SHARPC NCCD

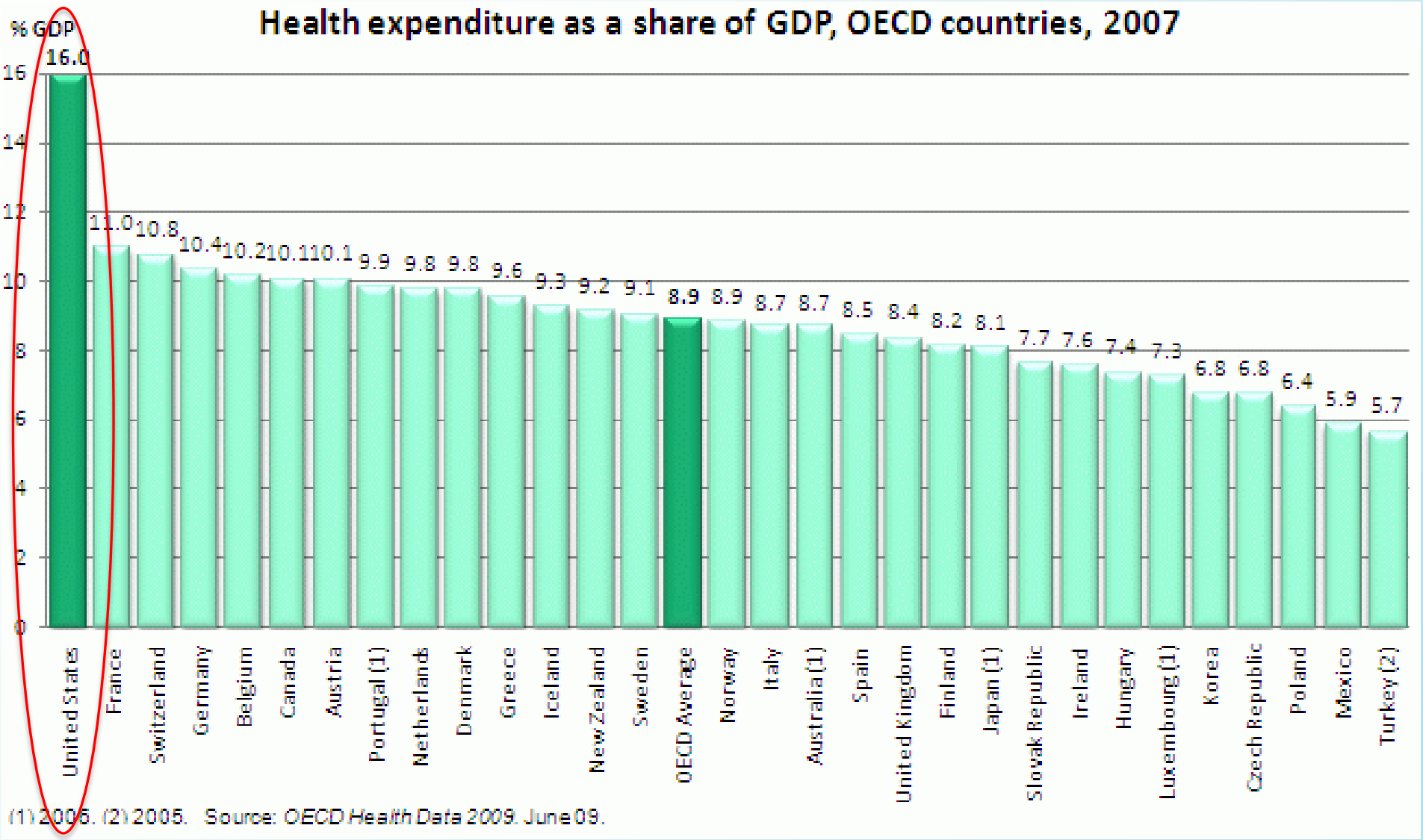
HUMAN CENTERED DESIGN & ENGINEERING
UNIVERSITY of WASHINGTON

MATH for Evidence-based HIT

Keith A. Butler
Co-PI SHARP-C
AMIA Usability Symposium
October 21, 2011

Team: Mark Haselkorn & Konrad Schroder, Univ. of WA
Ali Bahrami, Medico Systems & Chris Esposito, Flying Squirrel Software

A national problem – U.S. has most costly care in the world



Workflow efficiency must be a key goal of HIT

A *usable* HIT is needed for users to carry out preferred workflows with -

- greater efficiency to reduce cost and increase access
- fewer errors to improve quality

Standard[1] measures for usability -

- efficiency
- errors
- task completion

1. See ISO 25062

Key principle of efficiency and usability- *Synchrony* of information flow and workflow

If the information architecture of clinical HIT does not match the workflow of care, then users have a dilemma:

- either follow a sub-optimal workflow
- or, perform overhead tasks to compensate

In the worst case this puts safety at odds with ease-of-use

HIT can accidentally reduce efficiency with unplanned overhead tasks

Overhead also imposed when –

- presentation format does not match tasks
- information from diverse resources must be integrated manually
- controlling functionality requires excessive attention

Objective and Vision for MATH[2]

Technical Objective:

Make measurable workflow efficiency improvements integral to the way HIT software is created.

Vision:

HIT will serve as a understandable, reliable means for **health care leaders** to work with software project leaders to **plan** and **direct** strategic, cost-effective **workflow improvements** for clinical care.

2. Modeling & Analysis Toolsuite for Healthcare, an extension of OMG's BPMN standard

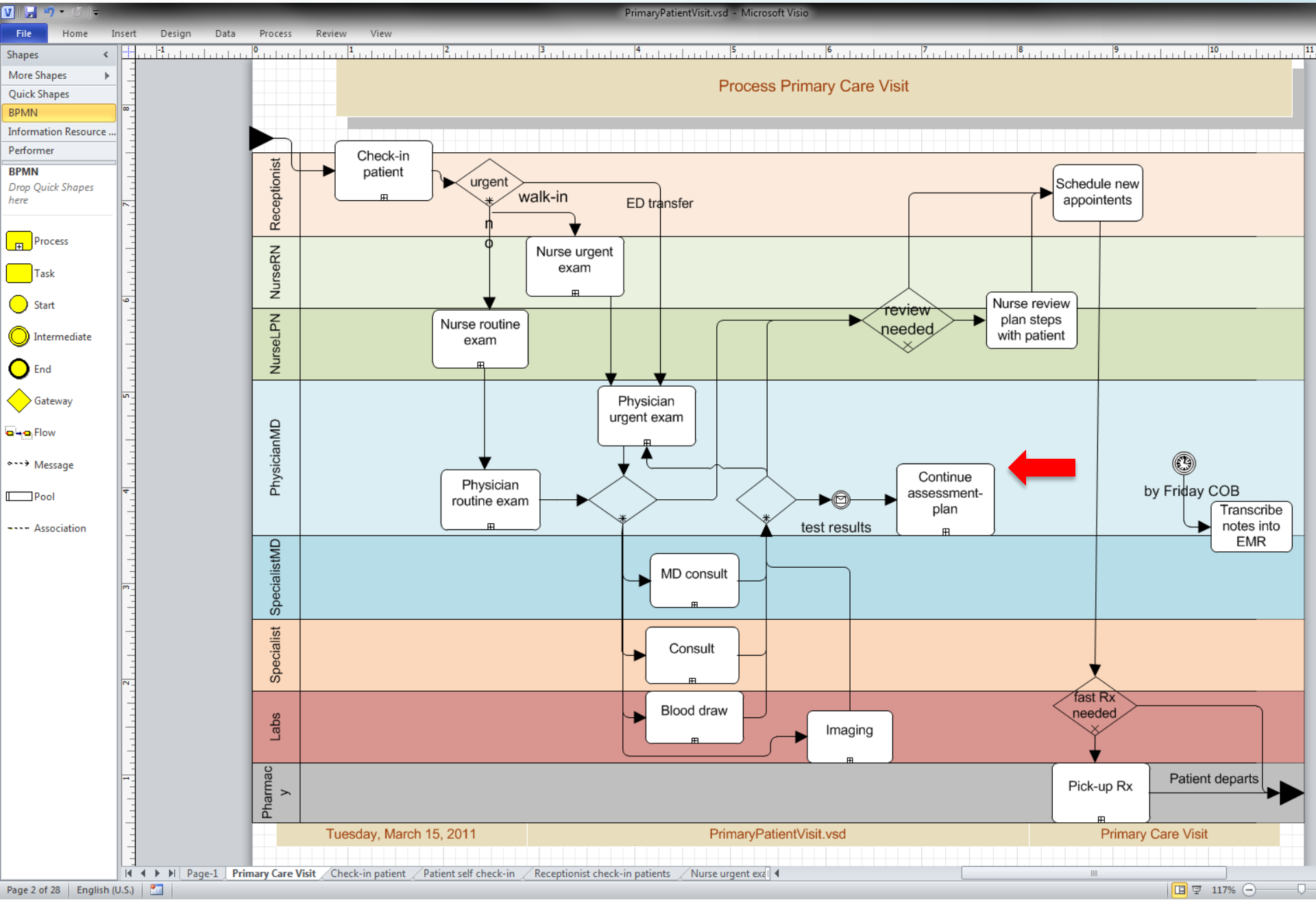
MATH for new HIT products & customizing current systems

