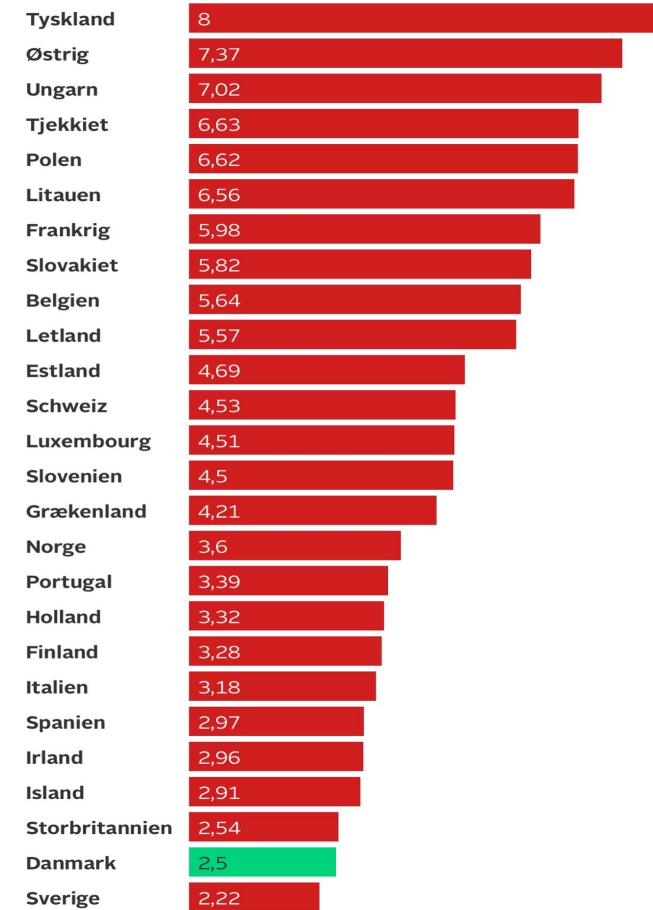
Foster arrytmier

Graviditetsbetinget intrahepatisk kolestase (leverkløe)



# Incitament?

## Hospitalssenge / 1000 indbyggere



# En hilsen fra Tina..

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*”Jeg vil endnu engang takke jer mange gange for at jeg måtte deltage i forsøget, og for al den hjælp I har givet mig.*

*Kan slet ikke forestille mig hvordan jeg skulle have klaret at være indlagt så længe hvis ikke i var kommet og "reddet" mig ”*

*Tina P*



# Spørgsmål?

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# Telemedicin: Kunsten at tænke ud af boksen...

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- Patienter / gravide med komplikationer!
- Lone Holst
- Anette Andersen
- Morten Kyng

**Tak!**

FONDEN FOR  
VELFÆRDSTEKNOLOGI

  
DIGITALISERINGSSTYRELSEN

SDU  UNIVERSITY OF  
SOUTHERN DENMARK

 AARHUS  
UNIVERSITET

  
ALEXANDRA  
INSTITUTTET

REGION  Rigshospitalet

Olav Bjørn Petersen Hjemmemonitorering af gravide med  
komplikationer

 KØBENHAVNS  
UNIVERSITET