

Real-world effectiveness of stroke units in Ontario. A matched cohort analysis

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Motivation

Organized care is the cornerstone of strategies to reduce post-stroke mortality /disability

Stroke Unit (SU): a specialized, geographically defined hospital unit dedicated to the management of stroke patients

SUs effective (improved survival / functioning) within an RCT environment¹

Some evidence suggest effectiveness in a real-world setting²

Wide variation on SU definitions across jurisdictions

1. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. Cochrane Database of Systematic Reviews 2007, Issue 4.
Art. No.: CD000197. DOI: 10.1002/14651858.CD000197.pub2.

2. Seenan P, Long M, Langhorne P. "Stroke units in their natural habitat systematic review of observational studies." Stroke 38.6 (2007): 1886-1892.

Motivation

- Implementation guidance on SUs in Canada focused on:
 - Inter-professional team approach,
 - Early mobilization and rehabilitation,
 - Recurrent Stroke prevention,
 - Effective stroke management/communication

- In Ontario, temporal variation on the definition of Best Practice for SU has been observed.

- Effectiveness/ Cost effectiveness of SUs in an Ontario setting is also unknown

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Objectives/the OSUN study

Four Objectives:

- Identify the characteristics of SUs in Ontario
- Estimate the effectiveness of Ontario SU vs General Ward (GW) care
- Estimate the cost-effectiveness of Ontario SU vs GW care
- Identify the characteristics of SUs that are associated with more favourable effectiveness and cost-effectiveness.

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Methods/ Outcomes

Retrospective matched cohort study of SU and GW patients using linked Ontario Stroke Audit and ICES data

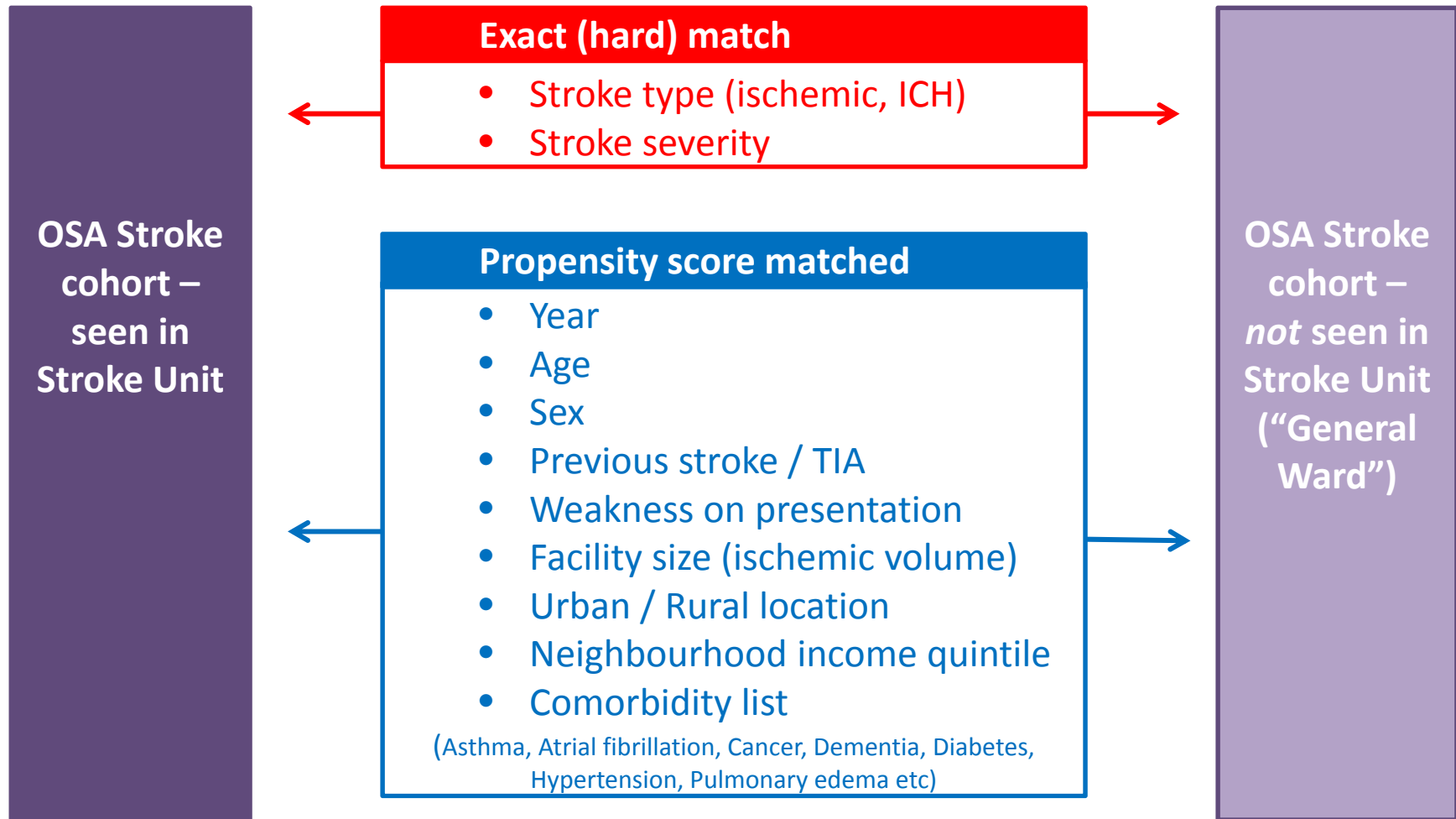
Outcomes:

- **Death within 7 days, 30 days, 1 and 2 years post discharge**
- Dependency at discharge (i.e. modified Rankin Scale [mRS] ≥ 3),
- Institutionalization (i.e. admission to Complex Continuing Care [CCC] or Long Term Care facilities),
- Acute care length of stay (LOS), and
- Stroke-related readmission to hospital within 90 days after initial discharge

Methods /Study sample

- Ontario Stroke Audit (OSA) database
 - Random sample of patients with stroke or TIA
 - Fiscal years 2002/03, 2004/05, 2008/09, 2010/11
 - Change in data sampling process on 2010/11
- Inclusion criteria
 - Ontario residents
 - Patients admitted with suspected stroke
- Exclusion criteria
 - Paediatric stroke cases (< 18 years of age)
 - Admission to ICU
 - Transient Ischemic Attack (TIA); Subarachnoid hemorrhage (SAH); Intraventricular hemorrhage (IVH)
 - Palliative care initiated at presentation

Methods/ PS Matching

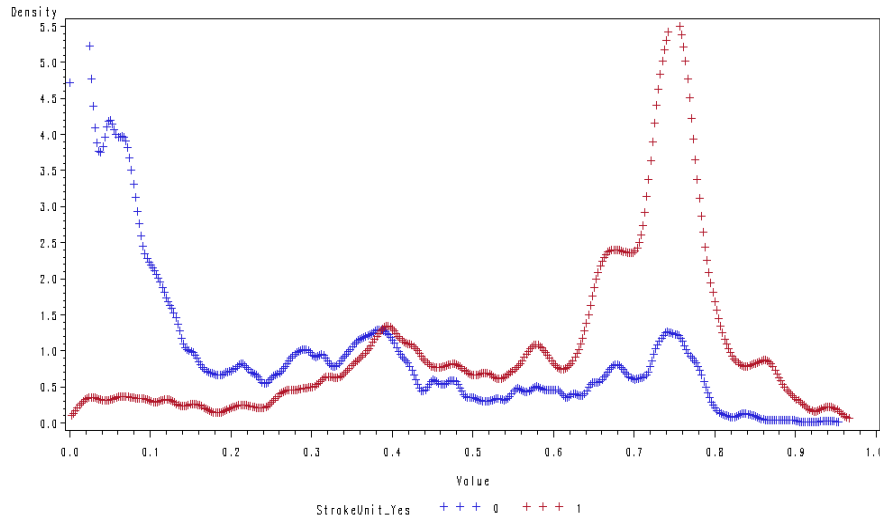


Methods / PS Matching

- PS matching
 - 1-to-1 matching:
 - Matching using the logit of the propensity score
 - “Greedy” nearest-neighbour matching algorithm
 - Matched sample “balance” was assessed using standardized differences of the mean (all < 0.05)