- Integrates workflow and information flow
- Makes workflow impact predictable
- Prioritizes HIT functions by workflow benefit
- Provides objective evidence that HIT investment will be worthwhile
- Closes the gap between measurably better workflow and HIT development

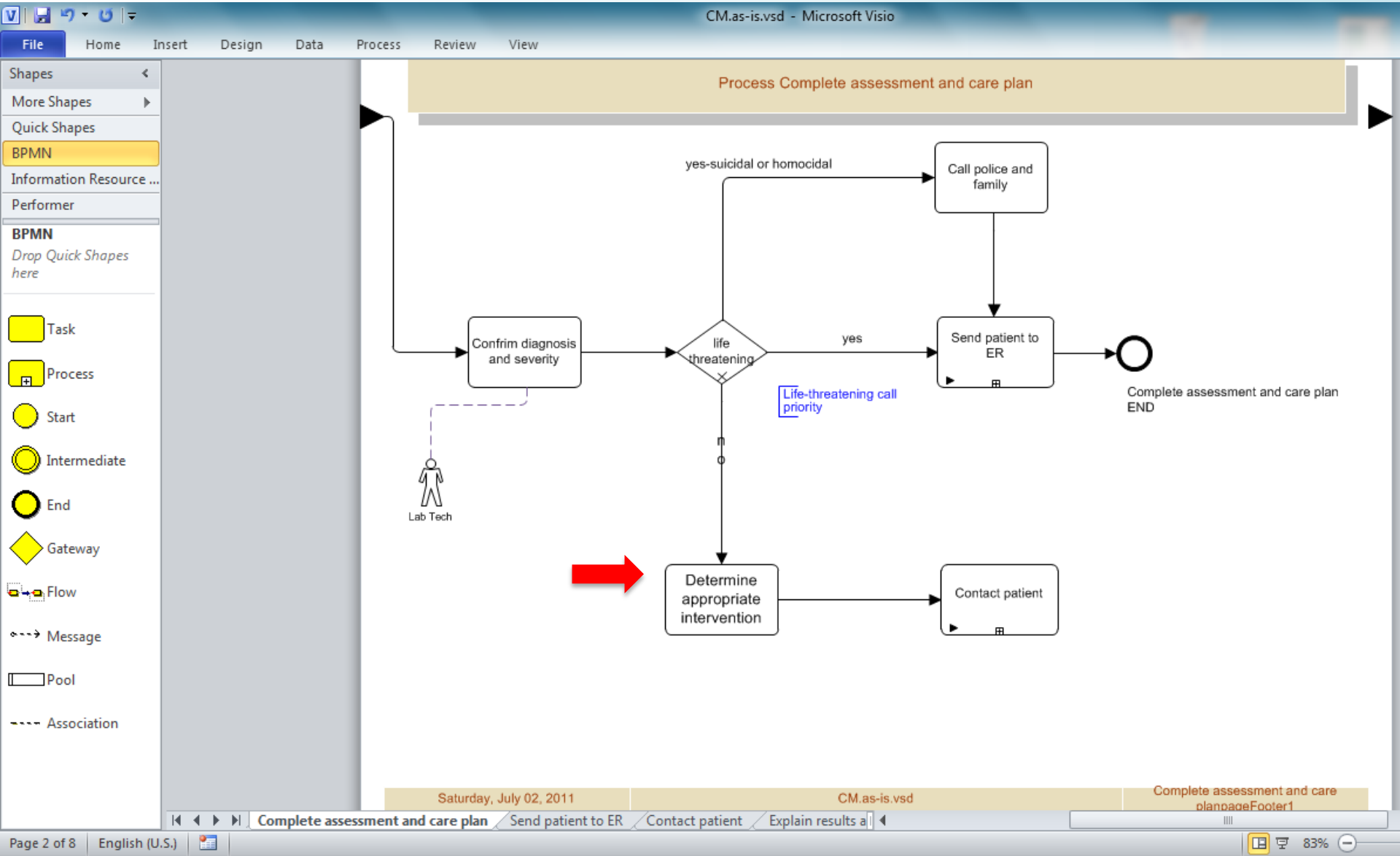
How MATH works-
Case study for *Priority Contact*

- can reduce unproductive doctor time to contact patients about test results by 40%
- won award in national SMART Apps competition

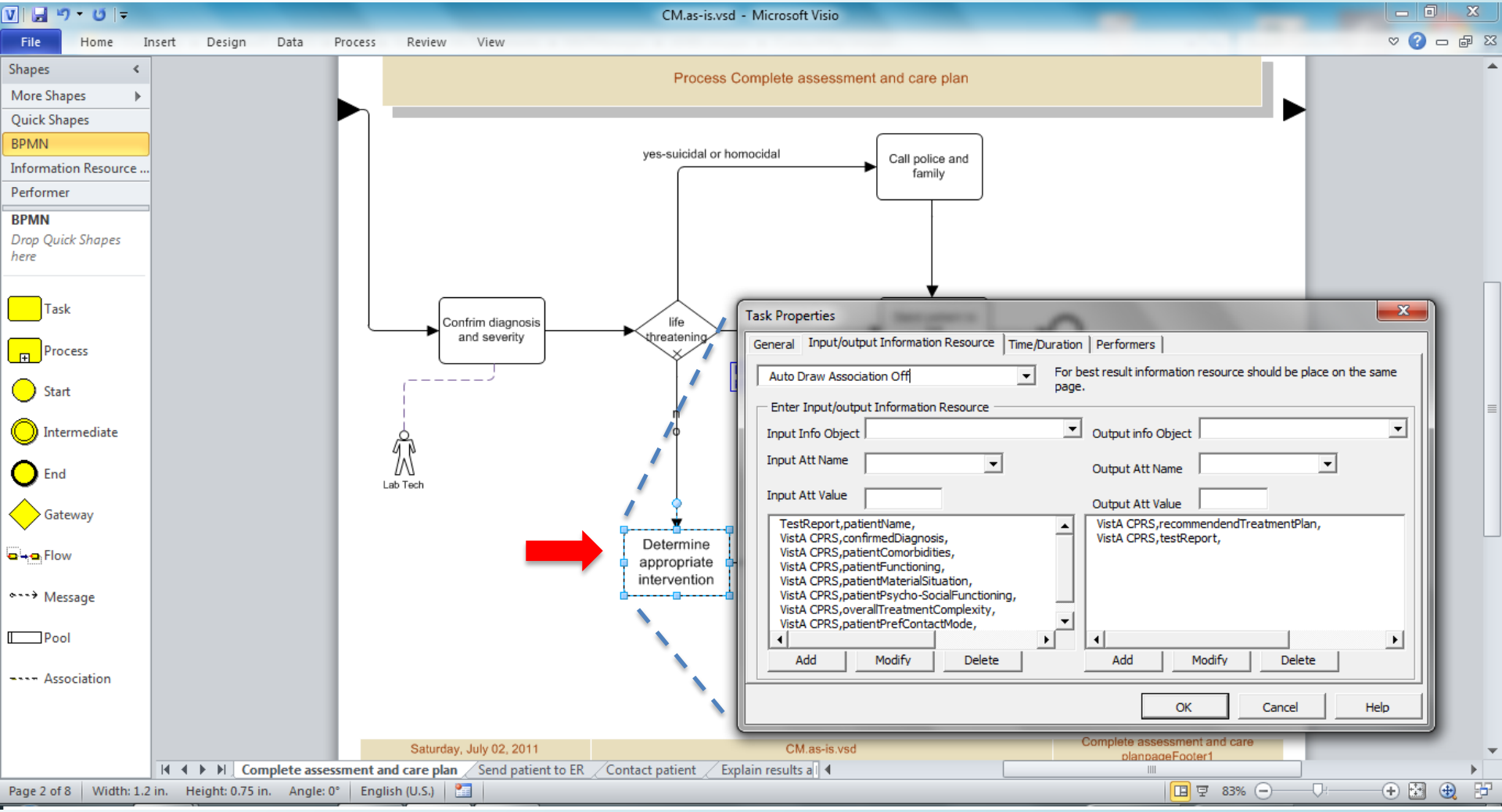
MATHflow of primary care at Puget Sound VHA



