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A MEASURE OF EMERGENCY DEPARTMENT USE BASED ON QUEBEC'S ADMINISTRATIVE DATA

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May 25, 2011

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Date of Report: May 25, 2011

Funding agency: Fonds de la recherche en santé du Québec (FRSQ)
May 1, 2007 - April 30, 2011

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Acknowledgements: Our team would like to acknowledge the help of Dr. Bruce Brown and Dr. Claude Rivard with information on billing procedures by doctors working in emergency departments.

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SUMMARY

Introduction: The Registre de la salle d'urgence (RSU) was created in the 1980s to study the use of emergency departments (ED) in Quebec. Not all EDs supply data to the registry, and of those that do, some do not provide data on ambulatory visits. Unlike the administrative data compiled by the Régie de l'assurance maladie du Québec (RAMQ), those compiled by the RSU cannot be linked to data compiled in other provincial administrative databases. Unfortunately, no validated definition of an ED visit can be explicitly derived from the RAMQ data.

Objectives: The main objective of this project was to propose several definitions of an ED visit, applicable to RAMQ data, for adult members of the Quebec population.[†]We wanted to identify visits with and without hospitalization and to compare those to measures provided by the RSU data.

Methods: Overall, data from 57 hospital-based EDs were analyzed as a function of two types of ED visit: 1) with hospitalization or 2) without hospitalization. Several definitions of an ED visit were explored, each a function of a sequence of consecutive daily billing records in the RAMQ administrative data. ED visits resulting in hospitalization were defined using linkable data on hospitalization (Med-Écho). To determine the best definition of an ED visit, we compared the annual number of visits estimated by each of these definitions with the number estimated using the RSU data. Agreement between the estimates of number of ED visits was measured by the concordance correlation coefficient (CCC). The results were stratified by ED types (small, medium, or large).

Results: In general, the annual number of ED visits estimated by defining a visit as two consecutive days of ED billing is in substantial agreement with the number of ED visits estimated by the RSU. This definition gives the best agreement for visits without hospital admission, especially for large EDs. The definition limiting a visit to a single day of ED billing leads to better agreement for small and medium-size EDs. In the case of visits with admission to hospital, all the definitions lead to similar agreement with the RSU. The distribution of user characteristics and the temporal context of the ED visits is similar.

Conclusions: The conclusions are based on the hypothesis that the data from the RSU, when complete for the EDs, are the most reliable. The data would thus suggest that ED stays lasting two consecutive days are more frequent than return visits to an ED. This supposition seems to apply better to large EDs than to medium or small ones. The difference noted between usage estimates derived from RAMQ/Med-Écho data using definitions of visits with hospital admission, and those based on RSU data is relatively weak. We recommend the usage of one of the created indicators by Quebec investigators and decision-takers. All the measures are imperfect, and it would be important in the future to provide user identifiers to the RSU data, in order to provide valid ED visit measures which would be linkable with other databases.

[†] Population aged 19 or more on April 1, 2004

INTRODUCTION

Though the use of emergency departments (ED) for healthcare in Quebec is an important subject of study, only poorly validated or unvalidated data sources are available to measure it. The Registre de la salle d'urgence (RSU) was created in the 1980s to follow the evolution of certain data on the use of EDs in the regions of Quebec and Montreal. Though no regulations oblige Quebec establishments to supply these data, 89 of them did so for the year 2004-05. Among the weaknesses of the RSU are the inability to identify users or to link data on users with data on the use of healthcare services, and the frequent absence of data on ambulatory users.

Moreover, the administrative data of the Régie de l'assurance maladie du Québec (RAMQ), which are based on billing for doctors' services, contain a lot of information on the use of healthcare services by users. Since the RAMQ supplies information on the type of place in which care was provided, it is possible to identify bills originating in EDs. On the other hand, discrete visits cannot be identified since no data are recorded on time of entry or departure from the ED. Most previous studies of ED utilization have ignored this methodological problem.

