


DEVICES USED FOR NON-INVASIVE TELE-HOMECARE FOR CARDIOVASCULAR PATIENTS: A SYSTEMATIC LITERATURE REVIEW

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2 AGENDA

- Research Context
 - Research Gap
 - Research method
 - Results description
 - Conclusions
 - Implications
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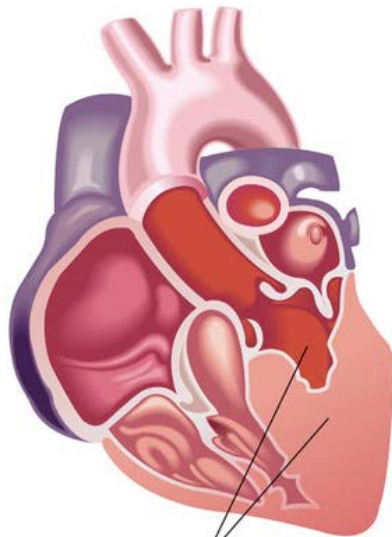
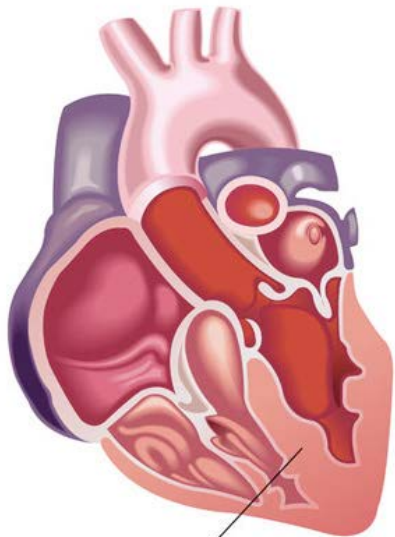
3 RESEARCH CONTEXT

- *Demographic changes: Aging and Growth of population*
 - E.g. 32% of the Dutch have a chronic disease such as Diabetes or
- **Cardiovascular diseases (CVD)**
 - coronary heart diseases, cardiac arrhythmia, heart failure
- *Challenge: To keep healthcare affordable*
 - Self-management, self-care
 - **Tele-homecare:** Application of such technologies in the *home* setting
 - Positive effects on patients
 - May save (i) costs, (ii) improve care access, (iii) improve outcomes

4 THREE TYPES OF CVD'S

Normal heart

Congestive heart

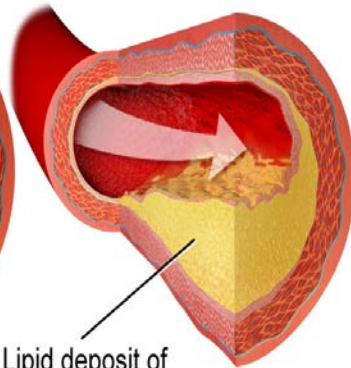
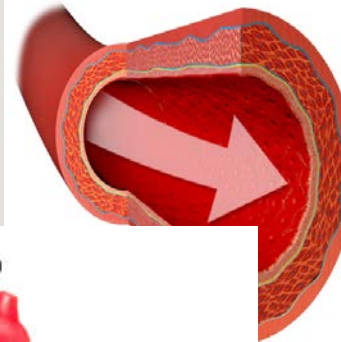


normal ventricular chambers

thickening of the ventricular chambers and smaller filling capacity and ejection of blood

Normal Artery

Narrowing of Artery



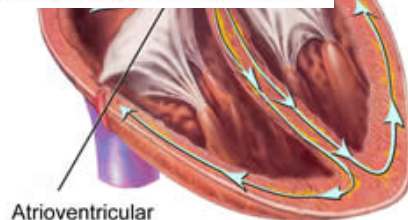
Lipid deposit of plaque

ary Artery Disease

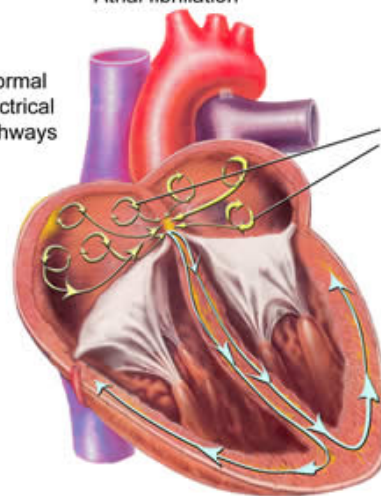
Atrial fibrillation

Normal electrical pathways

Abnormal electrical pathways



Atrioventricular (AV) node



5 RESEARCH GAP

1. No overview yet of current demand in the market
 - important aspect for both care providers and product suppliers
 2. No Systematic Literature Review (SLR) available yet
 - devices used for tele homecare of coronary heart disease, cardiac arrhythmia, or heart failure
- The objective of this SLR is therefore to provide an overview of these devices.

