

Evaluating of Population Health Interventions : Confronting Challenges with Pragmatic Approaches

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Content

- What is Population Health?
- Challenges of Randomization in Population Health Studies
- Pragmatic Evaluation Approaches To Enable Informed Decision Making
- Case Studies

Population Health Study: Features

- Addresses **health disparities**
- **Interdisciplinary:** public health, epidemiology, sociology, economics, build environment, etc
- **Health determinants** are accounted: social, environmental, behavioural, etc
- **Cross healthcare/organizational settings:** Acute hospitals, primary care, ILTC, community partners/volunteers
- **Population focus:** At geographic, demographic, socioeconomic levels



Population Health Study: Example



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Five Key Tasks

- Mobilise **family doctors** to deliver **preventive care** for residents;
- Develop **health plans** that include lifestyle adjustments, regular health screening and appropriate vaccinations
- Activate **community partners** to support residents in leading healthier lifestyles
- Launch a national enrolment exercise for residents to **commit** to seeing one family doctor and **adopt** a health plan
- Set up necessary **enablers** such as IT, manpower development plan and financing policy to make Healthier SG work.

Population Health Studies: Randomization?

- Ethical Concerns
- Intervention complexity due to multiple components designed to target multiple population groups
- Population heterogeneity
- Logistical Challenges

Evidence-Based Public Health: Moving Beyond Randomized Trials

Cesar G. Victora, MD, PhD, Jean-Pierre Habicht, MD, PhD, and Jennifer Bryce, EdD

Randomized controlled trials (RCTs) are essential for evaluating the efficacy of clinical interventions, where the causal chain between the agent and the outcome is relatively short and simple and where results may be safely extrapolated to other settings.

However, causal chains in public health interventions are complex, making RCT results subject to effect modification in different populations. Both the internal and external validity of RCT findings can be greatly enhanced by observational studies using adequacy or plausibility designs. For evaluating large-scale interventions, studies with plausibility designs are often the only feasible option and may provide valid evidence of impact.

There is an urgent need to develop evaluation standards and protocols for use in circumstances where RCTs are not appropriate. (*Am J Public Health*. 2004;94:400–405)

Conventional plausibility analyses:

Compare subjects who received the intervention and those who did not, and adjust for possible confounders.

Quasi-Experimental Study Designs

- Evaluate interventions without randomization
- Aim to demonstrate causality between an intervention and an outcome.
- Use pre-intervention, post-intervention measurements and/or nonrandomly selected control groups

Harris AD, McGregor JC, Perencevich EN, Furuno JP, Zhu J, Peterson DE, Finkelstein J. The use and interpretation of quasi-experimental studies in medical informatics. J Am Med Inform Assoc. 2006 Jan-Feb;13(1):16-23. doi: 10.1197/jamia.M1749.

Hierarchy of Quasi-Experimental Study Designs

Quasi-experimental Study Designs	Design Notation
A. Without control groups <ol style="list-style-type: none"> 1. The one-group posttest-only design 2. The one-group pretest-posttest design 3. The one-group pretest-posttest design using a double pretest 4. The one-group pretest-posttest design using a nonequivalent dependent variable 5. The removed-treatment design 6. The repeated-treatment design 	X 01 01 X 02 01 02 X 03 (01a, 01b) X (02a, 02b) 01 X 02 03 removeX 04 01 X 02 removeX 03 X 04
B. Use a control group but no pretest <ol style="list-style-type: none"> 1. Posttest-only design with nonequivalent groups 	Intervention grp: X 01; Control grp: 02
C. Use control groups and pretests <ol style="list-style-type: none"> 1. Untreated control group with dependent pretest and posttest samples 2. Untreated control group design with dependent pretest and posttest samples using a double pretest 3. Untreated control group design with dependent pretest and posttest samples using switching replications 	Intervention grp: 01a X 02a; Control grp: 01b 02b Intervention grp: 01a 02a X 03a; Control grp: 01b 02b 03b Intervention grp: 01a X 02a 03a; Control grp: 01b 02b X 03b
D. Interrupted time-series design (single vs comparative) <ol style="list-style-type: none"> 1. Multiple pretest and posttest observations spaced at equal intervals of time 	01 02 03 04 05 X 06 07 08 09 010

O = Observational Measurement; X = Intervention Under Study. Time moves from left to right.