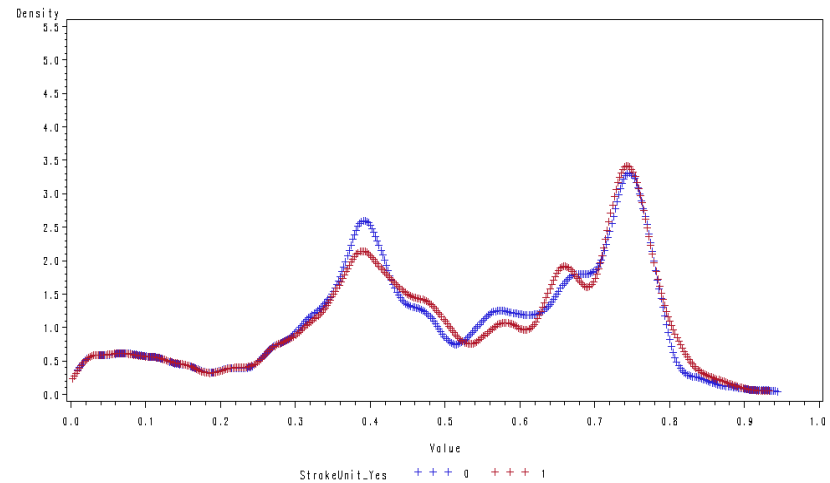
Results- Density plots (Matching)

- 3,743 patients receiving SU care - 1,989 (53%) possible to be matched to controls



← Before Matching

After Matching →



Results - Descriptives

| Variable Name | General Ward | Stroke Unit |
|--|---------------|---------------|
| N | 1,989 | 1,989 |
| Age (Mean ± SD) | 72.48 ± 13.47 | 71.85 ± 13.49 |
| Rurality Index for Ontario (Mean ± SD) | 8.89 ± 16.05 | 9.27 ± 15.02 |
| Inception cohort | | |
| 2002 | 36 (1.8%) | 34 (1.7%) |
| 2004 | 311 (15.6%) | 304 (15.3%) |
| 2008 | 351 (17.6%) | 327 (16.4%) |
| 2010 | 1,291 (64.9%) | 1,324 (66.6%) |
| Sex (female) | 955 (48.0%) | 944 (47.5%) |
| Income Quintile | | |
| 1(Lowest) | 462 (23.2%) | 467 (23.5%) |
| 2 | 452 (22.7%) | 432 (21.7%) |
| 3 | 372 (18.7%) | 380 (19.1%) |
| 4 | 366 (18.4%) | 368 (18.5%) |
| 5 (Highest) | 337 (16.9%) | 342 (17.2%) |
| Preadmission Independence | 1,699 (85.4%) | 1,708 (85.9%) |
| Comorbidities | | |
| Asthma | 232 (11.7%) | 219 (11.0%) |
| Cancer | 179 (9.0%) | 174 (8.7%) |
| Dementia | 147 (7.4%) | 138 (6.9%) |
| Diabetes | 544 (27.4%) | 547 (27.5%) |
| Hyperlipidemia | 822 (41.3%) | 825 (41.5%) |
| Hypertension | 1,405 (70.6%) | 1,389 (69.8%) |
| Prior Stroke/TIA | 578 (29.1%) | 566 (28.5%) |
| Stroke Type | | |
| Intracranial Haemorrhage | 224 (11.3%) | 224 (11.3%) |
| Ischemic | 1,758 (88.4%) | 1,758 (88.4%) |
| undetermined | 7 (0.4%) | 7 (0.4%) |
| Stroke Severity | | |
| Mild | 1,510 (75.9%) | 1,510 (75.9%) |
| Moderate | 251 (12.6%) | 251 (12.6%) |
| Severe | 176 (8.8%) | 176 (8.8%) |