6 RESEARCH METHOD

- Performed in March 2017
 - Adhering to the Prisma 2009 checklist
 - Using PubMed and Scopus databases, English-language, full-text articles
- Focus on devices that were used for healthcare professionals and patients with coronary heart diseases, cardiac arrhythmias, or heart failure.
- Search query

```
((telemonitor* OR telehealth OR telemedicine OR
telehomecare* OR tele-mon*)
AND
(heart failure* OR coronary* OR arrhythmia*)
NOT
(implement* OR machine learning OR robot* OR meta-analys* OR
review OR ICD OR pacemaker* OR child* OR infant*))
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7 INCLUSION CRITERIA

- Only articles published in the last 10 years
 - *i.e.* from January 2007 to March 2017
 - All observational and experimental studies, as well as randomized clinical trials and quasi experimental studies
- English articles that investigate ambulant adult patients
 - Who are diagnosed with one of the cardiovascular diseases
 - *i.e.* coronary heart disease, cardiac arrhythmia and heart failure
 - Who are able to independently use tele homecare devices
 - Which address the added value for patients or healthcare professionals

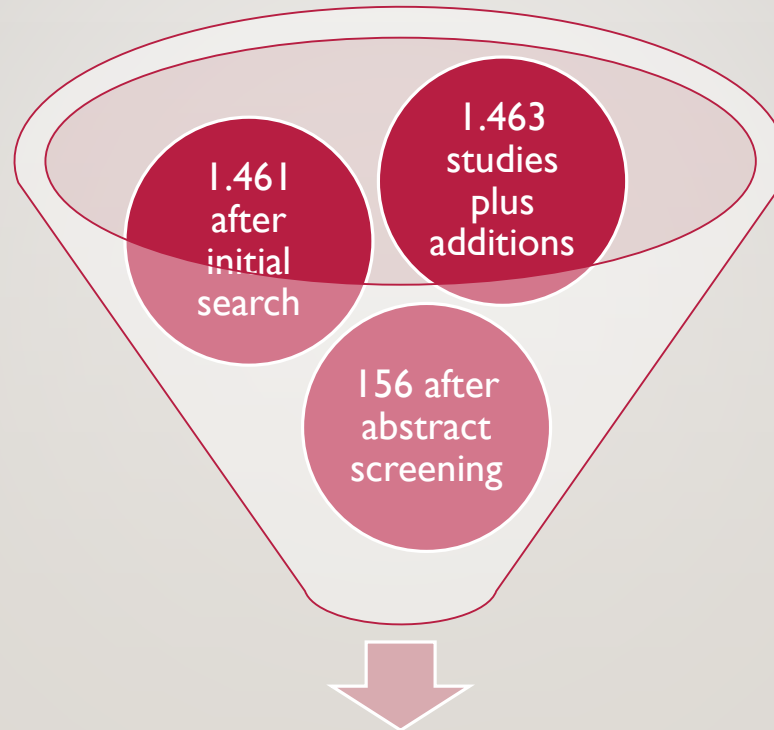
8 EXCLUSION CRITERIA

- No grey literature, opinion papers, and letters
 - to ensure the quality of the included studies
- No SLRs and meta-analyses
 - But their reference lists were checked for any additional articles to be included in this study
- No articles investigating the usage of tele homecare...
 - outside of the home setting
 - using invasive devices/interventions

9 EXTRACTED DATA FOR ANALYSIS

1. study design
 2. country
 3. study duration
 4. participant characteristics
 5. type of CVD
 6. study objective
 6. description intervention and control group
 7. tele homecare devices used
 8. added value
 9. usability aspects
1. demographic data description
 2. added value of tele homecare (generally)
 3. number of devices and their types, categorized per disease
 4. common combinations of devices

10 SEARCH OUTCOME



44 studies after full-text assessment



A LOT OF WORK...



12 APPENDIX A

Appendix A - SLR - Reasons for Exclusion

Study	Different definition of tele homecare	Type of tele monitoring not described	Different target group	Article not retrievable	Added value is not mentioned	Abstract was not available - full text not included	Not a quantitative research
Akematsu et al., 2013							
Anczykowski et al., 2016			X				
Atkin et al., 2012							X
Bai et al., 2008					X		
Bardsley et al., 2013							
Bekelman et al., 2013					X		
Bidargaddi et al., 2008	X						
Biddiss et al., 2009					X		
Boatin et al., 2016	X						
Boyne et al., 2013	X						
Boyne et al., 2011							X
Boyne et al., 2014	X						
Boyne et al., 2011					X		

13 APPENDIX B

Appendix B - SLR - Characteristics of Studies

Study	Study Country	Study Duration	Sample Size	Disease	Intervention Group	Usual Care Group	Healthcare professionals	Patients recruited from:	NYHA classification
