

We define a “Smart Problem List” as a high-veracity clinical amalgamation of (1) Active Medications, (2) Active Diagnoses, (3) Irreversible Procedures, (4) Imaging History, and (5) Active Lab Values, all of which are structured and amenable to analysis and clinical decision support. This is what the doctor needs at his/ her fingertips for patient care for immediate decision-making. Each are discussed briefly below.

In the interoperable future, payer data will be shared with multi-EMR data and with self-reported data from PHRs, and there will be a substantial problem in determining, in a single patient, which elements are real and/or currently active. In just a few years, a typical Medicare patient may generate 2000+ procedural transactions, 700+ diagnosis transactions, 1000+ lab tests, plus EMR point of care data (diagnoses, meds, allergies, vitals, BMI, etc) that is hand-maintained yet brought into the mix.

Furthermore, national availability of a medication history from organizations such as Surescripts will provide paid medication claims from multiple pharmacies for a patient for more than a year, many of which will have been discontinued due to side effects, cost, or tolerability. The list of medications for a patient with multiple comorbid conditions or cancer can include over 100 transactions a year. In addition, the EMR may have a record of prescriptions transmitted or printed, some of which were not filled, and some of which were switched from a brand to a generic at the pharmacy, leading to “comingled” NDCs in the EMR when the medication history is retrieved.

The ability to sift through all available information in realtime is essential in a data sharing world, because it is crucial to know what substances a patient is actively taking at the moment of decision making. The process cannot be performed in batch mode as decisions are needed in minutes of receipt of the shared data. The consequences of not knowing what is true and current means patients who are poor historians (or very ill) may be started on medicines that they are not taking, or worse, previously found to be intolerable and stopped. Thus, active medication list inferencing, in a realtime and fully automated fashion is very important for all HIT systems at the Point of Care.

Problem (diagnosis) inferencing is equally important as there are confusing/conflicting data among ICD claims. For example, diagnoses can be (1) presumptive (“Rule-Out”) and created for reimbursement of services, (2) created for services not actually rendered (fraud), (3) under coded, and not represent the most severe manifestation of a disease, due to lack of caregiver time (e.g., plain “diabetes” vs. “Uncontrolled Type II diabetes with renal manifestations”), (4) captured in health records by inadequately trained personnel across the entire spectrum of caregivers and hence unreliable, and (5) true in the past but not true today (e.g., knee sprain, influenza, or routine urinary tract infection from 1 year ago). These would be expected to have time-expired due to the natural history of the illness, and no longer be present today.

Irreversible procedure identification is pivotal, because among the hundreds of procedural transactions, there is co-mingling of interventions as routine as an office visit or skin tag removal, all the way to a complete liver transplant. Clearly, a liver

transplant has profound lifelong consequences. Knowing what to filter out and present to the caregiver is foundational. The same is true for being able to accumulate all a patient's actually performed imaging tests. There is a crisis in radiation over-exposure today, and knowing a patient's imaging history and cumulative lifelong dose is instrumental to proper patient care.

Finally, knowledge of which lab results are current (e.g., a low serum sodium, albumin, or T4 from 2 years ago is multiple analyte half-lives old, and completely irrelevant today) is core to medical decision making. However, in addition to time decay of lab values, in a shared world data may come in from multiple lab sources, each asserting its own unit of measure, even if HITSP compliant. It will be important to correct for molar vs. mass vs. charge units, as well as variability in factors of 10 (e.g., milli-, micro-, femto-, pico-) on the fly to be able to see the true picture of a patient and be able to use this information for clinical decision support. Semantic standardization and structuring of such mixed-mode data sources will be central to better care and better outcomes.

An example of a Smart Problem List is shown below. This single page, physiological patient summary was algorithmically generated in less than a second from a dataset of more than 4,200 healthcare transactions in one patient. It reflects intelligent signal-to-noise analysis of each data point to determine its veracity and timeliness, at that instant in time. It could look different just days later, as it is a dynamic picture. The Smart Problem List is effectively a real-time health record of essential and high-veracity clinical data:

Active Diagnoses				
Code	Description	Reasoning	Provider Specialty	Date
585.1	Chronic Kidney Disease, Stage I	Other identical diagnoses exist to corroborate this	Not Reported	2009-05-15
401.9	Hypertension Not Otherwise Specified	Other identical diagnoses exist to corroborate this	Not Reported	2009-05-15
716.90	Arthropathy Not Otherwise Specified of Multiple	Other identical diagnoses exist to corroborate this	Not Reported	2009-05-15
244.9	Hypothyroidism Not Otherwise Specified	Other identical diagnoses exist to corroborate this	Not Reported	2009-05-15
700	Corns and Calluses	Other identical diagnoses exist to corroborate this	Not Reported	2009-01-26
459.81	Venous Insufficiency Not Otherwise Specified	Other identical diagnoses exist to corroborate this	Not Reported	2009-01-26
454.0	Leg Varicosity with Ulcer	Other identical diagnoses exist to corroborate this	Not Reported	2008-12-16
443.9	Peripheral Vascular Disease Not Otherwise	Other identical diagnoses exist to corroborate this	Not Reported	2008-12-01
716.90	Arthropathy Not Otherwise Specified of Lower Leg	Other identical diagnoses exist to corroborate this	Not Reported	2008-10-28
272.0	Pure Hypercholesterolemia	Other identical diagnoses exist to corroborate this	Not Reported	2008-10-28
733.00	Unspecified Osteoporosis	Other identical diagnoses exist to corroborate this	Not Reported	2008-10-28
716.90	Osteoarthritis Not Otherwise Specified of Lower Leg	Diagnosis with corroborating medications and	Not Reported	2008-10-28
733.90	Unspecified Bone and Cartilage Disorder	Diagnosis with corroborating medications and	Not Reported	2008-10-28

Active Medications					
NDC	Description	Days supplied	Quantity Dispensed	Start Date	End Date
68645020154	Klor-Con 8 8 mEq Tab	90	90	2009-08-22	2009-11-19
54458098210	Lovalatin 40 mg Tab	90	90	2009-08-22	2009-11-19
00228257709	Diltiazem CD 180 mg 24 hr Cap	90	90	2009-08-22	2009-11-19
00378180501	Levothyroxine 75 mcg Tab	90	90	2009-07-21	2009-10-18