

Additional file 2: Tabular overview of all included systematic reviews and meta-analyses

Authors/ Year	Main topic and/ or included technologies of interest	Search period	Number of studies	Target set- ting/ Target groups (Population)	+, o, +/- ¹	Main results or conclusions with respect to effectiveness as stated by authors	Résumé on methodological quality or study limitations ad- dressed explicitly in the studies	Level of Evi- dence ²
Systematic Reviews on Hospital/Care institution information systems, EHR/EMR and Decision support Systems								
Meißner and Schnepp 2014 [26]	Computer-based nursing documentation	2000- 2013	7 studies (quali- tative)	Residential aged care facilities	+/-	Improvement in the quality of residents' records is assumed to lead to an overall improvement in quality of care. Time management is improved for nurses who are efficient with electronic documentation. "For those who are less efficient with electronic documentation the information processing is perceived as time consuming" (p. 1).	Evidence is based on a qualitative analysis of qualitative studies. Limitations are based on the different settings and timing of data collection of the included studies.	4
Reis, Maia et al. 2017 [25]	Cost benefit of of electronic health records and hospital information systems	2010- 2016	6 Systematic Reviews	Hospital	+	Some preliminary benefits in quality of care are identified: "Hospital information systems, along with information sharing, had the potential to improve clinical practice by reducing staff errors or incidents, improving automated harm detection, monitoring infections more effectively, and enhancing the continuity of care during physician handoffs" (p.1). The review "did not provide evidence that the eHealth interventions had a measurable impact on cost-effectiveness, mortality, or LOS [length of stay, KH] in hospital settings. Preliminary evidence indicates that the use of eHealth interventions with information exchange may improve clinical process outcomes" (p.10).	Search is based on four databases, the quality of the included studies is rated as poor.	1a
Bright, Wong et al. 2012 [66]	Electronic clinical decision support systems	Until 2010	148 studies (only RCT with n>=50)	Clinical settings	+	"Clinical decision support had a favorable effect on prescribing treatments, facilitating preventive care services, and ordering clinical studies across diverse venues and systems" (p. 38). 86% of the studies assessed health care process measures, 20% assessed clinical outcomes, and 15% measured costs. "Few studies measured potential unintended consequences or adverse effects" (p. 29). Clinical decision support systems improve "health care process measures across diverse settings, but evidence for clinical, economic, workload, and efficiency outcomes remains sparse" (p. 29). (The study is part of Lobach et al. 2012, see below)	Studies were heterogeneous in interventions, populations, settings, and outcomes. Publication bias and selective reporting cannot be excluded.	1a
Lobach, Sanders et al. 2012 [67]	Clinical decision support systems (CDSS) and knowledge	1976- Dez 2010	311 studies, (only studies)	No restrictions	+	"Both commercially and locally developed CDSSs effectively improved health care process measures related to performing preventive service (...), ordering clinical studies (...), and prescribing therapies (...). Evidence for the effectiveness of CDSSs on clinical outcomes and costs and KMSs on any	Studies were heterogeneous in interventions, populations, settings, and outcomes. Publication bias and selective reporting cannot be excluded.	1a

¹ Direction of effect; abbreviations: +=positive effect, -=negative effect, o=no effect, +/- =ambivalent effects

² Level of evidence is depending on the highest level of evidence of the included studies, Level of Evidence and related study design: 1a=Reviews that include more than one Randomised controlled trial (RCT); 1b=RCT; 2= Controlled studies, without randomisation, ie, quasi-experiments; 3= Case-control or Cohort studies; 4: Findings obtained from descriptive, other observational and/or qualitative research designs (including case studies), cross sectional studies, user studies.