Drill-down in MATHflow for more detail on *Continue Assessment-Plan* after test results arrive



Capturing information usage as a property of workflow tasks: *what is needed; where it comes from; where it goes?*



MATH's information dictionary- captures patterns of information usage

Information usage patterns establish a connection to software design for needed HIT

Information attributes

	1	2	3	. . .	N
User tasks					
A	0	1	1	0	1
B	1	0	0	1	0
C	1	0	0	1	0
. . .	0	1	1	0	1
Z	1	1	1	0	0

1 = used
0 = not used

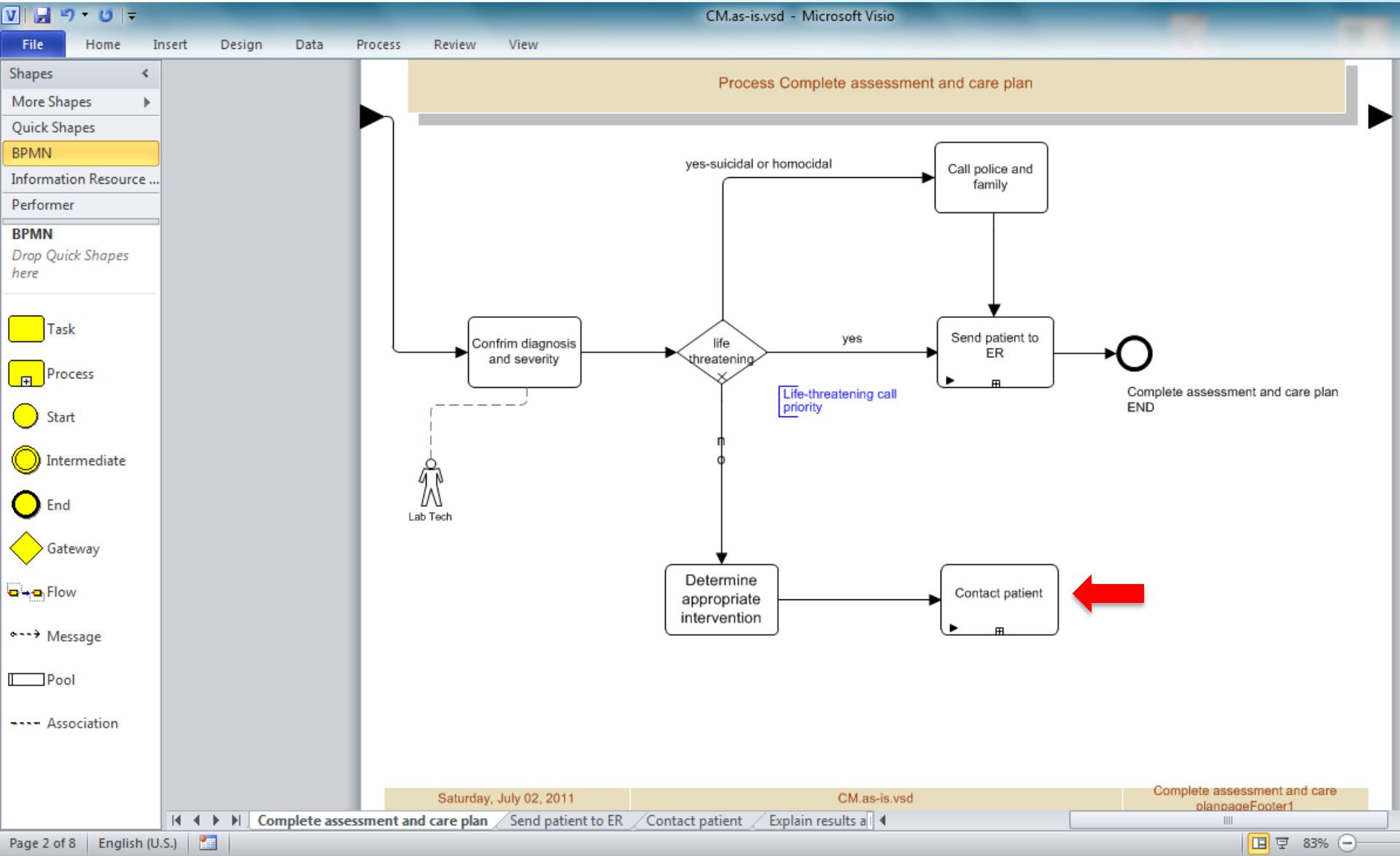
Rtn

Modeling clinical information flow in MATH

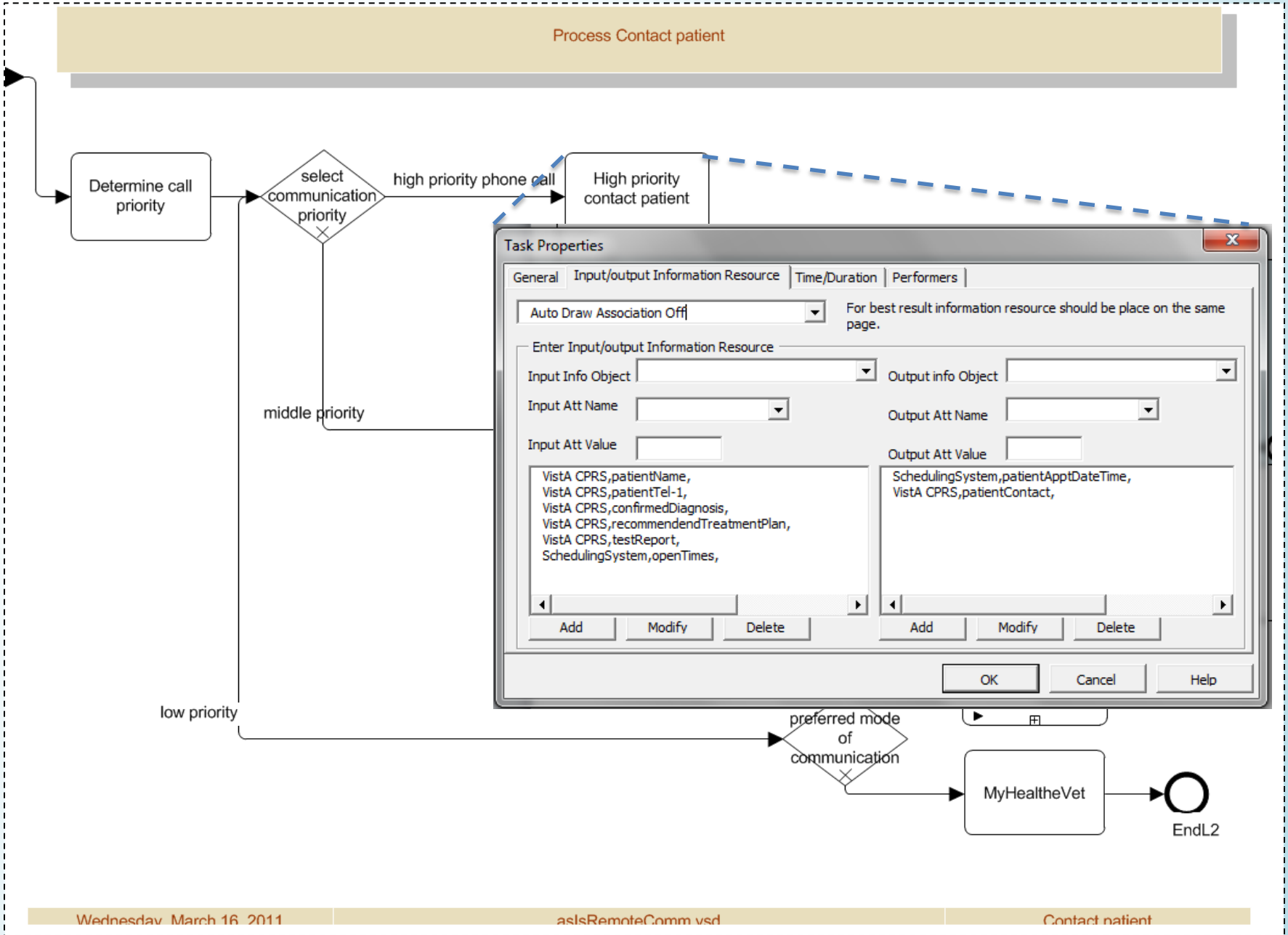
Important to capture use of all clinical information resources:

- EMR - Paper documents - Equipment
- The patient - Users, themselves - Colleagues
- The observable environment

Drill-down on *as-is* workflow to contact patients



Pain point: dozens of hours/monthly to contact patients manually



All models are wrong . .

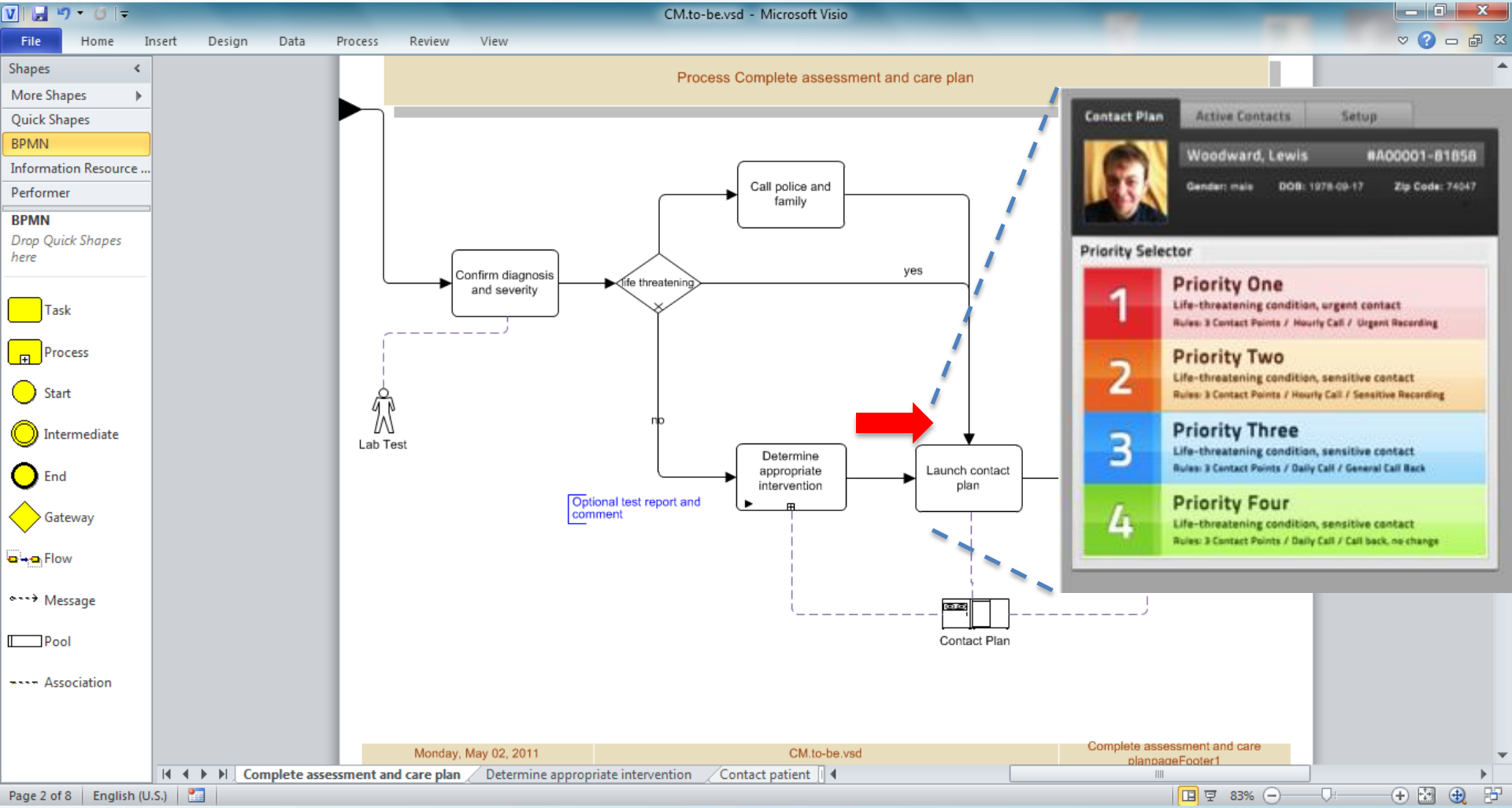
. . but some are useful.