Harris AD, McGregor JC, Perencevich EN, Furuno JP, Zhu J, Peterson DE, Finkelstein J. The use and interpretation of quasi-experimental studies in medical informatics. *J Am Med Inform Assoc.* 2006 Jan-Feb;13(1):16-23. doi: 10.1197/jamia.M1749.

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Case Study 1

Untreated control group with dependent pretest and posttest samples

Telehealth for improved glycaemic control in patients with poorly controlled diabetes after acute hospitalization – a preliminary study in Singapore

Chow Wai Leng¹, Jiang Jundong¹, Cho Li Wei², Foo Joo Pin², Fock Kwong Ming³ and Richard Chen²

Summary

We evaluated a disease management and education programme delivered via telephone support (TS) to patients with poorly controlled diabetes ($HbA_{1c} > 7\%$). All eligible patients were invited to participate in the programme, which involved education on lifestyle modification and disease management delivered via three scheduled monthly calls by trained nurses. Patients who declined or could not be contacted acted as the controls (usual care, UC). A per protocol analysis was conducted using a mixed effect model for two subgroups with different baseline HbA_{1c} levels (i.e. baseline $HbA_{1c} < 8.0\%$ and $HbA_{1c} \geq 8.0\%$). A total of 2646 patients with diabetes were eligible for enrolment. Of these, 1391 participants had HbA_{1c} measurements available. The study comprised 633 patients (46%) who completed the programme (TS), 598 (43%) who were not contactable or refused to participate at the first telephone call (UC) and 160 patients who dropped out. In the patients with $HbA_{1c} \geq 8\%$, TS reduced the adjusted mean HbA_{1c} by 0.38% ($P = 0.022$) but the reduction in diabetes-related admissions (4.2% lower adjusted mean admission rate) was not significant. In patients with $HbA_{1c} < 8\%$, TS had no additional effect on glycaemic control or diabetes-related admission. Telephone support appeared effective in improving glycaemic control in patients with poor diabetes control.

Accepted: 4 June 2014

Journal of Telemedicine and Telecare
0(0) 1–7
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sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/1357633X14544441
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- Telephone support on disease management and lifestyle modification for DM patients with $HbA_{1c} > 7\%$
- Significant reduction in HbA_{1c} among DM patients with initial $HbA_{1c} \geq 8\%$
- Programme team subsequently revised the inclusion criteria

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Case Study 2

Mittal et al. *Journal of Orthopaedic Surgery and Research* (2018) 13:129
<https://doi.org/10.1186/s13018-018-0819-9>

Journal of Orthopaedic
Surgery and Research

RESEARCH ARTICLE

Open Access



ValuedCare program: a population health model for the delivery of evidence-based care across care continuum for hip fracture patients in Eastern Singapore

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Abstract

Background: To test a population health program which could, through the application of process redesign, implement multiple evidence-based practices across the continuum of care in a functionally integrated health delivery system and deliver highly reliable and consistent evidence-based surgical care for patients with fragility hip fractures in an acute tertiary general hospital.

Methods: The ValuedCare (VC) program was developed in three distinct phases as an ongoing collaboration between the Geisinger Health System (GHS), USA, and Changi General Hospital (CGH), Singapore, modelled after the GHS ProvenCare® Fragile Hip Fracture Program. Clinical outcome data on consecutive hip fracture patients seen in 12 months pre-intervention were then compared with the post-intervention group. Both pre- and post-intervention groups were followed up across the continuum of care for a period of 12 months.

Results: VC patients showed significant improvement in median time to surgery (97 to 50.5 h), as well as proportion of patients operated within 48 h from hospital admission (48% from 18.8%) as compared to baseline pre-intervention data. These patients also had significant reduction (p value < 0.001) of acute inpatient complications such as delirium, pneumonia, urinary tract infections, and pressure sores. VC program has shown significant reduction in median length of stay for acute hospital (13 to 9 days) as well as median combined length of stay for acute and sub-acute rehabilitation hospital (46 to 39 days), thus reducing the total duration of hospitalization and saving total hospital bed days. Operative and inpatient mortality, together with readmission rates, remained low and comparable to international Geriatric Fracture Centers (GFCs).

Conclusion: The implementation of VC methodology has enabled consistent delivery of high-quality, reliable and comprehensive evidence-based care for hip fracture patients at Changi General Hospital. This has also reflected successful change management and interdisciplinary collaboration within the organization through the program. There is potential for testing this methodology as a quality improvement framework replicable to other disease groups in a functionally integrated healthcare system.