Ammenwerth et al., 2015	Austria	4.5 months	N = 25	CAD	N = 25 (mean age 63) (24 men and 1 woman)	N/A	N/A	Unknown	N/A
Antonicelli et al., 2010	Italy	12 months	N = 57	CHF	N = 28	N = 29	N/A	Unknown	NYHA I
Antonicelli et al., 2008	Italy	12 months	N = 57	CHF	N = 28 (mean age 77) (female 43%)	N = 29 (mean age 79) (female 35%)	N/A	Italian National Research Centre on Mean aging Hospital,	NYHA I
Bakhshi et al., 2011	USA	6 months	N = 44	CHF	N = 28 (female 7)	N = 16	N/A	Denver Health Medical Center	Unknown
Bekelman et al., 2015	USA	12 months	N = 392	CHF	N = 187 (mean age 67.3) (male 95.2%)	N = 197 (mean age 67.9) (male 98%)	N/A	4 Veterans Affairs centers	Unknown
Bowles et al., 2010	USA	6 months	N = 218 (mean age 72) (64% female)	CHF	N = 36	N = 182	N/A	Unknown	Unknown

14 APPENDIX C

Appendix C - SLR - Outcomes of SLR

	Quality of Life	Health perception	Health conditions	Physical activity	Medical intake	Self
Ammenwerth et al., 2015	Improved					
Antonicelli et al., 2010			Significant reduction in heart rate and blood pressure		The TM group had a significantly greater increase in the use of b-blockers HMG-CoA reductase inhibitors (statins) and aldosterone receptor antagonists. A significant reduction in nitrate administration relative to baseline was also observed in the TM group.	
Antonicelli et al., 2008		Better health perception			The home telemonitoring group was characterized by a significant increase in the use of beta-blockers, statins and aldosterone antagonists and by a reduction in nitrates administration as compared to baseline.	
Bakhshi et al., 2011						
Bekelman et al., 2015						
Bowles et al., 2010						No s
Bowles et al., 2011						
Chaudhry et al., 2010						

15 APPENDIX D

Appendix D - SLR - Telehomecare Devices

	Blood Pressure Monitor	Weight Scale	Pedometer	Heart rate	ECG Device	Urine Output data	Pulse oximetry	Motion sensor
Ammenwerth et al., 2015	X		X					
Antonicelli et al., 2010	X	X		X	X	X		
Antonicelli et al., 2008	X	X		X	X	X		
Bakhshi et al., 2011		X						
Bekelman et al., 2015	X	X		X				
Bowles et al., 2010	X	X					X	
Bowles et al., 2011	X	X					X	
Chaudhry et al., 2010		X						
Chiang et al., 2012	X				X		X	
Dansky et al., 2008	X	X		X				
Dar et al., 2009	X						X	
Davis et al., 2015		X						
De Vries et al., 2013	X	X		X				
Dendale et al., 2011	X	X		X				
Dierckx et al., 2015	X	X		X				
Domingo et al., 2012	X	X		X				
Frederix et al., 2015								X

- etc

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HERE ARE THE KEY RESULTS...




17 DEMOGRAPHIC DATA RELATED TO THE INCLUDED STUDIES

No cardiac arrhythmia!

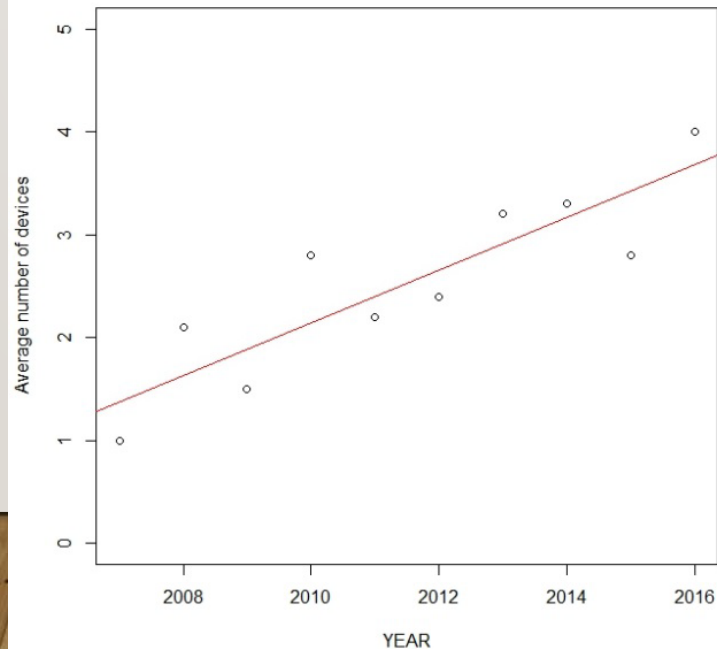
	Coronary Heart Disease (CHD)	Heart Failure	Total
Total number of studies	5 (100%)	39 (100%)	44 (100%)
Location			
Europe	4 (80%)	17 (44%)	21 (48%)
North-America	1 (20%)	21 (54%)	22 (50%)
Asia	0 (0%)	1 (3%)	1 (2%)
Gender			
Male	5 (100%)	19 (49%)	24 (55%)
Female	0 (0%)	15 (39%)	15 (34%)

18 RESEARCH DATA RELATED TO THE INCLUDED STUDIES

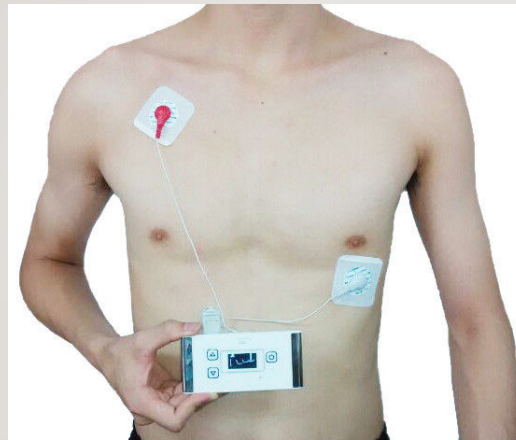
