

Table 1 – Synopsis of Reviews by Topic Area

Topic	Authors	HIS Features	Settings	Study Designs	Evaluation Metrics	Key Findings
Medication Management	Ammenwerth 2008 ²⁴ Austria	ePrescribing CPOE +/- CDS for medication errors, adverse drug events	Hospitals, medical centre, primary care	27 studies: controlled cohorts - pre/post, RCT	Relative risks in medication errors and adverse drug events	23/25 studies had significant relative risk reduction for medication errors
Medication Management	Bennett 2003 Australia ¹⁶	Medication reminders, feedback for providers and patients	Hospitals, outpatient clinics, pharmacy, general practices	26 studies: RCT	Relative compliance rates for providers on reminders/feedback, and patients on feedback	Reminders more effective in medication management by physicians; improve adherence by patients
Medication Management	Chatellier 1998 ²¹ (also medinfo 98) France	ePrescribing and drug dosing of anticoagulants	Not reported	9 studies: RCT	Odds ratios for proportion of days within range, outcome as thrombotic events, haemorrhage, death	29% increase in appropriate therapy; less frequent hemorrhagic events
Medication Management	Durieux 2008 ²⁸ France; also Walton 1999 ⁶⁷ 2001 ⁶⁸ United Kingdom	Drug dose advice	Inpatient, outpatient settings	23 studies: RCT, CT, time series	Risk ratios, mean differences in drug dose, serum level, therapeutic range, time to/in range, adverse drug events, death, length of stay	Reduced time to therapeutic range, length of stay, toxicity; improved initial dose and level
Medication Management	Eslami 2007 ²⁹ Netherlands	CPOE medication order +/- CDS/alerts	outpatient settings	30 studies: RCT, CT, observational	Medication adherence, alerts, safety, time, costs, efficiency; usability, use and satisfaction	6/11 studies positive adherence, 1/4 improved medication errors; negative for time, alerts; mixed satisfaction, use
Medication Management	Eslami 2008 ³⁰ Netherlands	CPOE medication order +/- CDS/alerts	Inpatient settings	67 studies: RCT, CT, observational	Medication adherence, alerts, safety, time, costs, efficiency; usability, use and satisfaction	Improved adherence and safety; mixed on cost, efficiency, alerts; increased physician time
Medication Management	Fitzmaurice 1998 ³¹ United Kingdom	CDS for oral anticoagulation therapy	Primary care	7 studies: 1 RCT, others not mentioned	Therapeutic range comparison; lacks detail	Improved therapeutic control shown
Medication Management	Handler 2007 ³⁴ United States	Pharmacy/lab event monitoring for adverse drug event	Teaching/community hospitals, medical centre	12 studies: not specified	Positive predictive values for 15 signals: 3 antidotes, 8 lab results, 4 medication levels	Positive predictive values lowest for antidotes then lab values then medication levels; should prioritize signals with highest positive predictive values
Medication Management	Kaushal 2003 ⁴⁰ United States	CPOE +/- CDS medication orders and drug dosing	Inpatient	12 Studies: RCT, CT, pre/post, time series	Rates of medication errors, adverse drug event, drug dose frequency/level, prescribing practice, corollary orders	CPOE had reduced errors, improved drug dose frequency or prescribing practice; 4/7 CDS had reduced medication errors
Medication Management	Oren 2003 ⁴⁶ United States	CPOE, barcoding, automated dispensing, medication admin record	Institutions, nursing units, ambulatory care pharmacy, no detail	CPOE 11, barcode 7, dispensing 7: controlled, pre/post, time series	Rates of medication use, entry, error, adverse drug event, order time, cost, on-schedule, dispensing	CPOE, barcode and dispensing reduced errors; CPOE improved medication use, cost but increased order time
Medication Management	Shebl 2007 ⁵² United Kingdom	CDS in prescribing antibiotic use	Hospitals, primary care	10 studies; RCT, pre/post	Antibiotic use frequency, duration, dose, rate, cost, adverse drug event, adjustment, post-op infection; length of stay, mortality	8/10 (80%) studies showed significant benefits in CDS use
Medication Management	Van der Sijs 2006 ⁵⁹ Netherlands	CPOE +/- CDS prescribing and drug dosing	Hospitals, clinics, general practitioners, primary care	17 studies: RCT, survey, focus group, interview, order analysis	Rates/types of alert and override; override reasons	Improve alert specificity, sensitivity, info content, override handling, latent conditions; reduce workflow disruption
Medication Management	Wolfstadt 2008 ⁶⁰ Canada	CPOE in alerts and overrides	hospitals, ambulatory care	10 studies; pre/post, time series, x-sectional	Relative rates of adverse drug events	Significant adverse drug event decrease in 5 studies, non-significant decrease in 4
Preventive Care	Austin 1994 ²⁷ United States	Reminders for preventive care	Family/internal medicine clinic	4 studies: RCT	Odds ratios for compliance in cancer screening, tetanus immunization	Reminders effective in cervical cancer screening and tetanus immunization
Preventive Care	Buntinx 1993 ¹⁸ Belgium	Reminders and feedback in provider performance	Medical centres, general practice	26 studies: RCT, non-RCT, pre/post	Rates of compliance, diagnostic test and cost	Feedback reduces test use, cost and compliance; reminders more effective