Keywords: Value-based care, Population health, Hip fracture, Singapore, Evidence-based medicine, ValuedCare, Integrated care, Care pathways

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Untreated control group with dependent pretest and posttest samples



- Reduce median time to surgery (97 to 50.5 h)
- Increase proportion of patients operated within 48 h from hospital admission (18.8% to 48%)
- Significant reduction of acute inpatient complications such as delirium, pneumonia, urinary tract infections, and pressure sores.
- Significant reduction in median length of stay for *acute* hospital (13 to 9 days) as well as median combined length of stay for *acute* and *sub-acute* rehabilitation hospital (46 to 39 days)

Table 1 Key process improvements achieved through ValuedCare methodology

Objectives	Pre-intervention	Post-intervention
Early surgery within 48 h	Anaesthetic guidelines appended in pathway not used routinely Investigations ordered by the accident and emergency department (A&E) and the orthopaedics team, resulting in missing or duplicate orders Delayed review of early surgery rates	Orthopaedic team identifies and lists patients for early surgery with the use of anaesthetic checklist upon clerking A&E doctor commences investigation order set to facilitate orthopaedics team in review and listing for surgery 2 weekly multi-disciplinary review of early surgery rates and documentation of reasons for delayed surgery
Reduce complications	No dedicated high dependency (HD) beds for post-operative care, causing surgical delays DVT prophylaxis starts from ward admission Ad hoc prescribing of pain, bowel medications, supplements and antibiotics	3 dedicated HD beds for ValuedCare patients DVT prophylaxis starts from A&E Standardized electronic orders used by orthopaedics team Medications reviewed by ortho-geriatrician and pharmacist
Restore patient's functional ability to pre-fracture state	(Post-operative day 1) POD 1 mobilisation by physiotherapist not tightly enforced Patient outcome measures acquired only from inpatient stay	POD 1 mobilisation by physiotherapist actively tracked and enforced Expanded patient outcome measures acquired from both inpatient, outpatient clinic and community hospital over 1 year post-surgery
Enhanced information flow and collection	Manual workflow in documentation with subsequent transcribing to electronic	Electronic documentation in organizational electronic medical record (EMR) system Real-time best practice elements compliance dashboard

Case Study 3



Contents lists available at ScienceDirect

Geriatric Nursing

journal homepage: www.gnjournal.com



The impact of community nursing program on healthcare utilization: A program evaluation

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ARTICLE INFO

Article history:

Received 16 January 2022

Received in revised form 21 April 2022

Accepted 21 April 2022

Available online xxx

Keywords:

Healthcare utilization

Community nursing

Older adults

Readmission

Program evaluation

ABSTRACT

Background: The role of nurses has evolved to meet the dynamic needs of an aging population. Community nursing has been established in Singapore with the aim to anchor population health and provide sustainable healthcare services beyond the hospital to the community. Community nurses provide health services to residents at the Community Nurse Posts (CNP) situated within the heartland residential estates.

Objective: To investigate the effect on healthcare utilization six months pre and post first community nurse visit in older adults, and if the effect is modified by the presence of two or more community nurse visits or absence of a polyclinic chronic disease diagnosis.

Design: A single-group pretest–posttest study

Setting(s): Fifty-one SingHealth CNPs at the southeast and east regions of Singapore

Participants: Community-dwelling older adults aged ≥ 60 years, seen at any of the SingHealth CNPs between 1 April and 30 November 2019.

Methods: The number of emergency department (ED) visits, unplanned inpatient admissions, length of inpatient stay, specialist outpatient clinic (SOC) and polyclinic visits at SingHealth institutions six months from the first community nurse visit were compared to six months prior. Negative binomial generalized estimating equations were used to model healthcare utilization events, adjusting for baseline age, gender, and race. **Results:** 1,600 community-dwelling participants were included, of whom 1,561 (median age of 71 years) survived the post-test period. There was a population-average 23% lower rate of ED visits (incidence rate ratio 0.77, 95% confidence interval 0.68 to 0.87, $p < 0.001$) and 15% lower rate of unplanned inpatient admissions (0.85, 0.75 to 0.96, $p = 0.011$). A trend towards a lower rate of inpatient length of stay and a higher rate of SOC and polyclinic visits was also observed. The reduction in acute care utilization may have been greater among adults with two or more community nurse visits. Participants with no recent polyclinic chronic disease diagnosis had a greater increase in SOC visits.