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	management systems (KMS)		with n>=50)			outcomes is minimal" (p. V). Based on a meta-analysis the study managed to identify or confirm "nine features of CDSSs/KMS that correlate with suc- cessful impact of clinical decision support" (p. V.).		
Roshano v, Fernande s et al. 2013 [68]	Identification of factors that differentiate between effective and ineffective computerised clinical decision support systems	1973- 2009	Meta- regression of 162 RCTs	No restrictions	+/o	58% of the included trials "showed improvements in pro- cesses of care or patient outcomes" (p. 3). Several factors were identified that partially explain success or fail of the system: Odds of success were greater for sys- tems that "provided advice for patients in addition to practi- tioners (...), required practitioners to supply a reason for over-riding advice (...), or were evaluated by their develop- ers" (p. 1). In contrast, the presentation of "advice in electronic charting or order entry system interfaces were less likely to be effec- tive" (p.1).	Although based on randomized controlled trials, the "analysis re- mains observational and the findings should not be inter- preted as if they were based on head to head trials of features of computerised clinical decision support systems. Failure to in- clude important covariates in (..) [the] models could have biased the estimates and given false findings" (p.4).	1a
Systematic Reviews on Telecare								
Capurro, Ganzinge r et al. 2014 [79]	E-health in palliative care	Until Jun 2012	17 studies (no RCTs)	Outpatient palliative care	+	"Some studies reported some improvement on quality of care, documentation effort, cost, and communications" (p. 1). One study reports quantitative results (lower number of hos- pitalizations, less emergency room visits and bed days (after introduction of text messaging and videophone devices). No study described "patient-relevant clinical outcomes" (p. 7).	"Studies tended to be observa- tional, non-controlled studies, and a few quasi-experimental studies. Overall there was great heterogeneity in the types of in- terventions and outcome as- sessments" (p.1).	2
Davies, Rixon et al. 2013 [23]	Telecare	Until Nov 2009	7 studies	Outcomes on informal carers	+	"The evidence tentatively indicated that telecare exerts a positive effect on carer stress and strain, but there is no evi- dence to indicate benefits on burden or quality of life" (p. 582). Evidence on the amount of time spent on caring duties and "on relationships between the carer, cared-for person and other family members" (p. 582) is inconsistent.	"All included evaluations were rated as being of weak method- ological quality, indicating risk of bias within the evidence base" (p. 582).	2
Karlsen, Ludvigse n et al. 2017 [81]	Telecare	2005- 2017	11 qualitative studies	Outpatient long-term care	+	"The experiences with the use of telecare are diverse. Find- ings indicate telecare systems can promote safety and secu- rity to age in place. However, (...) Telecare systems must fit individual needs, and be supported by service providers to accommodate sustainable use over time" (p. 2913).	"The duration of use of telecare devices was not well described in many of the included studies, which likely affected participants' experiences" (p. 2932).	4
Oliver, Demiris et al. 2012 [80]	Telehospice	2000- Mar 2010	26 studies (3 studies on clinical outcomes)	Outpatient palliative care	o	None of the 3 studies with clinical outcomes (patient anxiety, caregiver quality of live, communication anxiety, caregiver perceptions of pain medication) "was large enough to find significance in these clinical measures" (p. 45).	"The evidence base, although growing and promising, is of mixed scientific rigor with lower- medium strength evidence in quantitative studies and me- dium-higher strength evidence in qualitative studies" (p. 46).	2

