

Annex 9: Decision Support classification with examples

Clinical decision support systems are analysed according to the business sector (giving the overview of different products in this field, because most of the vendors are offering complementary solutions); description of the system (rules, properties); methodology (methodology used and whether the solution is internet based or integrated solution); for whom the solution is directed to (administrators, general vs specialty physicians, other health care workers, patients and others); data management describing the inputs and data transfer standards.

1. Improved Data Usage and Visualisation

Improved data aggregation and representation is the main enabler of services in all other DSS categories. The aggregated and visualised data from various EHR-s in a usable medical doctor application already by itself becomes a strong decision support in medical specialist workflow.

Main users:

Clinical specialists, GPs, family nurses.

Enablers:

- Aggregating data in current databases.
- Implementing better processes for data collection. Standardised process for data input based on commonly accepted coding systems (ICD-10, NCSP, SNOMED)
- Implementing patient medical profile with event-based data tied to patient profile rather than document based separate units.
- Integration of patient QS + lifestyle data.

Benefits:

Saving GP, clinical specialist, work time during clinical visits. More accurate health overview for both patient and clinician. Improved treatment quality. Notifications based on aggregated data.

Services:

- Standardised process for data input in clinical specialist interfaces enabling solid data analytics.
- Improved data aggregation across various EHR-s.
- Improved data visualisation and health condition overview with highlights for over threshold measurements.

Examples:

➤ Cortellis for Decision Support

Business sector	Thomson Reuters Cortellis for Decision Support is one of the services under the product group for pharma and life sciences.
Description of the System	Thomson Reuters Cortellis™ for Decision Support is a series of easy to use, visual dashboards which help to identify and understand connections, patterns and relationships between ideas, facts, and statistics.
Methodology	Platform independent service accessible via Internet.

	Converting information into interactive visualizations.
For Whom	<ul style="list-style-type: none"> • Competitive intelligence professional • Medical researcher • Pharmacologist • Oncologists¹
Data Management	Thomson Reuters Cortellis™ offers services for information Integration. Information is delivered through the Cortellis web portal.
➤ Elsevier Decision Support System	
Business sector	Elsevier Clinical Decision Support is a subsidiary of Anglo-Dutch publishing company Reed Elsevier Group. The Elsevier CDS product line includes brands First Consult ² and ClinicalKey.
Description of the System	ClinicalKey is independent online clinical insight engine covering 27 different specialities. Users are offered saved searches, personal reading lists, presentation maker and mobile access.
Methodology	The ClinicalKey's search is powered by Elsevier Smart Content . It maps content to EMMeT (Elsevier's proprietary medical taxonomy), and builds relationships using a semantic framework. It results in faster, more clinically relevant answers with connections highlighted between medical concepts and suggestions of related content.
For Whom	<ul style="list-style-type: none"> • Physicians • Medical librarians • Hospital executives
Data Management	EMMeT includes RxNorm, MeSH, SNOMED CT and ICD-9. ClinicalKey covers: Elsevier medical and surgical journals (over 500) and reference books (over 1000), selected third-party journals and content sources, First Consult point-of-care clinical monographs, Procedures Consult content and videos, Clinical pharmacology drug monographs from Gold Standard, Elsevier medical and surgical videos (over 13,000) and images, over 2,000 Practice Guidelines, Elsevier and third-party published patient education handouts.

¹ Cortellis for Decision Support Oncology Dashboards are a suite of five dashboards that support clinical development strategy: Trial Duration Viewer, Portfolio Viewer, Drug Safety Viewer, Disease Area Viewer, and Drug Program Viewer.

² Content quality and editorial methodology of First Consult's is analysed in the paper Banzi R, Liberati A, Moschetti I, Tagliabue L, Moja L A Review of Online Evidence-based Practice Point-of-Care Information Summary Providers, 2010

2. Health Management

Personalised health management and disease prevention screening process based on lifestyle data, medical history, family disease history and genetic risks. Disease risk score enabling to assess the risk derived from genetic risk or certain lifestyle habits.