Conclusions: Community nursing services are associated with reduced acute care utilization, especially for older adults with two or more community nurse visits. The trend of a higher rate of SOC visits could be attributed to the community nurses' referrals for undiagnosed/ new conditions and/or treatment of suboptimal health issues. There is a potential role for community nursing towards a sustainable healthcare system.

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The one-group pretest-posttest design



- There was a population-average 23% lower rate of ED visits (incidence rate ratio 0.77, 95% confidence interval 0.68 to 0.87, $p < 0.001$)
- 15% lower rate of unplanned inpatient admissions (0.85, 0.75 to 0.96, $p = 0.011$)
- A trend towards a lower rate of inpatient length of stay and a higher rate of SOC and polyclinic visits was also observed.
- The reduction in acute care utilization may have been greater among adults with two or more community nurse visits
- Participants with no recent polyclinic chronic disease diagnosis had a greater increase in SOC visits.

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Interrupted time-series (Single)

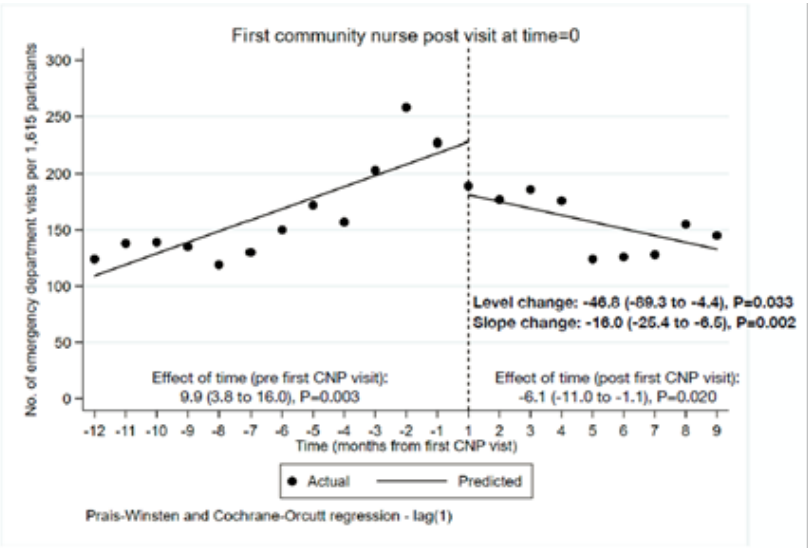


Fig 1. Participation in CNP on ED visits

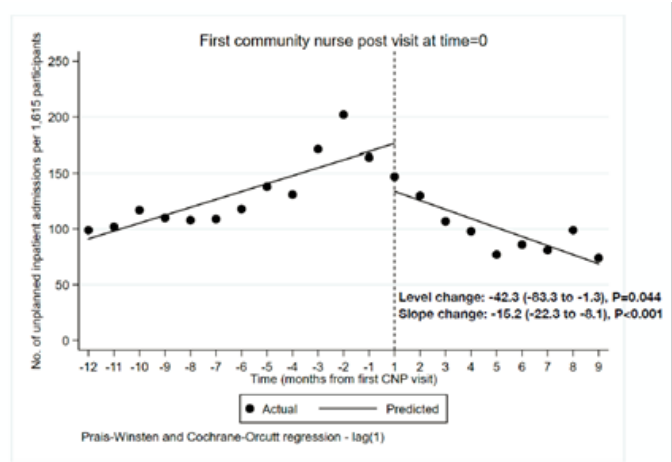


Fig 2. Participation in CNP on unplanned inpatient admissions

Significant reduction within the first year from the 1st CNP visit

- ED visits
- Inplanned inpatient admissions
- Inpatient LOS and Polyclinic visits

Presented at SingHealth Duke-NUS Scientific Congress 2023

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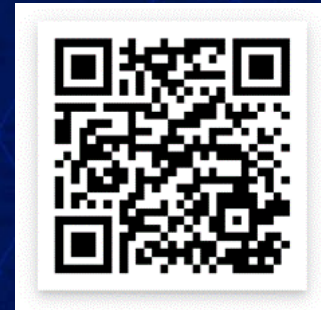


Conclusions

- Population health interventions need to be evaluated to allow informed decision-making on the next move
- Pragmatic evaluation approaches may have to be considered due to operational constraints
- Important to choose the strongest evaluation design that is operationally feasible

Thank You!

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