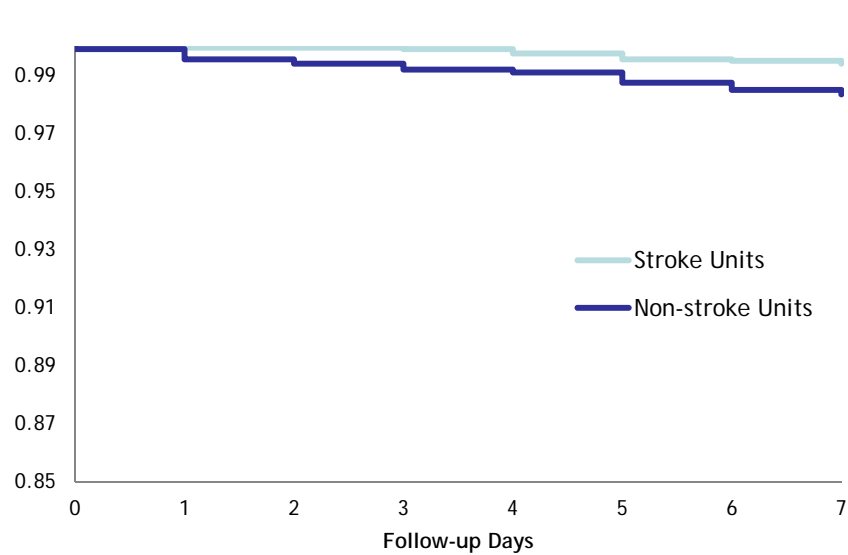
Results - Outcomes

| Outcome | Stroke Unit | General Ward | Odds Ratios |
|-----------------------------|-------------|--------------|--------------------------|
| Mortality | | | |
| 7-day in-hospital | 0.6% | 1.7% | 0.36 (0.17, 0.70) |
| 30-day | 2.6% | 4.7% | 0.54 (0.38, 0.77) |
| 1-year | 11.6% | 16% | 0.67 (0.56, 0.81) |
| 2-year | 18% | 21.7% | 0.78 (0.67, 0.92) |
| Length of Stay (mean,SD) | 13.88 days | 13.66days | 0.22 (0.795) |

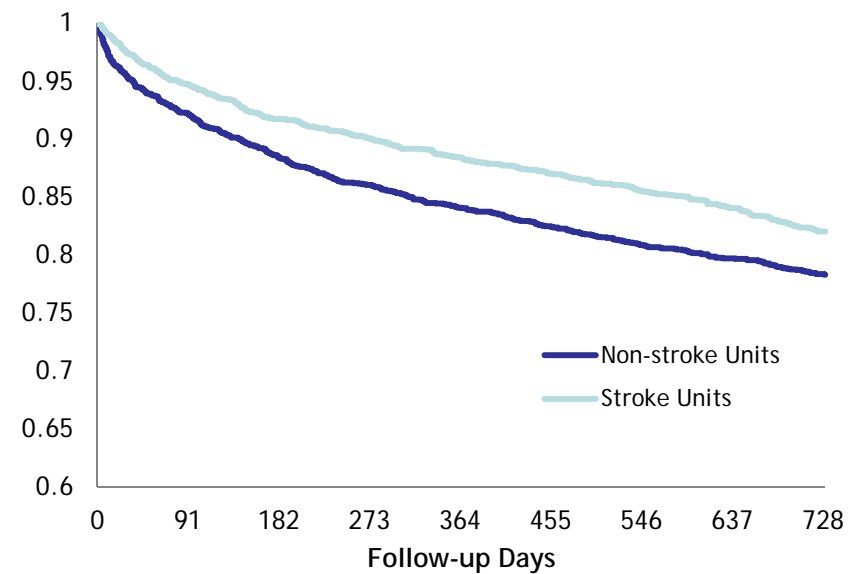
No difference in dependency, institutionalization, admission to CCC or LTC, readmission.

Results – Survival benefits

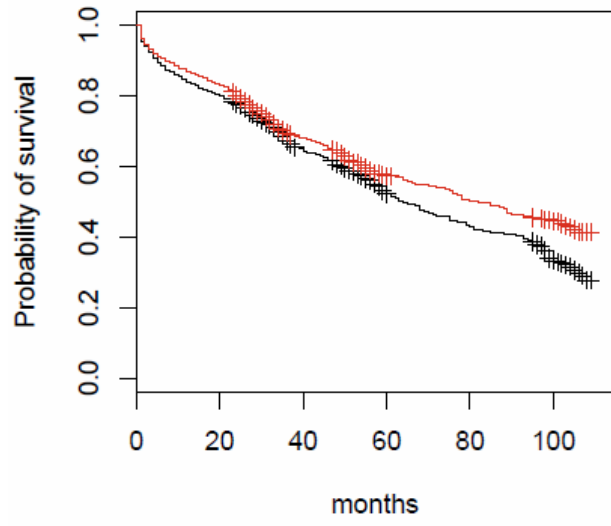
Kaplan-Meier survival 7 days in-hospital death