Main users:

Patients in collaboration with clinical specialists, GPs, family nurses.

Enablers:

New processes for more accurately targeted GP-level screening (changing healthcare from diagnosis-based to condition-based and preventive).

Benefits:

Better quality from more efficient prevention. Cost effectiveness through more focused screening programs.

Services:

- Patient disease risk score calculation
- Screening and clinical visits prioritisation based on patient risk score
- Personalised lifestyle management suggestions
- Health diary enabling systematic collection of quantified self and fitness data
- Pregnancy planning
- Personal diet suggestions

Examples:

- Archimedes InDigo3 (Individualized Guidelines and Outcomes)

Business sector

Archimedes has three core products:

- ARCHeS, an online population simulation and real-time healthcare analytics platform
- IndiGO, is a clinical decision support and population management tool to engage patients to improve their health outcomes.
- Modeling & Consulting Services, to address specific modelling and analytics needs.

Description of the System

IndiGO generates individualized guidelines that include:
 The patient's risk of specific adverse health outcomes (such as heart attack, stroke, onset of diabetes, cancer)
 A prioritized list of evidence-based lifestyle, screening, and medication interventions that reduces those risks
 By this information patients are motivated to initiate a preventive regimen or remain with their current care plan.
 Results are displayed in a patient's EHR or disease registry,

³ Archimedes InDigo was ranked 10th in the list of TOP 20 CDSS vendors by Black Book Rankings in Top Knowledge-Based Clinical Decision Support Systems Vendors, 2012

	within an easily understood graphical interface.
Methodology	Risks are calculating based on the Archimedes Model . The Archimedes Model is a single integrated model of advanced algorithms that contains pathways relating to 20 most common diseases and 20 health outcomes.
For Whom	<ul style="list-style-type: none"> • Physicians • Other healthcare providers (nurses, care managers, health coaches) • Patients
Data Management	Inputs: laboratory results, diagnoses, medications, office measurements (e.g. blood pressure), and risk factors such as smoking and family history extracted from electronic sources (e.g. electronic health records (EHR), data warehouses, or disease registries).

➤ Instant Medical History

Business sector	<ul style="list-style-type: none"> • IMH Office • IMH Web • IMH Spanish • IMH Software Development Kit
Description of the System	<p>Patient interview software. E-visit is made prior to the encounter. Information gathered from patient is transferred to EHR.</p> <p>E-visit can be filled over the internet before the visit or in the waiting or exam room. E-visit can be filled by the nurse.</p>
Methodology	<p>Instant Medical History is offered as an integrated component of electronic medical record systems.</p> <p>Instant Medical History contains almost 6000 questionnaires for distinct patient complaints. Patient will start filling the questions with chief complaint which will be followed with the best possible set of questions.</p>
For Whom	<ul style="list-style-type: none"> • General practitioners • Specialty physicians
Data Management	Patients enter the text in rich text format. The data is transformed into clinical terminology and organizes the positives and the negatives according to the patient organ system, before information is passed to EHR.

3. Patient Monitoring Supports

Patient monitoring supports are divided to:

- Chronic disease and post-clinical episode monitoring and management.
- Telemedicine solutions for chronic patient regular check-ups.
- Patient diary enriched with lifestyle data.

- Notifications for expiring prescriptions.
- Treatment adherence monitoring.

Main users:

Chronic patients (diabetes, hypertension) in collaboration with clinical specialists, GPs, family nurses.

Enablers:

New processes (e.g. GP, family nurse monthly virtual reviews based on collected data).
IT solutions for health and medical diaries, notifications).
Integration of tracker and lifestyle data to patient portal.

Benefits:

- Better patient engagement.
- Resource savings from more efficient prevention and treatment.
- Time savings through more time and resource effective regular check-ups.