- George Box, noted statistician

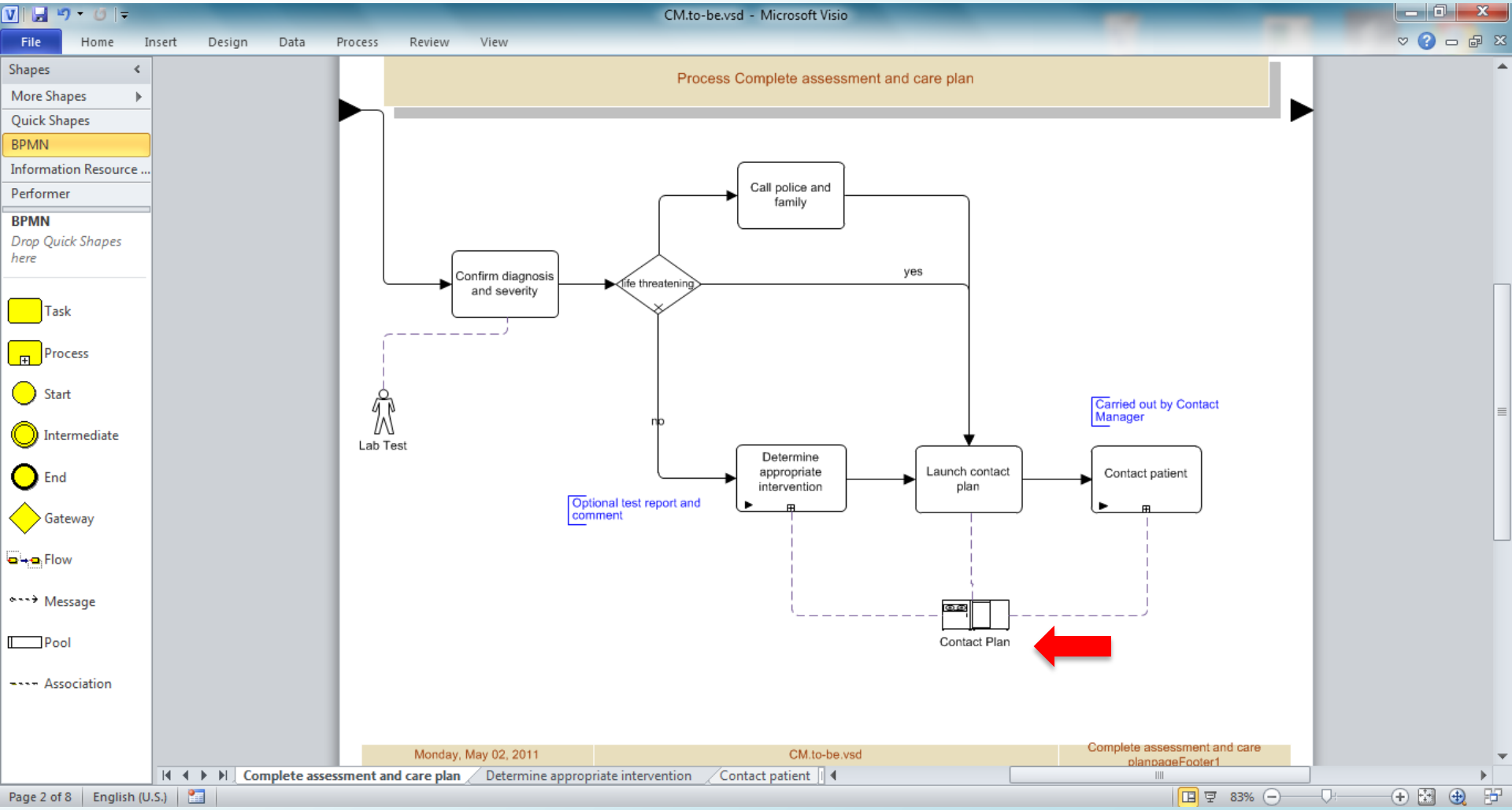
Improving workflow with HIT -

using MATH to create *Priority Contact*

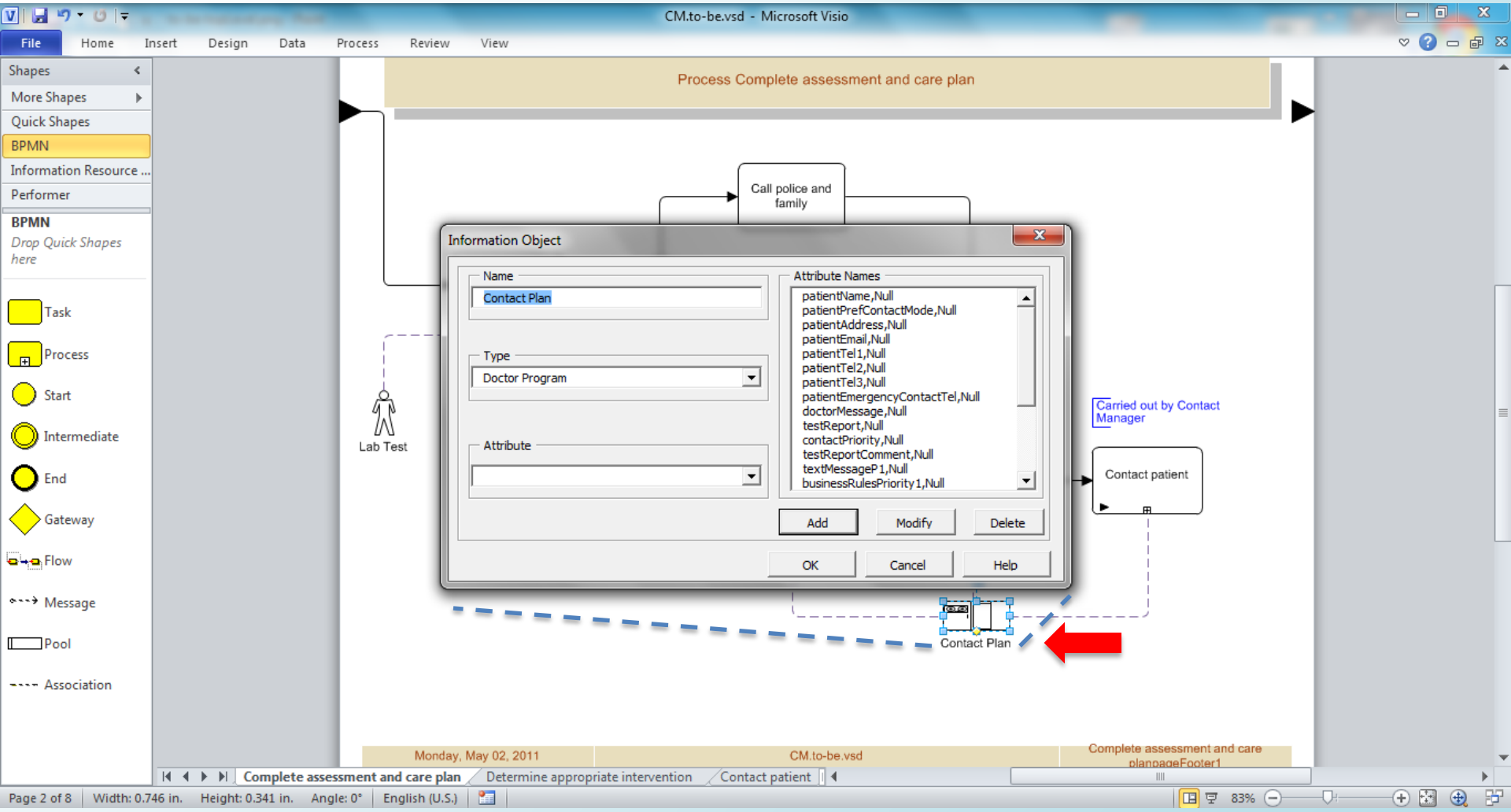
Using *Priority Contact*



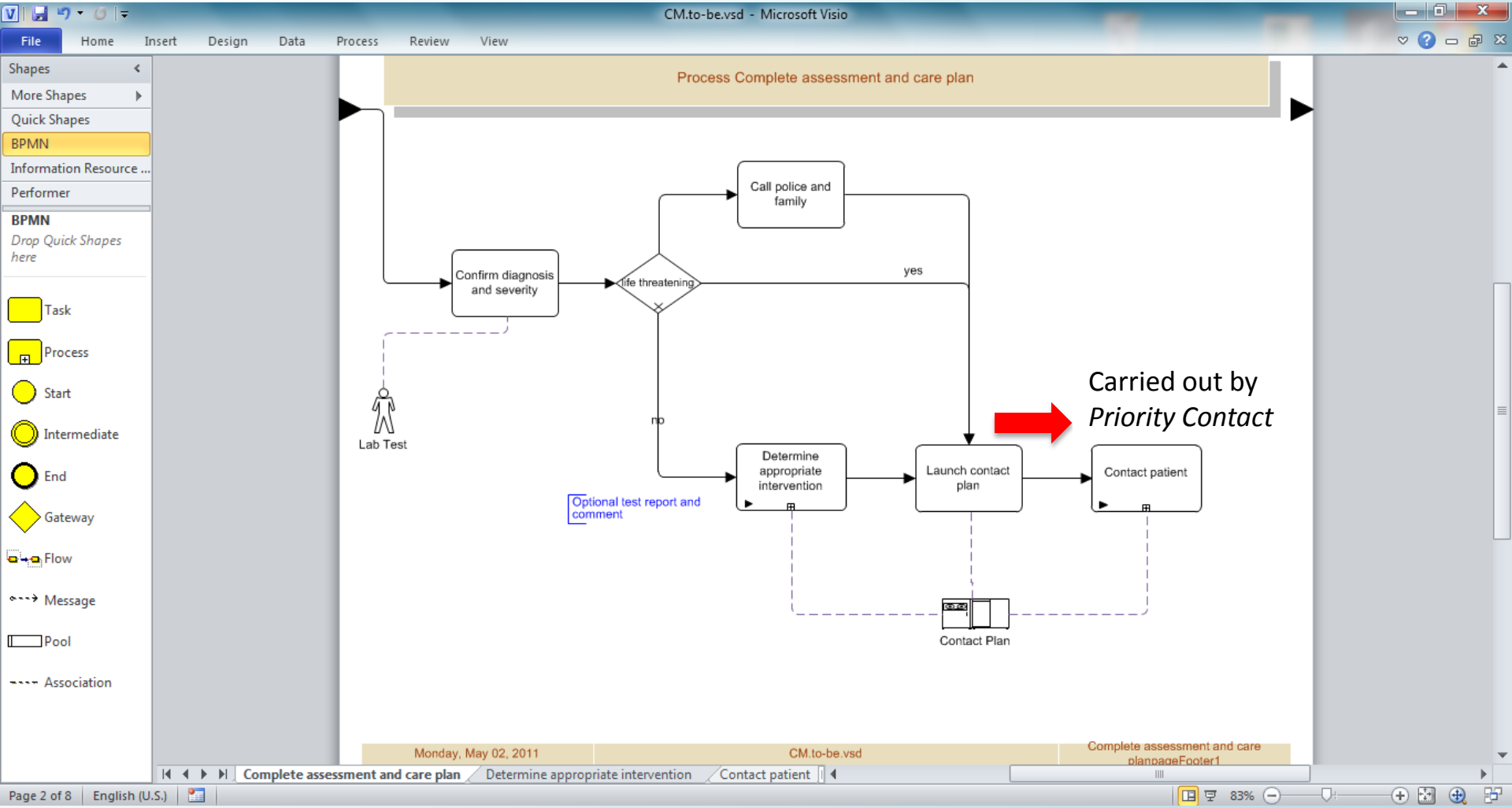
The *to-be* workflow using *Priority Contact* – exploiting