Legends: RCT-randomized controlled trial; CT-controlled trial; CPOE-computerized provider order entry; CDS-computer decision support;

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Preventive Care	Dexheimer 2008 ²⁶ United States	Reminders in preventive care	hospitals, medical centres, primary care	61 studies: RCT	Odds ratios as percent difference for 16 preventive measures	Prompting clinicians had positive effects; limited by HIS use, behaviour
Preventive Care	Jimbo 2006 ³⁸ United States	Reminders for cancer prevention	Academic, private, health maintenance org, primary care	30 studies: RCT, time series, pre/post	Rates of compliance to reminders for breast, cervical, colorectal screening	Modest increase in breast, colorectal and cervical cancer screening
Preventive Care	Shea 1996 ³¹ United States	Reminders in preventive care	Ambulatory care	16 studies: RCT	Adjusted odds ratios for compliance in preventive practices	Improved breast/colorectal cancer screening, vaccination, cardiovascular risk reduction, not cervical or others
Health Condition	Balas 2004 ³² United States	Prompts, home records for insulin adjustment, patient education	Hospitals, outpatient clinics, primary care, teleconsultation	44 studies: RCT	Effect size for hemoglobin A1c, blood glucose, insulin adjustment, compliance; cost, hospitalization, length of stay; satisfaction	Prompting follow-ups, adjustment of insulin via home glucose records, remote feedback can improve care
Health Condition	Colombet 1999 ²³ France	CDS – decision aids in triage of acute chest pain	Emergency room	11 studies: RCT, time series	Sensitivity/specificity of decision aid; length of stay in intensive care unit	7/9 studies had reduced length of stay; slightly improved diagnostic performance
Health Condition	Dorr 2007 ¹⁴ United States	CDS advice/info/prompts, results management, communication, CPOE, patient support, admin	Outpatients: primary and specialty care	109 studies: experiment, observation, descriptive, review, case studies	Technical: usability, accuracy; care process: adherence, visit, referral, documentation, tests; outcome: lab values, hospitalization, quality of life, complication, assessments	34/50 (67%) experimental studies had positive effects, correlated with EMR link, computer prompts, population management, scheduling, specialized CDS, personal health record
Health Condition	Jackson 2005 ³⁶ United States	Communication, disease management, telehealth, flowsheet, education	Clinic, phone, web-based, teleconsult	26 studies: RCT, CT, post-only, pre/post	Rates of hemoglobin A1c, visit, hospitalization, foot/eye exam, cost, satisfaction, behaviour, knowledge	Most studies had positive results with improved healthcare use, behaviour, attitude, knowledge, skill
Health Condition	Liu 2006 ⁴² United Kingdom	Diagnostic aids for acute abdominal pain	Inpatient, outpatient, emergency room	32 studies: RCT, quasi-RCT	Diagnostic accuracy as sensitivity, specificity, error rates, odds ratios	Greater specificity and lower false-positive rates than doctors; can confirm acute appendicitis but not rule-out
Health Condition	Montgomery 1998 ⁴⁴ United Kingdom	CDS in charting, recall, prescribing, feedback, reminders	Clinics, health centres, general practice	7 studies: RCT	Rates in patient uptake, follow-up, blood pressure control; in physician recording, prescribing, knowledge	Improved patient update, follow-up but not physician performance or blood pressure control
Health Condition	Sanders 2006 ⁵⁰ United States	CDS in compliance, drug dosing, patient data collection/survey and education, detection, diagnosis, monitoring	Outpatient, home and emergency room	64 studies: descriptive, survey, RCT and CT as retro/prospective	Change in compliance, symptoms, hospitalization, dose level, visit length, cost and patient self-care knowledge	Improved rates in compliance and hospitalization; reduced rescue medications; improved prevention and patient self-care knowledge
Health Condition	Sintchenko 2007 ²⁴ Australia	CDS consultation as drug dosing, prescribing, info, advice; critiquing as alerts, reminders	Hospitals and primary care	24 studies: RCT	Rates of therapies, adverse drug event, admissions, visits, length of stay, lab tests, compliance, assessments, mortality, morbidity	13/24 (54%) studies had improved clinical or surrogate outcomes; all were for acute vs. 38% for chronic conditions
Data Quality	Byrne 2005 ¹⁹ United Kingdom	Administrative registers in psychiatry	Registries/database from 7 countries	14 studies: descriptive only	Accuracy/agreement of diagnosis vs. standards; sensitivity/specificity	No gold standard; accuracy/agreement varies but generally favourable
Data Quality	Hogan 1997 ³⁵ United States	Electronic patient record	hospitals, clinics, health maintenance org, general practice	26 studies: sampling of EPR data vs. standard	Percent accuracy in correctness and completeness by data type	Accuracy fair to good, but variable by data type in completeness, correctness
Data Quality	Jordan 2004 ³⁹ United Kingdom	Morbidity register in general practice	General practice office	24 studies: sampling comparison vs. standard	Percent completeness/correctness, sensitivity of morbidity register and consultation reporting	Quality of morbidity coding variable, and can be improved with training

