



JOHNS HOPKINS
MEDICINE

POPULATION
HEALTH ANALYTICS

Outcomes Measurement & Evaluation Using the ACG System

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Wednesday, 02 August 2023



RISK ADJUSTMENT

- Controlling for factors that may affect outcomes
- Case-mix adjustment
 - e.g. ACG actuarial cells, Age, Sex
- Segmentation and stratification: compare outcomes within defined strata
 - Stratified Sampling
 - PNGs, Modifiers, e.g. age ≥ 65
- Propensity score matching (PSM) - quasi-experimental method
 - Observational study, Mimics randomization, Creates matched-pair controls



- **Outcomes do not directly assess quality of performance.** They only permit an inference about the quality of the process
- The degree of confidence in that inference depends on the strength of the predetermined causal relationship between **process and outcome.**

Data Needs

- Because the relationship between process and outcomes is a probability, it is necessary to collect an appropriately large number of cases before one can infer if care is better or worse or meets specified standards.

Time Window

- Outcome measurement requires specification of the appropriate **time window** which is the time when outcome differences caused by degrees of quality in health care are most manifest.



OUTCOMES FROM DIFFERENT PERSPECTIVES

- Clinical Perspective
- Patient Perspective
 - Subjective health status
 - Quality of life
 - Satisfaction
- Societal Perspective
 - Utilization
 - Cost
- Measures: Structure – Process – Outcome
(Donabedian, A, 1988)