HIT for measurably gains in efficiency



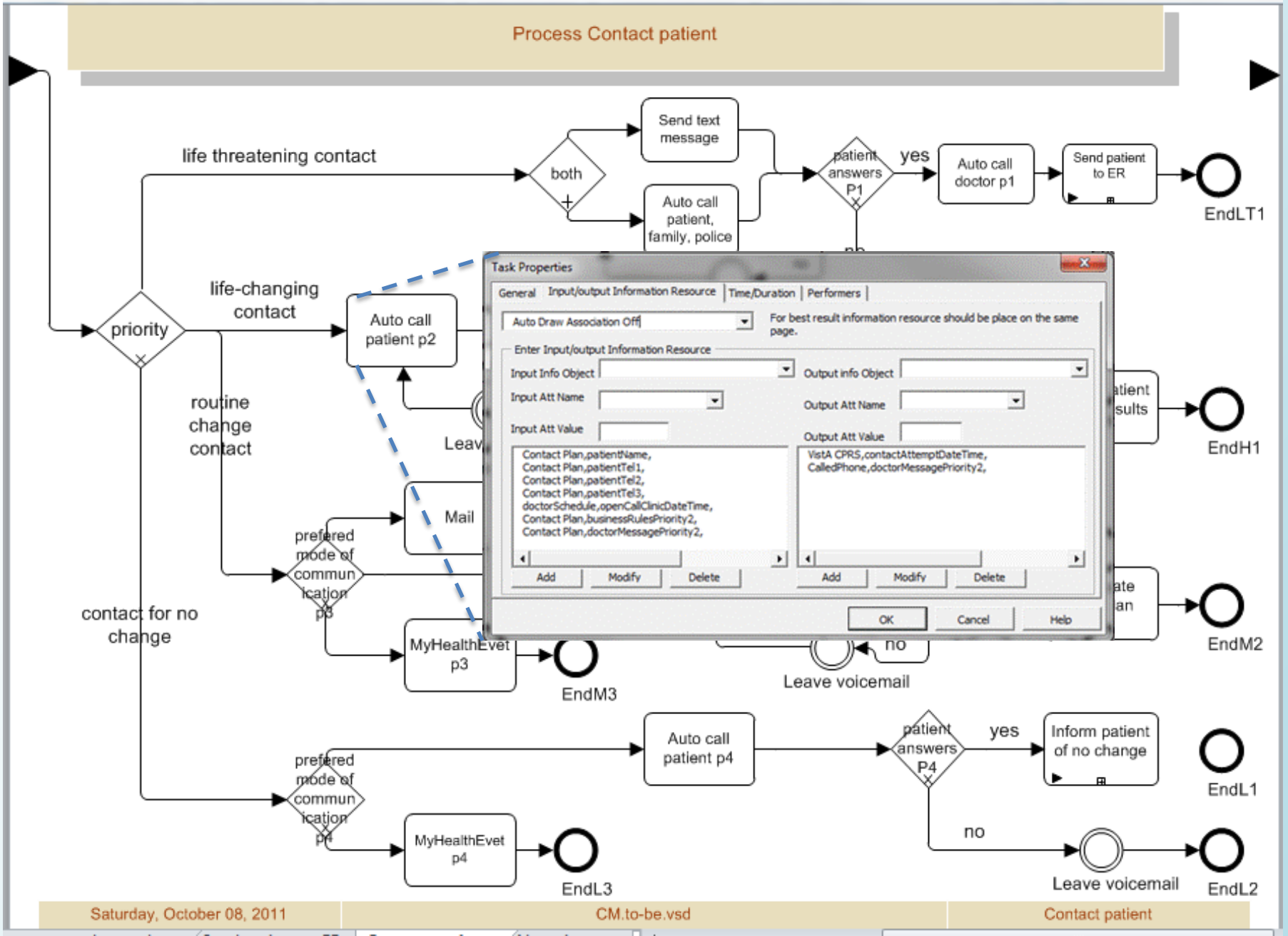
Priority Contact harvests EMR to create the *contact plan*



Priority Contact replaces unproductive activity



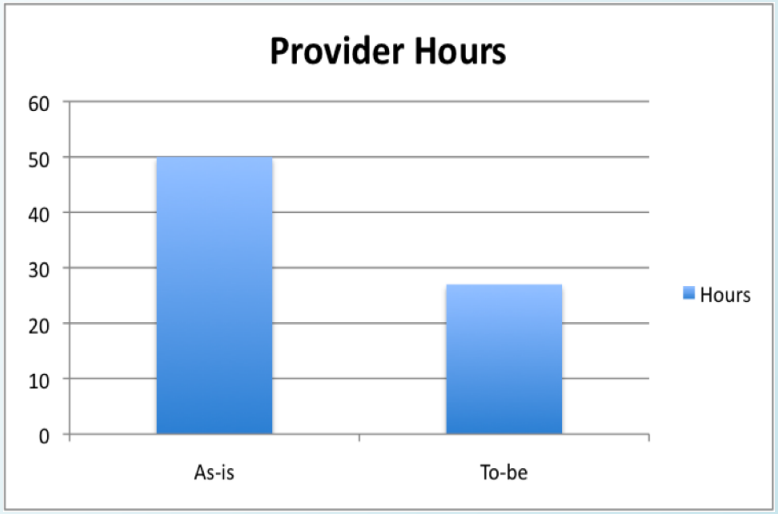
Priority Contact uses data from EMR and algorithms from MATHflow