Kaplan-Meier survival 2 years follow up

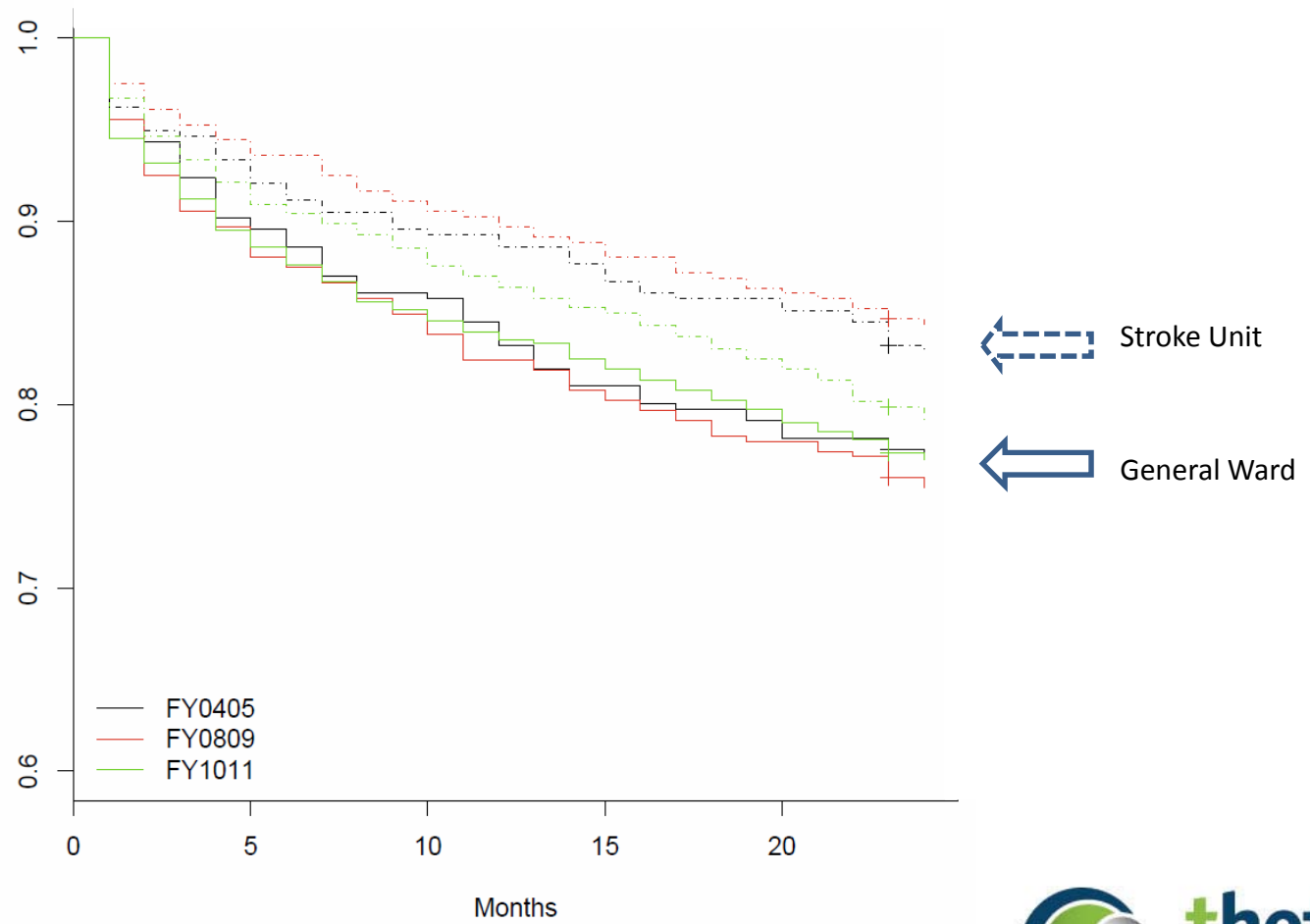


all cohorts



Results – Cohort Analysis

Kaplan-Meier survival 2 years follow up
- Inception cohort stratification -



Conclusion

- Overall, SUs significantly improved short and long term survival
- Survival benefit of SUs vs GW consistent with literature (e.g. 2013 Cochrane review 1 year OR of 0.75 [0.63, 0.90])
- No differences in dependency, institutionalization, admission to CCC or LTC, readmission rates.
- Patients receiving care in SUs as defined by the 2010/11 OSA were less likely to observe survival benefits
 - Temporal variation in interpretation of SU definition
 - 2010: A turning point in Ontario's stroke system

Conclusion

Limitations

- Difficult to find similar patients across SU and GW care
Only 53% of patients receiving SU were matched
- Varying SU definition across OSA inception cohorts
Temporal trends in survival benefit hampers policy relevant inference

Next Steps

- Linking administrative data with OSUN survey and SU-level OSA registry data.
- Identify SU characteristics that can explain survival benefit variation

Thank you!