Services:

- Notification system for expiring prescriptions
- Personalised long-term treatment schedules (instructions for medication intake, lifestyle guidelines, medical doctor visits, etc)
- Patient and medical specialist communication platform for data exchange and progress reviews
- Patient diary for collecting patient measurements and assessing drug/treatment scheme adherence
- Virtual medical appointment for chronic patients based on patient diary data

Examples:

- Persivia (Formerly: Alere Analytics CDS and Diagnosis One) ⁴

Business sector **Under the solutions Meaningful Use⁵ Alere Analytics offers following solutions:**

- Interventional Clinical Decision Support (CDS)
- Patient Education & Infobutton
- Electronic Laboratory Reporting
- Quality Reports & Data Submission

Description of the System	Interventional CDS: 30 000 evidence-based care rules. Using scored and prioritized alerts. Real-time patient specific (not just disease specific)
----------------------------------	--

⁴ DiagnosisOne was ranked 4th in the list of TOP 20 CDSS vendors by Black Book Rankings in Top Knowledge-Based Clinical Decision Support Systems Vendors, 2012

⁵ Meaningful use criteria was established by the Centers for Medicare & Medicaid Services (CMS) as a standard for the effective use of electronic health record systems (EHRs) to standardize care and improve clinical outcomes.

	information. <u>Additional services for patients:</u> Patient education brochures in electronic format in English and Spanish about medication, medication allergy, demographics, laboratory tests and values/results, and vital signs.
Methodology	End-to-end CDS solution. Includes data capture, normalization, cleansing and transmission to stakeholder-specific portals.
For Whom	Providers Pharmacy Payer organizations
Data Management	Data transfer standards: HL7v3.0/2.X, CCD and CDA. Incorporates ICD10, SNOMED and LOINC codes.

4. Clinical Decision Supports

Diagnosing and treatment suggestions based on patient life style, medical, family history and gene risk data. Notifications for conflicting prescriptions. Checklists for medical procedures.

Main users:

Clinical specialists, GPs.

Enablers:

- Implementation and management of digitised medical treatment scheme algorithms.
- Standardisation of medical data (ICD-10, NCSP, SNOMED) for implementing pre-existing decision support systems (EBMeDS, etc).

Benefits:

- Higher average treatment quality through providing support for less experienced practitioners
- Saving time and improving certainty of clinical decisions
- Enabling clinical specialists to grasp and consider vast amounts of data in decision making

Services:

- Notifications for conflicting prescriptions
- Diagnosing and treatment scheme selection support
- Medical procedure checklists

Examples:

- EBMeDS (Evidence Based Medicine electronic Decision Support)

Business sector	Duodecim Medical Publications Ltd is the largest Nordic medical publisher whose products include EBMeDS, EBM Guidelines and publishing.
------------------------	---

Description of the System	<p>EbMeds is a clinical decision support tool based on recommendations from evidence based summaries.</p> <p>It can be described as a set of rules (scripts) applied to structured health data.</p> <p>It can also be used to automatically prefill forms and calculators with patient specific data.</p> <p>In addition to real-time use, the EBMeDS decision support rules can be run in patient populations ("virtual health checks").</p> <p>Over 1000 scripts and 26 000 different reminders.</p>
Methodology	<p>The EBMeDS runs as a platform-independent service and communicates with XML through a web listener. Easy integration with any electronic health record system (EHR) capable of providing structured patient data. The production package is compiled in a way that no database is needed. The EBMeDS can be installed as a local service or as a centralized solution servicing many organizations at the same time.</p>
For Whom	<p>Healthcare professionals</p> <p>Patients⁶</p>
Data Management	<p>Inputs: structured patient data from electronic health records (EHRs).</p> <p>Outputs: alerts, prompts and reminders (according to the importance), therapeutic suggestions and diagnosis-specific links to guidelines.</p> <p>Data transfer standards: HL7.</p> <p>The output of the scripts is in English, but several other languages are supported including Estonian.</p>
<p>➤ Map of Medicine⁷</p>	
Business sector	<p>Map of Medicine produce care maps for NHS Choices, which is the UK's biggest health website.</p>
Description of the System	<p>The Map of Medicine standardises 1) care across care pathways and 2) referral activity. It is a web-based knowledge support tool of evidence-based patient care journeys covering 28 medical specialties and 390 pathways. The care maps can be customised according to local needs and practices by commissioners looking to devise new care pathways.</p>
Methodology	<p>Map of Medicine is web based support tool.</p> <p>Map Referral is integrated to the GP-s workflow, containing the referral forms with the patient information and a local directory of service providers</p>

⁶ Descriptions of published decision support functions are available free in the EBMeDS Script Description Database.