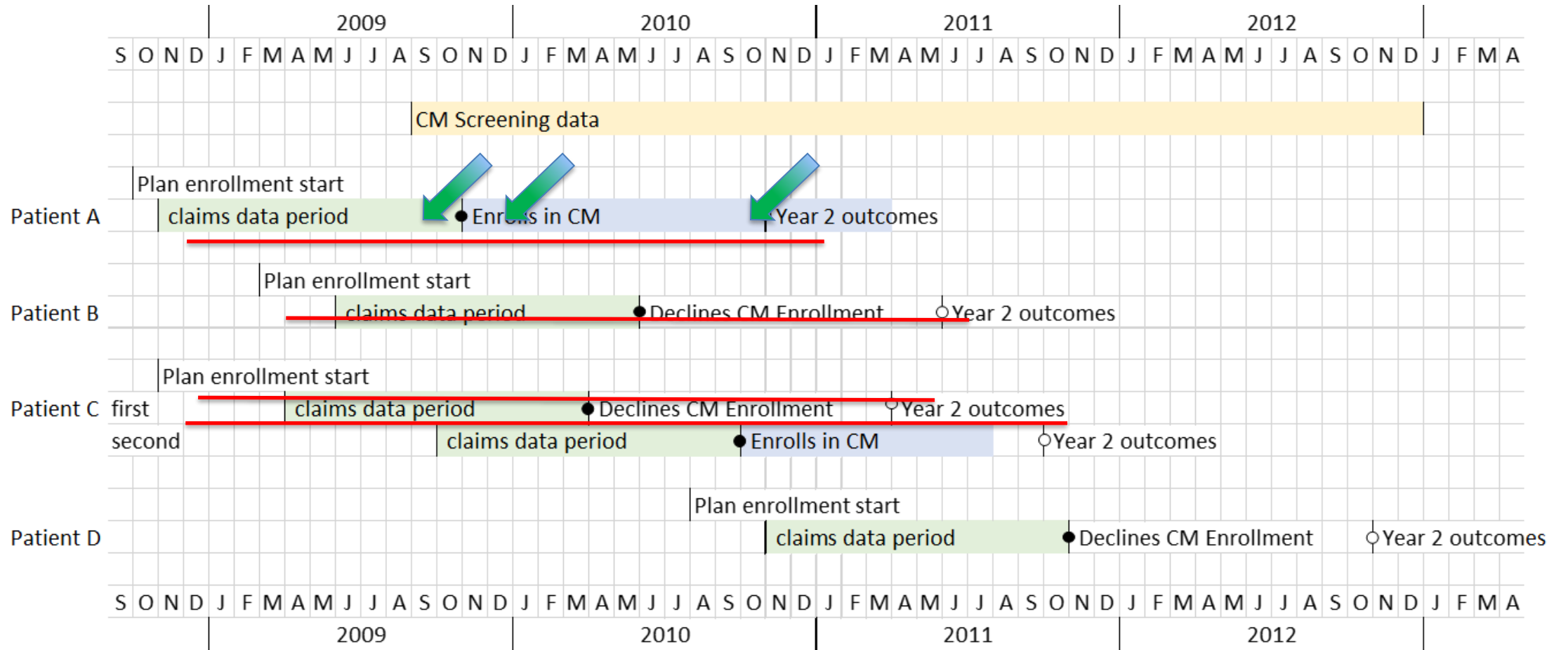


- Outcome indicators of quality are more comprehensible to patients and the public than indicators of the process of technical care.
- However, they can cause misunderstanding by the public if the problem of multiple causation is not understood.

Other Considerations

- Availability
- Completeness
- Accuracy
- Susceptibility to manipulation
- Information about delayed outcomes

Data collection timeline



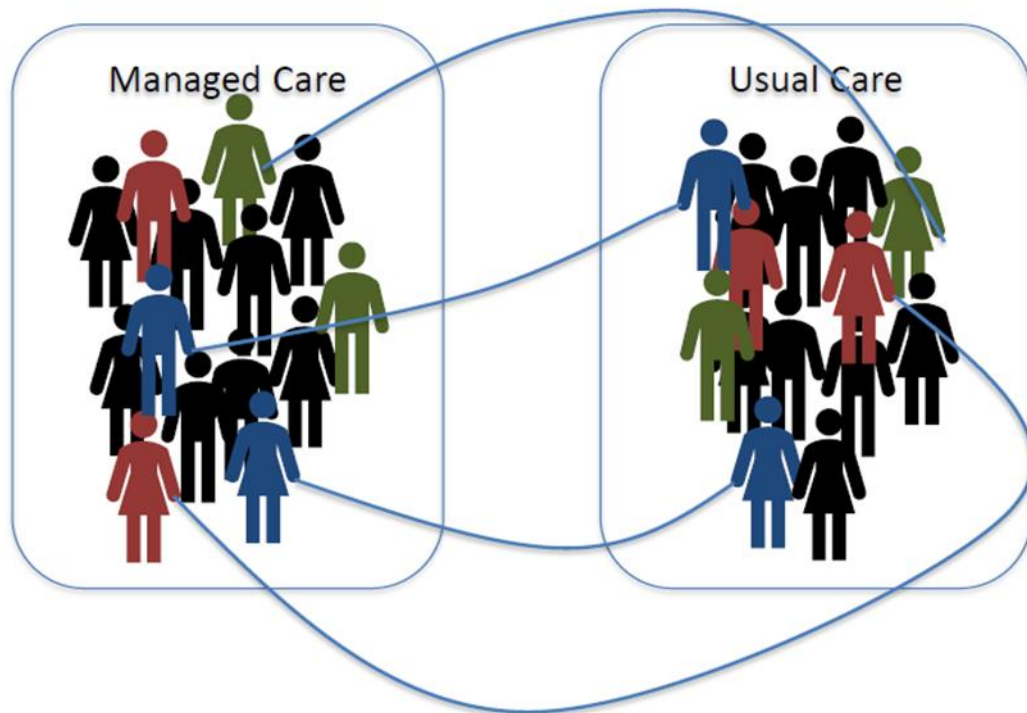


MEASURING OUTCOMES: OVERCOMING SELECTION BIAS

- Want to know the participants' outcome with and without treatment
- Participants differ from non-participants
- Objective: find a large group of individuals who match the participants in all relevant pre-treatment characteristics
- Therefore difference (if well selected) can be attributed to the program
- With multiple characteristics to control for, suggested use of propensity score – e.g. Probability of participation in the program given the pretreatment characteristics



PROPENSITY SCORE MATCHING (PSM)



- Score each patient, data prior to enrolment
- Managed Care to Usual Care matching (“counterfactual”)
- Nearest Score
- Can be paired or multiple e.g. 1-3, 1-4
- Follow-up and measure outcomes e.g. 6mth, 12mth, 24mth
- Compare results



JOHNS HOPKINS ACG MODELS (WHAT CAN WE USE AS A PSM?)