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Systematic Reviews on other Communication Technologies								
Arditi, Rège- Walther et al. 2012 [91]	Computer generated reminders (delivered on paper)	Until 2011	32 studies	Mainly outpatient care in North America	+	Interventions “achieved moderate improvement in profes- sional practices, with a median improvement of processes of care of 7.0% (...). In the only study that had sufficient power to detect a clinically significant effect on outcomes of care, reminders were not associated with significant improve- ments”(p. 2).	“The quality of evidence for these comparisons was rated as moderate according to the GRADE approach” (p. 2).	1a
Bhattarai and Phillips 2017 [92]	Digital technologies for pain management (Coaching & Assessment)	2000- Aug 2015	9 studies	Older people’s pain management across care- settings	o	“There is insufficient evidence demonstrating the effective- ness of digital health technologies in reducing older people’s pain intensity and pain interference” (p. 23), but there are some contradictory findings, indicating a need for further re- search.	“There is lack of high-quality studies investigating the effec- tiveness of digital health technol- ogies in management of older people’s pain, with most limited to pilot or feasibility studies that do not appear to have led to larger adequately powered phase III RCTs” (p.22).	1a
Fagerström, Tuvesson et al. 2017 [94]	Information and communication technologies in general	2009- 2015	20 studies	Nursing practice in Sweden	+/-	The “review indicates that ICT integration into nursing prac- tice is a complex process that impacts nurses’ communica- tion and relationships in patient care, working conditions, and professional identities and development” (p. 434).	“Due to the variety of aims and research questions in the quali- tative and quantitative studies (..) examined, it was difficult to provide an all-encompassing un- derstanding of the role of ICT in nursing settings” (p. 445).	4
Hu, Kung et al. 2015 [19]	Internet based interventions to decrease caregiver stress	Until 2013	24 studies (16 RCTs, 8 open label trials)	Informal caregivers	+/o	Three out of eight included open-label studies reported “posi- tive benefit in reducing caregiver stress, four were partially positive (...), and one was a negative study” (p. e194). Six out of the 16 included RCTs “showed positive benefit, five were partially positive and five were negative. There were no clear patterns as to the variables (...) associated with better outcomes” (p. e194).	(No limitations are discussed in the study, KH).	1a
Mickan, Atherton et al. 2014 [93]	Personal digital assistants used to access information or support clinical decision making	2001- Aug 2013	7 studies (small RCTs)	Healthcare professionals in clinical settings	+	Accessing Information: “When healthcare professionals used handheld computers to access clinical information, their knowledge improved significantly more than peers who used paper resources” (p. 1) (based on 2 pilot RCTs). Adherence to guidelines: “When clinical guideline recom- mendations were presented on handheld computers, clini- cians made significantly safer prescribing decisions and ad- hered more closely to recommendations than peers using paper resources” (p. 1) (based on 2 feasibility RCTs). Diagnostic Decision making: “healthcare professionals made significantly more appropriate diagnostic decisions us- ing clinical decision-making tools on handheld computers	Only RCTs included. Only 4 of the 7 studies “reported convinc- ing, statistically significant evi- dence (...). The heterogeneity of study designs and purposes makes the synthesis of this liter- ature difficult” (p. 8).	1b

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						compared to colleagues who did not have access to these tools" (p. 1) (based on 3 pilot RCTs).		
Systematic Reviews on Robotic Technologies								
Bemelma ns, Gelderbl om et al. 2012 [1]	Socially assistive robots (mostly animaloid)	Until sept 2009	41 publi- cations on 17 studies	Elderly Care	+	"Most studies reported positive effects of companion-type robots on (socio)psychological (eg, mood, loneliness, and social connections and communication) and physiological (eg, stress reduction) parameters" (p. 114).	"The methodological quality of the included studies was mostly low" (p. 114) (very small sample sizes, 1 RCT included with n=12 in intervention group).	2
Kachouie , Sedighad eli et al. 2014 [113]	Socially assistive robots (13 different robots included, mostly animaloid)	Until 2012	68 studies (37 study groups)	Elderly Care	+	Most studies report positive effects on well-being, only few studies report negative or no effects	Generalizability of outcomes is problematic, methodological quality is mostly low, most studies without control groups, mostly situated in Japan.	2
Pearce, Adair et al. 2012 [112]	Robotic devices enabling older people to live at home	1990- 2012	42 studies (4 studies on effec- tiveness)	Older people living at home	+	Exoskeleton: "improved walking speed and reduced energy expenditure" (p. 3) Robotic Wheelchair: maneuvering less mentally demanding than hand control	Only very limited evidence on effectiveness available, all studies are small and situated in laboratory setting	4
Systematic Reviews on Monitoring/Sensors								
Choi, Lawler et al. 2011 [176]	Fall prevention strategies in general (including bed- alarm systems)	1990- 2009	34 studies	Fall prevention in hospital settings	o	Only 2 of the studies refer to digital technologies: "Despite observing a clinical tendency towards fall reduction, studies investigating the efficacy of a bed alarm system did not observe a statistically significant reduction in the number of falls" (p. 2517)	The methodological quality of the included studies is moderate. (The specific technology included remains unclear, KH).	2
Kosse, Brands et al. 2013 [142]	Sensor technologies for fall prevention	Until 2011	12 studies	Elderly persons in hospital or nursing care	+/o	3 RCTs "reported no reduction in falls, but three before-after studies reported significant reductions of (..) falls (...). The current data "is inconsistent whether current sensor technologies are effective in reducing fall rates in institutionalized geriatric patients" (p. 743). False alarm rates are often high.	"The relatively low methodological quality of the included studies and the low number of the studies limit the conclusion (...) the (..) review can offer" (p. 751)	1a
Walia, Wong et al. 2016 [143]	Monitoring Devices to prevent pressure injuries	2005- Jan 2016	9 studies (2 studies in meta- analysis)	Any setting and target group	+	"All studies included reported a significant reduction in the risk factors for and/or the incidence of PIs [pressure Injuries, KH]. The (..) meta-analysis showed that risk of developing new PIs may be 88% lower than without the use of monitoring devices" (p. 572).	No RCTs included, but methodological quality of non-randomized and observational studies was rated good.	2
Systematic Reviews on Assistive Devices								
Anttila, Samuels on et al. 2012 [157]	Assistive Technologies (AT) for people with disabilities	2000- Apr 2010	44 Systematic Reviews	People with disabilities	+	Most of the included reviews assess non-digital AT. Two Reviews on digital AT for people with dementia are included, that identify some positive effects. One of the review has moderate limitations, the other one major limitations in study quality. Two reviews on powered mobility devices identify beneficial effects based on low to moderate levels of evidence.	"Low-quality or unclear evidence was found for the effectiveness of (...) [most] evaluated AT interventions" (p. 9).	unclear