⁷ Content quality and editorial methodology of Map of Medicine is analysed in the paper Banzi R, Liberati A, Moschetti I, Tagliabue L, Moja L A Review of Online Evidence-based Practice Point-of-Care Information Summary Providers, 2010

For Whom	<p>Map of Medicine was born as a tool to improve dialogue between primary and secondary care.</p> <p>Mainly directed to general practitioners.</p> <p>Pathways are available to patients and the public via NHS Choices.</p>
Data Management	
➤ MICROMEDEX® ⁸⁹	
Business sector	<p>Truven Health Analytics offers following clinical solutions:</p> <ul style="list-style-type: none"> • Disease and Condition Management • Formulary Management • Medication Safety • Patient Education • Toxicology Solutions <p>Micromedex® offers following solutions:</p> <ul style="list-style-type: none"> • Micromedex 2.0 • Micromedex® Clinical Knowledge • Micromedex® Patient Connect
Description of the System	<p>Micromedex 2.0 is an independent evidence-based clinical decision support system offering clinical solutions for disease and condition management, formulary management, medication safety, patient education and toxicology solutions.</p> <p>Micromedex® Clinical Knowledge Suite offers comprehensive evidence-based resources at the point of care for: medication, toxicology, and disease and condition management.</p> <p>Micromedex® Patient Connect Suite offers information specific to the patient's medications, diagnosis, and lab results with context-specific links to more information.</p> <p>Micromedex offers apps for its drug reference guide and medication interaction checker.</p>
Methodology	<p>Clinical solutions in the decision support system are created by the Truven Health Medical Episode Grouper (MEG) which is the proprietary episode grouping methodology of Truven Health Analytics™.</p> <p>Micromedex is accessible via the internet, mobile apps or can be integrated with electronic health records (EHR) or hospital information system (HIS).</p>

⁸ Content quality and editorial methodology of MICROMEDEX is analysed in the paper Banzi R, Liberati A, Moschetti I, Tagliabue L, Moja L A Review of Online Evidence-based Practice Point-of-Care Information Summary Providers, 2010

⁹ Truven Health Analytics (Formerly Thomson Reuters) was ranked 3rd in the list of TOP 20 CDSS vendors by Black Book Rankings in Top Knowledge-Based Clinical Decision Support Systems Vendors, 2012

For Whom	<ul style="list-style-type: none"> • Nurses • Pharmacists • ER/ED Clinicians • Physicians • Medical Libraries • Students & Residents • Patients
Data Management	Data transfer standards: HL7.
➤ Zynx Health ^{10 11}	
Business sector	<p>Clinical Decision Support solutions:</p> <ul style="list-style-type: none"> • ZynxOrder • ZynxCare • ZynxAmbulatory • ZynxValue+ • ZynxEvidence
Description of the System	<p>Zynx Order includes more than 790 evidence-based order set templates, clinical decision support rules, and quality measures. ZynxCare delivers more than 240 evidence-based plans of care templates.</p> <p>ZynxValue+ includes assessment and optimization services that provide the quickest, most cost-efficient path to significantly improve clinical and financial outcomes across the continuum of care.</p> <p>ZynxEvidence is an evidence-based online resource. The content is divided into more than 155 modules addressing clinical conditions, procedures, and patient problems.</p>
Methodology	
For Whom	<ul style="list-style-type: none"> • Administrators • Physicians • Nurses • Other health professionals
Data Management	<p>Solutions are customizable in an online content management system that enables version control and maintenance.</p> <p>Zynx Health works collaboratively with electronic health record (EHR) vendor partners to embed content in the format and structure that meets each client's needs.</p>