The user interface for checking the status of contacts

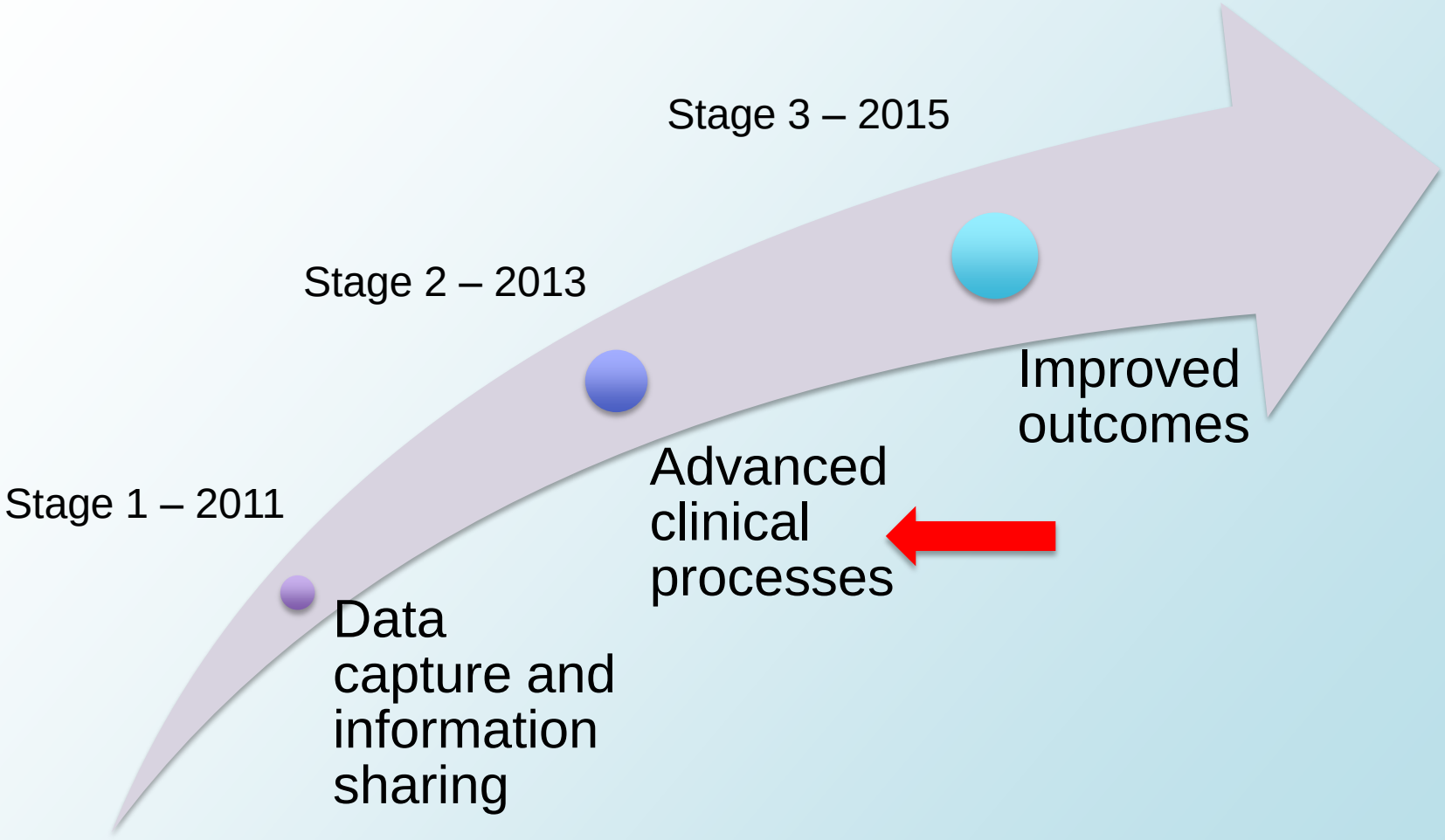
Objective evidence for efficiency from discrete-event simulation

- Re-assign information to HIT *service* to simulate impact of new system
- Run MATHsim to compare efficiency of *as-is* with *to-be*



- Priority Contact can eliminate >40% of unproductive doctor time to contact patients about test results

Long-term Approach to *Meaningful Use*



MATH

1. Integrates workflow and information flow
2. Makes workflow impact predictable
3. Prioritizes HIT functions by workflow benefit
4. Provides objective evidence that HIT investment will be worthwhile
5. Closes the gap between measurably better workflow and HIT development

We're looking for partners for beta testing -

- **If you have a good trial for MATH please leave your card and say hello**

Back-up slides

MATH gives health care leaders credible, understandable evidence on fundamental HIT questions . .

A. How will a new HIT system change healthcare processes?	D. How large are the reductions of operational cost?
B. What benefits to health care will the new processes bring?	E. What is the range of options offered by HIT?
C. What are the undesirable impacts?	**F.** How favorable is the ROI for each option**?**

The answers will increase EMR adoption by enabling health care leaders to:

- Plan and compare HIT projects;
- Participate in concept design by deciding the appropriate role of computing for their profession and their organizations;
- Provide the visibility needed to direct the execution of projects more reliably to achieve health care improvement and cost reduction.

MATH Directions

Near-term

- Patent application for *Priority Contact*
- License the rights for 1st commercial product based on MATH
- Collaborate with HL-7 group on MATH for data requirements
- Collaborate with ONC workgroups on Workflow, *Meaningful Use* and on Quality of Care measures

Mid-term

- Model the Nursing Intervention Classification tasks with MATH
- Pre-load MATH with a standard healthcare data dictionary
- Extend modeling to patient participation in their own care

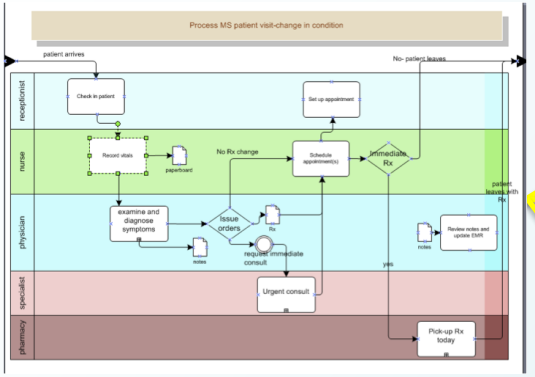
Longer-term

- Derive social networks from MATH to model implicit work
- Plan validation studies for productivity analysis

Your questions and ideas?