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Nicolson, Moir et al. 2012 [177]	Assistive Technologies (AT) for children with disability	Until 2011	4 studies, 1 systematic review	Informal caregivers of children with disability	+	“Three articles reported that AT lightened caregiver assistance in the areas of mobility, self-care and social function” (p. 345). Besides adaptive seating devices and switches it remains unclear what type of technology has been studied in the studies.	Two studies are of moderate, two studies of low methodologi- cal quality.	2
Van der Roest, Wenborn et al. 2017 [151]	Assistive Technology for memory support	Until Feb 2017	No study met inclu- sion criteria (RCT)	People with dementia		No studies included		
Systematic Reviews on Multiple Technologies								
Ofek Shlomai, Rao et al. 2015 [178]	Handhygiene interventions (reminders on PC screen savers, e-mails, educational performance feedback by UV- sensor)	Until 2013	16 studies	Neonatal intensive care units (NICU)	+	Meta-analysis “indicated that a range of strategies, such as educational campaigns, musical parodies, reminders, easy access to hand hygiene sanitisers, UV sensors and performance feedback, improved HHC [hand hygiene compliance, KH]” (p. 887). “Strategies to improve HHC in NICUs seem to be more effective when they include performance feedback at the personal or group levels” (p. 887).	No RCT included, significant statistical heterogeneity in the studies, “duration of follow-up was inadequate in the majority of the studies” (p. 896).	
Fleming and Sum 2014 [2]	Assistive Tech- nologies (AAL, Tracking, Assis- tive Devices, Telecare)	1995- 2011	41 studies	People with dementia	+/-	Diverse findings for a broad range of technologies are pre- sented. Results are reported qualitatively, focused on the fol- lowing topics: independence, prompts and reminders, safety and security, leisure and lifestyle, communication and tele- health, therapeutic interventions.	“The studies are usually limited by very small samples, high drop-out rates, very basic statis- tical analyses and lack of adjust- ment for multiple comparisons and poor performance of the technology itself” (p. 14).	1a
Khosravi and Ghapanc hi 2016 [4]	Technologies applied to assist seniors (ICT, Robotics, Tele- medicine, Sen- sor technology, medication man- agement, Smart Games)	2000- 2014	41 studies	Seniors aged 60 years or older	+	“The effectiveness of the technologies in the studies include health outcomes (...), social influence (eg, caregiving benefits, independent living and hospital readmission), and well-being (...). The major findings (...) showed that a number of the technologies have a positive impact on enhancing seniors’ lives” (p. 23).	“Most of the studies in the final pool were experimental, making it difficult to provide robust con- clusion. (...) Most of the studies suffer from small sample size; therefore, the findings (...) did not validate strong evidence to support the effectiveness of the assistive technology” (p. 24)	1a
Liu, Stroulia et al. 2016 [3]	Smart homes and home based health-monitor- ing	Until Oct 2014	48 studies (18 studies on effec- tiveness)	Home or supportive care environm- ents for older	+/-	“There is no evidence that smart homes and home health monitoring technologies help address disability prediction and health-related quality of life, or fall prevention; and (..) there is conflicting evidence that (...) [they] help address chronic obstructive pulmonary disease” (p. 44).	No meta-analysis performed “because of the heterogeneity of the technologies used, the medi- cal conditions and disability ad- dressed with those technologies	1a