¹⁰ Zynx Health was ranked 1st in the list of TOP 20 CDSS vendors by Black Book Rankings in Top Knowledge-Based Clinical Decision Support Systems Vendors, 2012

¹¹ Content quality and editorial methodology of Zynx Health is analysed in the paper Banzi R, Liberati A, Moschetti I, Tagliabue L, Moja L A Review of Online Evidence-based Practice Point-of-Care Information Summary Providers, 2010

➤ Up to Date¹² / ProVation Medical¹³

Business sector	Wolters Kluwer¹⁴ Health clinical solutions consists of Clinical Informatics and Surveillance CIS, Clinical Drug Information CDI and two complementary branches Clinical Decision Support CDS (UpToDate knowledge base) and Clinical Documentation CD (ProVation Medical offering evidence-based clinical content and software for care plans).
Description of the System	UpToDate is a comprehensive synthesis of the evidence, followed by recommendations that can be acted on at the point of care. ProVation Medical provides electronic order set (ProVation® Order Sets), care plan (ProVation® Care Plans) and procedural documentation solutions that eliminate inefficient, error-prone processes with an intuitive user interface, robust technology, and deep medical content. ProVation covers 11 specialities and consists of over 3000 procedure documentation paths.
Methodology	The Anticipatory Interface® reminds the physician to document key elements for the procedure and ProVation Medical will automatically generate billing codes, personalized letters for referring physicians, patient instructions, quality registry submissions and data reports.
For Whom	<ul style="list-style-type: none"> • Administrators • Physicians • Nurses • Health Information Management (HIM) professionals • Finance professionals • CIOs
Data Management	ProVation MD can be integrated with EHRs, scheduling, billing, vitals monitors, PACS and medical imaging devices. Interoperability standard HL7, DICOM; InfoButton API. The terminology including SNOMED CT, RxNorm, LOINC, CPT, and ICD-9.

➤ Symptify

Business sector	An online self-assessment tool that uses a customized algorithmic engine to help users educate themselves about causes of symptoms.
Description of the System	An online self-assessment tool that uses a customized

¹² Content quality and editorial methodology of Up To Date is analysed in the paper Banzi R, Liberati A, Moschetti I, Tagliabue L, Moja L A Review of Online Evidence-based Practice Point-of-Care Information Summary Providers, 2010

¹³ 2012 Top 20 Best in KLAS Awards: Software and Professional Service. December 2012

¹⁴ Wolters Kluwer was ranked 2nd in the list of TOP 20 CDSS vendors by Black Book Rankings in Top Knowledge-Based Clinical Decision Support Systems Vendors, 2012

System	algorithmic engine to help users educate themselves about causes of symptoms. Symptify has combined the cumulative experience of multiple ER doctors with current medical knowledge to create a tool that helps users narrow the causes of their symptoms, find the closest place to get care and give a heads-up when going to a facility.
Methodology	Patient management system where doctor can easily view a patient's history of present illness, medical history and differential diagnosis way before they arrive at the facility.
For Whom	<ul style="list-style-type: none"> • Healthcare facilities • Doctors • Patients
Data Management	<p>Symptom checker can be personalized to a person's needs and gives them access to information about thousands of diagnoses, symptoms and procedures. It has one of the most extensive and user-friendly databases of diseases, symptoms and procedures available online</p> <p>Simplify is a person's very own secure, portable and transmissible health vault. Reference, update and transmit medical profile anytime, anywhere. Symptify's proprietary algorithmic engine also uses this profile to render quicker and more accurate results.</p> <p>Tracking symptoms over time often provides many clues as to the cause of disease. It also helps assess the efficacy of therapies and treatments.</p>

5. Scientific Gene Research

DSS-s mainly targeted for research scientists.

Main users:

- Scientists and researchers who are concentrating on how genes affect and are connected to health and diseases
- Institutions and consultants that need and process genetic information and transmit it to certain people

Enablers:

- Sequencing existing tissue samples.
- Building applications and algorithms for scientific studies.