A previous study created and validated a measure, based mainly on RAMQ data, of ED visits by users aged 65 and older.¹ Patients were recruited in 4 EDs in the Montreal region. Three sources of data were compared at the level of the individual: a self-administered questionnaire; a measure based on patients' hospital charts; and finally, two measures based on the RAMQ administrative data. These two measures were based on defining a visit either as being limited to 1 billing day, or to an unlimited sequence of billing days. The latter measure proved to be the better in terms of validity. To distinguish between ED visits with hospitalization from those without, we used hospitalization data (Med-Écho), as in the same previous study.² Finally, the previous study's limitations in sampling only the elderly in a small number of EDs led to the present study, which explores a more complete set of data.

OBJECTIVE

For the adult Quebec population,[‡] the objectives of this study are:

1. To propose several possible definitions, based on RAMQ/MED-ÉCHO data, of an ED visit, and to classify such visits as being either with or without hospital admission;
2. To compare measures of numbers of visits based on these definitions with data from the RSU,
 - a) for all hospitals, and
 - b) as a function of the size of the ED.

Only hospital-based EDs were used in the creation and comparisons of measures.

METHODS

This study used data from the financial year 2004. The target population was the entire adult population of Quebec healthcare users, linked to one or more medical billings in one or the other of two databases (Med-Écho, RAMQ).

1) Databases and linkage

Provincial administrative data Two administrative databases recording the use of medical services by the population of Quebec were linked by means of the provincial health insurance registration number

[‡] Population aged 19 or more on April 1, 2004

identifying each user: the hospitalization database (Med-Écho) and the medical billing database (RAMQ). The RAMQ supplies information on each user's age, sex, and place of residence.

Registre de la salle d'urgence (RSU) [The usual course of an ED visit is described in the appendix]³ The RSU database compiles information on visits to most EDs⁴. It supplies the following information on patients: age on arrival at the ED; sex; date, time, and place for the beginning and end of the visit; type of visit (either on stretcher or ambulatory); mode of arrival (ambulance or other); and destination after the visit (released, hospitalized, transferred, referred, or other — that is, died, or left for any other reason). The RSU does not record the registration number of the individual visiting the ED, which means its data cannot be linked with that of other databases. It is, however, possible, to link the RSU and RAMQ data on EDs. Since some (33) hospitals did not supply data on ambulatory ED visits to the RSU at the time of the study, only data from the 57 EDs that supplied data on visits by both stretcher and ambulatory patients were used in the analyses.

2) Definition of an ED visit

RSU Data: The number of visits to an ED per day was estimated using the date of arrival at an ED. Any record of a visit lacking information on the patient (i.e., age, sex), or on the visit was excluded from the analysis. Such records represent less than 1% of all the visits recorded in the registry. The destination code allowed determination of the type of visit: with hospitalization (hospitalized or transferred, or without hospitalization [released, referred, or other (i.e., died or left for any other reason.)] Less than 5% of visits have “other” as their destination code.

RAMQ/Med-Écho data: A user can generate several billings from several doctors during a single visit to an ED. Moreover, some billings occur during a hospitalization (between the hospital admission and release dates, as recorded in the Med-Écho data). We excluded such billings, which represent less than 1.5% of all ED billings. Another difficulty is the impossibility of determining if two billings at the same ED from the same user generated at moments that are near each other in time stem from the same visit; it is possible these data represent either a patient who left the ED to return soon after for a second visit, or that a single visit lasted for more than a day. To define an ED visit, we used a sequence of daily billing for one user from the same ED during a sequence of consecutive dates.¹ We limited the eligible sequences to a maximum of x consecutive dates, where x is to be determined. We explored four definitions of a single visit:

- 1) The sequence is limited to a single day ($x=1$),
- 2) The sequence is limited to two consecutive days ($x=2$),
- 3) The sequence is limited to three consecutive days ($x=3$), and
- 4) The sequence is unlimited.

All sequences lasting more than x days were partitioned into other sequences, and allocated to a maximum number of days based on the first day of billing.