- **Concurrent risk**
 - Age-gender
 - Local ACG concurrent
 - Reference ACG concurrent
 - Concurrent risk (regression-based)
- **Predictive cost risk**
 - Predicted cost
 - Rank probability
 - Reference probability
 - Persistent high user
 - High risk unexpected pharmacy cost
- **Hospitalization risk**
 - Inpatient admission
 - Injury
 - Readmission
 - ICU
 - Extended stay

Cost and Utilization Outcome, Year 2

- Propensity Score matching (PSM) applied to reduce the risk of selection bias
 - Estimation of the Propensity Score
 - Matching algorithm, treatment / non-treatment pairs
 - Check matching quality and treatment effects
- Two matching methods used
 - **Nearest Neighbor**, each treatment case the control is chosen that had the closest propensity score (probability of enrollment in case management). Ensures a control match for each treatment case, but does not ensure the absolute difference in scores are close
 - **Caliper** method allows for a minimum absolute difference in prevalence to be specified, but does result in data loss where a match cannot be found within the specified absolute difference
- (Coca-Perraillon, 2006)



Propensity Score matching - Year 2 Outcome Measures

Medicaid Health Plan	PSM - Near Neighbor (n=4662)				P value*
	Not-Enrolled (n=2331)		Enrolled (n=2331)		
	mean	CI	mean	CI	
Total Cost \$	30,718	(28906-32531)	26,644	(24809-28479)	0.002
Inpatient hospitalization	1.0854	(1.003-1.167)	0.828	(0.751-0.905)	0.000
Emergency Visits	3.2986	(3.071-3.526)	2.6319	(2.461-2.803)	0.000

- Employee plan mean cost reductions (Near Neighbor, Caliper)
 - -\$4486.86 (18.3%), -\$4186.91 (17.1%)
- Medicaid plan
 - -\$4074.07 (13.3%), -\$1372.66 (4.6%)
- Family Health plan
 - -\$2458.51 (7.3%), -\$2604.29 (7.7%)



Propensity Score matching

Year 2 Total Cost by sub-group

Plan/Sub-Group	N	Total Cost (CI)		N	Total Cost (CI)		P value*
		Not-Enrolled			Enrolled		
PSM - Near Neighbor (n=4662)							
Medicaid Health Plan							
<2 Chronic Conditions	342	14,939	(11901-17978)	559	13,305	(11353-15257)	0.374
0-2 Major ADGs	751	24,708	(21778-27638)	828	20,688	(18286-23091)	0.037
3-4 Major ADGs	821	34,632	(31606-37658)	674	33,614	(29927-37302)	0.675
5+ Major ADGs	417	46,779	(41448-52110)	270	55,127	(46356-63899)	0.110

- Medicaid plan mean cost reductions (Near Neighbor, Caliper)
 - <2 Chronic cond. **-\$1634.77 (10.9%), -\$1480.85 (9.7%)**
 - 2+ Chronic cond. **-\$4019.44 (16.3%), -\$3468.01 (14.1%)**
 - 3-4 Major ADGs **-\$1017.33 (2.9%), -\$1274.02 (13.7%)**
 - 5+ Major ADGs **+\$8348.21 (17.8%), +\$11,288.15 (25.7%)**





- Establish measures and data collection from the outset, not retrospectively
- Decide on randomised study, or casemix adjust population cohorts
- Is there an obvious comparison population (Intervention v Control)
- Matched pairs create a population similar to those in managed care (“Intervention group”)
- Creation of a risk score or probability, assigned pre-enrolment



- Consider the time frame (time window), is it absolute (same months), or did individuals/groups join at different times
- Follow up measurement at specific time periods
- Lost to study – how do you measure/adjust when individuals leave the study or intervention
- Compare outcome measures of different groups
- Create strata of sub-groups to better understand impact e.g. PNGs



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M E D I C I N E

Thank You

Questions?

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Additional Analyses

- Distribution of utilization in 5ADG groups, are outliers leading to higher costs?
 - +18,463.00 / +11,288.15 / +1,451.33
 - +4,645.50 / - 913.17 / +7,720.49 Simple IQR trim
- Chronic condition count = 0, who are these patients? Referral only?, EDCs, ADGs
 - Year 2 CC+Count 1.45 / 1.85 / 3.15
- Check on underlying assumptions on PSM, re unmeasured effects
- TRIPOD: Set of recommendations for reporting the results of multivariate predictive model development and/or validation.
- CART analysis