Benefits:

New scientific discoveries related to specifics of genome data.

Services:

Gene based gene risk model

Examples:

➤ Mantis (Cypher Genomics)

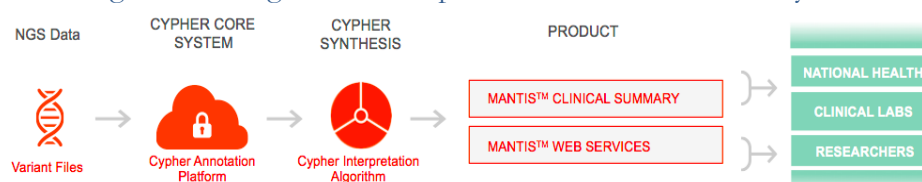
Business sector Mantis is a robust and scalable solution built to support population genomics efforts. With Mantis, it is now possible to work with whole exome or genome data across large patient populations.

Description of the System Cypher Genomics intelligent filtering utilizes proprietary data sources along with precise prioritization tools that can be tuned for virtually any application.

Methodology Platform accepts variant files from DNA sequencing. Users access proprietary software, analytics and data.

Automated, modular variant annotation and interpretation built for whole genome datasets. High-throughput, platform agnostic analytic pipelines to support large scale clinical interpretation needs.

Product integration layer provides customization for varied applications, including clinical-grade interpretation and discovery efforts.



For Whom

- Clinical labs
- Pharmaceutical companies
- Specialist doctor
- Scientists

Data Management

Genome Summary - High specificity automated whole genome summary returns high priority known or predicted pathogenic variants

Phenotype-informed Genome Summary - Highly sensitive automated summary returns known or predicted pathogenic variants related to a specific phenotype of interest

Copy Number Variant Summary - Automated summary classifies and returns all CNVs, highlighting known or predicted pathogenic CNVs.

Cancer Summary - Automated summary identifies and reports clinical significance for likely somatic driver mutations.

➤ GeneRx

Business sector Abomics is a company specialized in genetic information. The aim is to promote the use of relevant genetic tests in clinical practice.

Description of the System The services:

- Pharmacogenomic databases (personalized drug selection and dosing guidance)
- Database of diagnostic genetic tests
- Filtering of clinically relevant information

Methodology	<p>The Abomics GeneRx database includes information about genotypes that are associated with clinically relevant variation in drug responsiveness or drug-induced adverse effects. Abomics experts have selected the tests based on scientific evidence. Database consists of following information:</p> <ul style="list-style-type: none"> • Active ingredient, ATC code(s), generic drug name • Genetic variations related to the drug • Information about the phenotype affected, e.g. metabolic rate • Recommendation texts, e.g. dosing recommendations • References • Available genetic tests and their indications • Genetic test providers, contact information and ordering instructions
For Whom	Doctors
Data Management	<p>Database is regularly updated and delivered as XML messages. The messages are unambiguous and well documented. Technical white papers, example data and schema (DTD) definitions are delivered upon request.</p> <p>Abomics GeneRx can be integrated as a part of electronic health record systems (EHR) drug database. The database update is available as an automated scheduled service.</p>

6. Public Health Analysis Tools

Live overview of general health trends, opportunities for prevention and resource allocation management.

TAI, health insurance funds, Ministry of Social Affairs.

Enablers:

- Analysable aggregated patient data.
- Patient health risk data.
- Meta-data regarding patient health seeking behaviour, clinical doctors' visits etc.

Benefits:

Measuring treatment quality. Better resource management. Assessing effects of prevention and treatment.

Services:

- Public health and disease trend analysis support
- Supports for allocating resources for increased effectiveness

Examples:

Most decision support systems mentioned before have public health application or service, but concrete options are part of the main functionality of the system. For example EBMeDS has an option that decision support rules are applied on a bigger group of people (for example on all of one region's medical cases), which returns a rate of what amount and which treatment guidelines or warnings are used by decision support system. This enables a possibility to make public health decisions and apply measures if needed.