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				adults (60 years and older) /outpatient care			and the outcomes reported in the studies included” (p. 57). (The study claims that studies published before 2010 were ex- cluded, but actually included study range is from 2004-2014, KH)	
Manias, Williams et al. 2012 [179]	Interventions to reduce mediation errors (Decision support, CPOE, smart pumps)	Until Oct 2011	24 studies	ICU	+/-	“Sixteen out of the 24 studies demonstrated statistically significant reductions in medication error rates. Four studies showed increased medication error rates and four studies demonstrated no change or an unclear effect” (p. 412). “Four intervention types demonstrated reduced medication errors post-intervention: CWS, ME, MR and PG [changes in work schedules, modes of education, medication reconciliation and protocols and guidelines, KH]” (p. 411). Mixed results were found on CPOE and Decision Support Systems.	“It is not possible to promote any interventions as positive models for reducing medication errors. Insufficient research was undertaken with any particular type of intervention, and there were concerns regarding the level of evidence and quality of research” (p. 411).	1a
McKib- bon, Lokker et al. 2011 [59]	Impact of health information technology on medication management process (MMIT)	Until summe r 2010	428 studies (377 studies on effec- tiveness)	No restrictions	+	“Process and other outcomes related to use and satisfaction with MMIT were often improved, especially for prescribing and ordering and the monitoring phases. Improvements in the appropriateness of prescribing and decreased errors (...) seem to be consistently shown” (p. 100). Less frequently addressed are changes in workflow, improvements in communication and time reductions that are often positive. Clinical endpoints improved sometimes, but this was shown more often in observational studies than in controlled trials.	Study quality varied according to phase of medication manage- ment. Study outcomes and discussed limitations are too broad to be represented adequately in this table.	1a
McKib- bon, Lokker et al. 2012 [60]	Impact of health information technology on medication management process (MMIT)	Until summe r 2010	87 studies (RCTs only)	No restrictions	+/o	“Processes of care improved for prescribing and monitoring mostly in hospital settings, but the few studies measuring clinical outcomes showed small or no improvements” (p. 22). Most of the RCTs were situated in hospitals and clinics, only some of the studies included nurses. The analyzed technologies were mostly clinical decision support and computerized provider order entry systems. (The study is an analysis of the RCTs included in McKibbon et al. 2011.)	“Few studies measured clinical outcomes. (...) [The] large body of literature, although instructive, is not uniformly distributed across settings, people, medica- tion phases, or outcomes” (p. 22).	1a

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Vedel, Akhlaghp our et al. 2013 [180]	Application of health informa- tion technolo- gies in geriatrics & gerontology (telecare, EHR, decision support, web-based support for patients/ family care-givers, assistive IT)	2000- Apr 2010	112 studies	Older adults	+	The main outcomes that were analyzed are: - Impact on clinical processes (65 studies, 94% positive re- sults) - Patients' satisfaction (33 studies, 82% positive results) - Patients' health outcomes (25 studies, 96% positive results) - Impacts on productivity, efficiency or costs (16 studies, 88% positive results) - Patients' empowerment (15 studies, 80% positive results) - Clinicians' satisfaction (13 studies, 85% positive results)	"The quality of the studies in- cluded varies considerably. Nev- ertheless, a sensitivity analysis did not reveal that inclusion of poor quality studies was skewing the results" (p. 116). A publi- cation bias due to the more fre- quent publication of studies with positive outcomes is possible.	Type of included studies not reported

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(Numbering refers to main text and table)

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