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Data Quality	Thiru 2003 ⁵⁶ United Kingdom	Electronic patient record data quality	Primary care settings	52 studies: descriptive surveys	Rate, predictive value, sensitivity, specificity of diagnostic/symptom, management, care vs. reference data	Overall good validity, better prescribing than diagnosis/lifestyle data; sensitivity dependent on data type
Data Quality	Thiru 2003 ⁵⁶ United Kingdom	Electronic patient record data quality	Primary care settings	52 studies: descriptive surveys	Rate, predictive value, sensitivity, specificity of diagnostic/symptom, management, care vs. reference data	Overall good validity, better prescribing than diagnosis/lifestyle data; sensitivity dependent on data type
Care Process/Outcome	Balas 1996 ⁸ United States	Reminders, feedback, info access, prediction, diagnosis, treatment	Hospitals, outpatient primary/specialty care	98 studies: RCT - parallel and crossover	Ratios of provider prompt/reminder, treatment planner, info access, feedback, diagnosis, patient therapy	Provider prompt/reminder, treatment planner, patient education/therapy, patient prompt/reminder were effective
Care Process/Outcome	Bates 2003 ⁴⁵ United States	Adverse event monitors	Hospitals and primary care clinic	25 studies; 8 had chart review as gold standard	Accuracy/rate of adverse events for nosocomial infections, adverse drug events and falls in sensitivity, specificity, positive/negative predictive values	Events monitoring had variable success rates in detecting adverse events
Care Process/Outcome	Bryan 2008 ¹⁷ United States	CDS in disease/medical management, prevention, drug dosing	Ambulatory/primary care	17 studies: RCT/cluster, CT, observational	Compliance, medication use, test frequencies and values, reminders	13/17 (76%) studies had positive outcomes - with 9 definite, 4 some
Care Process/Outcome	Car 2008 ²⁰ United Kingdom	Info exchange, electronic health record, CDS, ePrescribing	Inpatient, outpatient, primary care settings	284 studies: RCT, CT; 67 reviews; others not reported	Qualitative summaries of quality, safety and eHealth impacts	Electronic health record improved legibility, preventive care, analysis; HIS+CDS and ePrescribing improved performance e.g. compliance
Care Process/Outcome	Chaudhry 2006 ²² source <i>Shekelle'06</i> ⁶⁴ United States	Reminders, clinical event monitoring, CPOE+/- CDS, ePrescribing, drug dosing	Inpatient and outpatient settings	257 studies: reviews, quantitative and qualitative studies	Rates of guideline adherence, clinical monitoring, medication errors, care utilization, provider time, cost	Improved adherence, monitoring, medication errors, utilization; mixed on time, little cost; mainly 4 institutions
Care Process/Outcome	Cramer (Klassen) 2003 ⁹ Canada	Information on diagnosis, prediction, prevention, management, support, treatment	Inpatient, outpatient, home and conference settings	67 studies: RCT, reviews	Odd ratios and mean differences for evidence adherence, improved outcome and knowledge level	Some care process improved- diagnosis, management, prescription, prevention; mixed outcomes; improved knowledge
Care Process/Outcome	Delpierre 2004 ²⁵ France	EMR, CPOE, CDS, nursing care, ePrescribing with advice, info or reminders	Inpatient, primary care	26 studies: RCT, cross-sectional, pre/post, qualitative	Rates/proportions/means for risk, compliance, treatment, test, time, length of stay, morbidity, attitude, satisfaction	Improved satisfaction, preventive care; mixed care quality, patient outcomes
Care Process/Outcome	Garg 2005 ¹⁰ <i>Updates Hunt 98</i> ⁶¹ <i>Johnston 94</i> ⁶² Canada	CDS in EMR/CPOE with feedback/prompts for diagnosis, prevention, drug dosing/prescribing, disease management	Inpatient, outpatient settings (no detail)	100 studies: RCT, CT	Success defined as >= 50% outcome improvement across groups	62/97 (64%) studies had improved performance; 7/52 (13%) had improved outcome; more success with automated prompts and CDS developers
Care Process/Outcome	Georgiou 2007 ⁵³ Australia	CPOE +/- CDS for pathology services	Hospitals, laboratory	19 studies: RCT, CT, pre/post, time series, lab	Test volume, cost, redundancy, time, compliance, phone calls, follow-up; adverse event rates, length of stay, total costs	10 impact assessment areas and 39 indicators on pathology services; CPOE benefit clinical/lab work process
Care Process/Outcome	Jerant 2000 ³⁷ United States	EMR reminders/prompts for preventive care	Outpatient primary care	16 studies: RCT and CT	Compliance and hospitalization/visit rates; care scores; documentation, response and encounter time, remote EMR access	Improved rates in documentation, response time and compliance; higher rates in reminder calls and letters; low remote access