Hospitalizations, as indexed in the Med-Écho database, were linked to a maximum of one single billing sequence, using the following hierarchical algorithm:

- 1) The hospital admission occurred on the last day of an ED billing sequence
- 2) The hospital admission occurred on the day following the last day of an ED billing sequence
- 3) The hospital admission occurred within 3 days following the end of an ED billing sequence and billings for acute care were recorded on all days between the last day of the ED sequence and the date of hospital admission.

This algorithm is adapted from one which was validated for ED users aged 65 or more². All definitions adapted in the study reflect clinical judgment on appropriateness given the correct context of ED services in Quebec.

Characteristics of the individual and of the hospital

The individual characteristics of patients during their visit were: age category, sex, and temporal context of the visit (weekday/ weekend). We compared the characteristics of ED users as recorded by the RSU with those linked to various definitions used to define a visit and applied to the RAMQ/Med-Écho data.

Each ED was classified using a previously established method⁵: small EDs, medium EDs or large EDs, according to 4 indicator variables (geographical location, university affiliation, number of beds, and level of care provided). The large EDs are likely to have more than 20 beds, to be affiliated to a university and to provide tertiary-level care. Small (N=10) and medium (N=21) EDs were merged into one group due to the small number of small EDs. Definitions of ED visits were compared according to the 2 ED groups.

Statistical Analyses

Overall descriptive statistics were obtained. In order to compare the definition of an ED visit as used by the RSU with the definition used in the administrative data, we compared the average annual number of ED visits for each of 57 hospitals. The concordance correlation coefficient (CCC) served as a measure of agreement.⁶ The analyses were stratified by type of visit (with or without hospitalization) and type of ED (large versus medium or small). The T-test was used to compare the average daily number of ED visits by hospital as determined using different definitions of a visit. Scatterplots are shown in order to visualize the agreement. Statistical analyses and graph production were carried out using the SAS 9.2 and STATA 10.0 software applications.

RESULTS

Table 1 shows summary statistics for all the definitions of an ED visit for the 57 EDs and indicates the total number of ED visits, the percentage of visits with and without hospitalization, the age and sex of users, and the time of visit (weekday or weekend). Definition 1 overestimates the number of ED visits.⁸ The other definitions (2 to 4) underestimate this number. The percentage of visits that resulted in hospitalization is similar to that reported by the RSU when using definitions 2, 3, or 4. The characteristics of ED users are similar for all the definitions, as is the percentage of weekend visits.

Table 2 reports the agreement between the number of ED visits calculated from provincial administrative data and that reported by the RSU. Perfect disagreement is represented by a CCC of 0, perfect agreement by a CCC of 1. Comparisons with the best agreement are highlighted in yellow. The agreement for all the EDs surveyed (n=57) for the two types of ED visit (with and without hospitalization) is moderate to substantial.^{7,8} Agreement as to the number of visits without hospitalization to large EDs is better for a visit defined by a sequence of a maximum of 2 consecutive billing days. For small and medium EDs, agreement is best for a sequence limited to a maximum of one billing day. For visits with hospitalization, agreement is similar between all definitions of a visit, but global agreement is slightly better for small and medium EDs.

Table 3 reports the results of T-tests. Relative to the RSU record, the size and tendency of average daily differences in number of ED visits per day calculated from RAMQ/Med-Écho data are about 6 to 8 fewer for visits without hospitalization, using definitions of a visit as a sequence of 2 or more billing days. The definition limiting a visit to a single billing day overestimates by, on average, about 6 visits without hospitalization. In general, all the definitions applied to the RAMQ/Med-Écho data underestimate around 0.5 to 1.5 visits with hospitalization per day, on average. We note significant differences for ED size, both for visits with hospitalization no matter definition is used with RAMQ/Med-Écho data, and for visits with

⁸ In this section, it is understood that measures based on definitions applied to RAMQ data are compared to measures from the RSU data.

hospitalization when definition #1 is applied to these data. Finally, we note that we obtain similar results whether we compare the daily number of ED visits for each ED or the sum of these visits for the year.