	Coronary Heart Disease (CHD)	Heart Failure	Total
Publication period			
2007-2012	2 (40%)	25 (64%)	27 (61%)
2013-2017	3 (60%)	14 (36%)	17 (39%)
Sample size			
> 100 patients	3 (60%)	23 (59%)	26 (59%)
 > 100 healthcare professionals	1 (20%)	0 (0%)	1 (2%)

19 NUMBER OF TELE HOMECARE DEVICES



	<i>Coronary Heart Disease (CHD)</i>	<i>Heart Failure</i>	<i>Total</i>
# of included devices			
1 – 3 devices	5 (100%)	29 (74%)	34 (77%)
! 4 – 5 devices	0 (0%)	10 (26%)	10 (23%)



20 TYPES OF TELE HOMECARE DEVICES



21 TYPES OF TELE HOMECARE DEVICES

	<i>Coronary Heart Disease (CHD)</i>	<i>Heart Failure</i>	<i>Total</i>
Blood Pressure Monitor	2 (40%)	29 (74%)	31 (70%) 
ECG Device	3 (60%)	10 (26%)	13 (30%)
Heart Rate	0 (0%)	17 (44%)	17 (39%)
Motion Sensor	1 (20%)	0 (0%)	1 (2%)
Pedometer	1 (20%)	0 (0%)	1 (2%)
Pulse Oximeter	1 (20%)	9 (23%)	10 (23%)
Urine Output Meter	0 (0%)	2 (5%)	2 (5%)
Weight Scale	0 (0%)	34 (87%)	34 (77%) 

22 COMBINATIONS OF HOMECARE DEVICES

<i>Homecare devices</i>	#1	#2	#3	#4	#5	#6	#7	Totals
Blood Pressure Monitor	✓	✓		✓	✓	✓	✓	6
ECG Device						✓	✓	2
Heart Rate Monitor		✓	✓		✓	✓	✓	5
Motion Sensor								
Pedometer								
Pulse Oximeter				✓				1
Urine Output Meter							✓	1
Weight Scale	✓		✓		✓	✓	✓	5
<i>Number of devices combined:</i>	2	2	2	2	3	4	5	
<i>Percentage combined:</i>	57%	39%	36%	23%	36%	9%	5%	

23 CONCLUSIONS

- Eight devices were found in the literature to be used in tele homecare
 - for patients diagnosed with coronary heart diseases, cardiac arrhythmia, or heart failure
- Most studies used multiple devices per study
 1. weight scale and blood pressure monitor, also in combination
 2. blood pressure monitors and heart rate monitors
 - The latter *nearly always* found in combination with blood pressure monitors
 3. With 3 devices: blood pressure monitor, weight scale, heart rate monitor
- Only eight studies looked into feasibility or usability of the devices
 - mentioning that not much is known yet about this
 - stressing the importance of this aspect in the usage of tele homecare

24 IMPLICATIONS

1. Give product suppliers insight into current demand of the market regarding tele homecare devices → Better response to market demand
2. Foundation for future research on the reasons why these devices are used could be investigated
3. Importance to study usability to improve success criteria of implementing and utilizing tele monitoring
 - comprehensive usability guidelines for these devices are needed to standardize testing of the usability aspects
 - increasingly more frequent multi-device monitoring programs
4. More insight into the effects of interventions is needed
5. Help healthcare providers in deciding which devices they should invest in

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THANK YOU

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<https://www.uu.nl/en/research/software-systems/organization-and-information/labs/applied-data-science>



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