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Care Process/Outcome	Kawamoto 2005 ⁴¹ <i>update</i> 2007 ⁶³ United States	CDS with CPOE, charting, prescribing, reminders, advice, feedback	Academic, outpatient and multi-site settings	70 studies: RCT	Rate difference and adjusted odds ratios by CDS feature for compliance, follow-up, drug use	Improved practice if CDS is computer-based, part of workflow, actionable, at time/location of decision making
Care Process/Outcome	Mitchell 2001 ⁴³ <i>also Sullivan 95</i> ⁶⁵ United Kingdom	CPOE in prescribing, test orders, reminders, charting	Primary care settings	89 studies: RCT, CT, pre/post	Rates in compliance, prescribing, cost, consult report content, time; outcomes as parameter in-range, referral, service, satisfaction	Improved performance especially in health promotion; unclear in outcomes
Care Process/Outcome	Nies 2006 ¹⁵ France	CDS for CPOE, reminders, advice, prescription/drug dosing	Not mentioned	106 studies; RCT/cluster, controlled cohorts	Statistical significance in guideline compliance, patient outcomes - care, prescribing, risk factors, reminders	CDS more successful if system initiated, has corollary actions, with less user data entry and output control
Care Process/Outcome	Poissant 2005 ⁴⁷ Canada	EHR documentation of notes, orders, referrals	Inpatient settings	23 studies: RCT, post test-control, pre/post	Relative difference in documentation time of physicians and nurses	Bedside/central computers saved nurse time but increased physician time
Care Process/Outcome	Randell 2007 ⁴⁸ United Kingdom	CDS for drug dosing, phone triage, glucose regulation	Intensive and primary care, telephone triage	8 studies; RCT, CT, time series, pre/post	Relative risks in glucose regulation, anticoagulation care, nurse triage	CDS effects on nursing performance and patient outcomes inconsistent
Care Process/Outcome	Rothschild 2004 ⁴⁹ United States	CPOE +/- CDS in reminders, info, advice, prescribing	General inpatient and intensive care settings	18 studies: pre/post, RCT, time series	Rates/proportions: medication error, frequency, duration; compliance; lab test/value; charge and length of stay	Improved medication error, antibiotic therapy, compliance, testing, cost
Care Process/Outcome	Shiffman 1999 ⁵³ United States	Guideline alerts/advice, reminders; explanation; charting; communication; registration; presentation	Hospitals, general practices	20 studies: RCT, CT, time series	Rates of guideline adherence, cost, event documentation, satisfaction	Improved adherence in 14/18 (78%) studies, documentation in 4/4 studies
Care Process/Outcome	Tan 2008 ⁵⁵ from 2005 report ⁶⁶ United Kingdom	CDS in drug prescribing, physiologic monitoring	Inpatient neonatal units	3 studies; RCT	Relative risks in mortality/morbidity; mean difference in colloid use, blood gas, drug dose calculation time/error	Inconclusive on CDS benefit for newborn use
Care Process/Outcome	Urquhart 2008 ⁵⁷ United Kingdom	Nursing record systems for charting with notes, +/- care plans, client-held	Hospital, community and primary care	9 studies; RCT, pre/post	Pain management, empowerment, loss of notes, data entry time/errors, amount of paper	Reduced lost notes, paper and data entry time; uncertain improvement in nursing practice or patient outcome
Care Process/Outcome	van der Kam 2000 ⁵⁸ Netherlands	Electronic communication of information, e.g. lab results, consult letters	General practice	30 studies; design not reported	Communication speed, content and process; quality of care; costs; workload; physician appreciation; confidentiality; hospital adherence	Demonstrated effects: 3 papers with subjective data; 5 with objective data; 25 papers reported positive effects, 4 also negative, 1 negative only

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