Summary: uses of MATH workflow models

Analyzing & improving health care



Process modeling → Improved care → Prioritized HIT functions

Workflow management control code

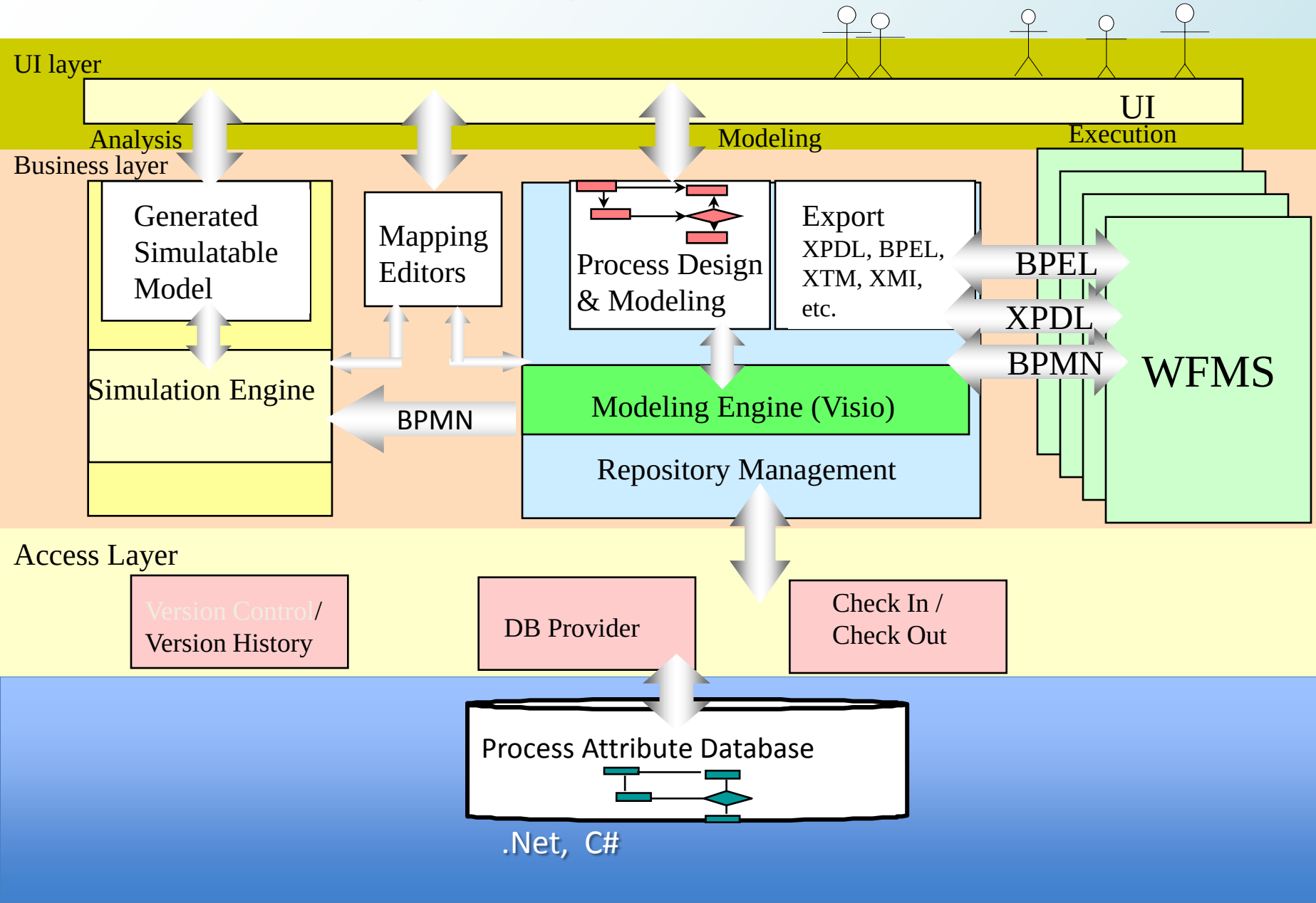
Code generation

Information flow → Information architecture → Technical feasibility

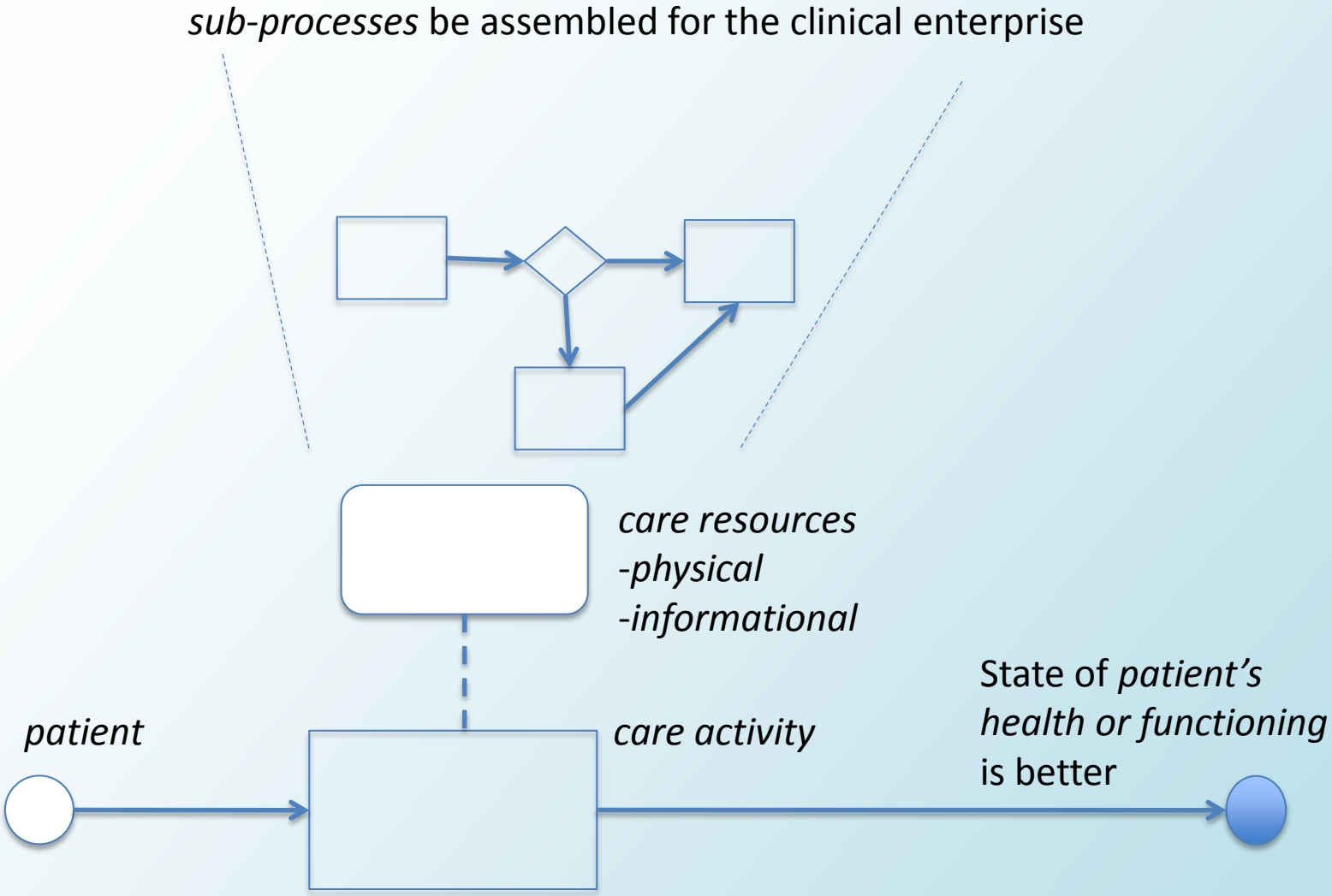
Cost estimation

Analyzing & working with HIT

MATHflow 3-Layer Implementation Architecture



MATH applies BPMN[5] to capture information use in clinical care



5. Business Process Modeling Notation is a standard of the Object Management Group

Features of the MATH Tool Suite

MATHflow	Capture Clinical Workflow & Information Flow	Status
Hierarchies of workflows	Easily assemble models of care workflows	10/10
Model management	Reuse model parts, generate queries & exports	10/10
Information properties editor	Capture the information users need to perform a given workflow	11/10
Information dictionary	Map information use back to workflows steps	11/10
Discrete-event simulation	Compare efficiency of workflow options	3/11
MATHsim	**Evaluate HIT Impact on Workflow**	
Discrete event simulation	Estimate efficiency gains from HIT	3/11
Definitions of metrics	Prioritize HIT functions based on impact of (A) efficiency (B) quality	A. 3/11 B. ECD 5/12
Metric data requirements	Calculate and interpret (A) efficiency (B) quality	A. 5/11 B. TBD
MATHview	**Calculate the Required Information Architecture**	
Data dictionary import	Provide workflow information usage patterns	12/10
Cluster analysis on information usage patterns	Visualize, discover & edit the organizing dimensions of information architecture	9/11
Export clusters as UML classes	Reuse classes for software development; technical feasibility; cost estimation	6/11

Proximal metrics of workflow improvement

- Workflow productivity
  - More healthcare with same resources
  - Less expensive, more accessible care
  - More efficient use of information
  - Less overhead, waiting and wasted time

- Workflow Quality
  - Decision-making and planning that adheres more closely to protocol
  - More reliable execution of workflows and teamwork to carry them out.
  - More coherent and understandable flow of information
  - Fewer errors and increased safety

healthit.hhs.gov/blog/faca/index.php/2010/12/06/quality-measures-workgroup-seeks-comment-on-clinical-quality-measures-concepts-for-stage-2-and-stage-3-meaningful-use-by-december-23-2010/

Rtn