Figures 1 and 2 show the agreement according to type of visit (with or without hospitalization).

In order to explore the hypothesis that differences in the most suitable ED visit definition, between large EDs and small or medium EDs, could be explained by longer stays and more severe cases in larger EDs, we explored these factors in the RSU (data not shown). The median visit duration is 5.2 hours in larger EDs, while it is 2.8 hours for smaller or medium EDs. The proportion of stretcher patients is also greater in larger EDs (44% compared to 29%).

DISCUSSION

The objectives of this study were to explore definitions of ED visits and visit type applied to the RAMQ/Med-Écho administrative data, and to compare these measures to the one from the RSU. The definition that gives the best global agreement between the RAMQ/Med-Écho and RSU databases is one in which a visit is limited to a sequence of 2 consecutive billing days. On the other hand, if small and medium-size EDs are considered separately, the best agreement is obtained with a definition of a visit limited to a single billing day. Smaller EDs, mainly located outside metropolitan areas, have more visits for minor problems with users returning to the ED for follow-up, and thus have shorter visits.^{5, 9, 10} The larger EDs in urban areas have more users, longer wait times, and patients with more serious illness (and thus longer actual visit durations).^{5, 9, 10}

The definitions applied to the RAMQ/Med-Écho data underestimate the number of hospitalizations reported by the RSU. The difference between the two databases regarding hospitalization is however small.

Despite limitations inherent in the nature of the data, the proposed ED visit measures applied to RAMQ/Med-Écho data can be used by Quebec investigators and decision-takers. In the future, it would be important that RSU data be linkable to other provincial databases (as is the case in other Canadian provinces), in order to produce valid measures of ED visits that would be compatible with other databases.

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**Table 1: Descriptive statistics of ED visits for RSU and RAMQ/Med-Écho database
(2004-05: adult patients)**

Variables	RSU data	RAMQ data			
		1-sequence is limited to 1 day	2-sequence is limited to 2 days	3-sequence is limited to 3 days	4- sequence is unlimited
Number of visits to emergency	1,716,256	1,817,894	1,554,540	1,524,016	1,515,498
Percentage of visits to emergency with hospitalisation*	15.1%	13.3%	15.5%	15.8%	15.8%
Patients characteristics***:					
Age:					
19-39	35.8%	30.1%	32.1%	32.5%	32.6%
40-64	39.1%	38.7%	39.4%	39.5%	39.6%
65-79	16.7%	18.7%	18.0%	17.8%	17.8%
80 +	8.4%	12.5%	10.5%	10.2%	10.0%
Percentage of women	51.2%	52.2%	52.0%	52.0%	52.0%
Percentage of visits during the weekend	26.0%	25.2%	25.1%	25.1%	25.1%

RSU: Registre de la salle d'urgence. RAMQ: Régie de l'assurance maladie du Québec.
Med-Écho: Maintenance et exploitation des données pour l'étude de la clientèle hospitalière.

* For RSU data: destination=1(hospitalisation) or 3(transfer)

** For RSU data: destination=2(holiday) ou 4(referred) ou 5(others)

*** at the time of their visit

Limitation : RAMQ/Med-Écho data: Patients aged of 19 + on april 1st 2004 / RSU data: Patients aged of 19+ at the time of their visit arrival

Table 2 Agreement between RSU and RAMQ/Med-Écho database by different groups of ED (2004-05: adult patients)

Type of visit RAMQ definition	Total (n=57)		Large ED (n=26)		Medium or small ED (n=31*)	
	CCC	95%C.I.	CCC	95%C.I.	CCC	95%C.I.
1) Emergency visit with hospitalisation						
1-sequence limited to 1 day	0.98	[0.97; 0.99]	0.95	[0.89; 0.98]	0.99	[0.98;0.99]
2-sequence limited to 2 days	0.98	[0.96; 0.99]	0.94	[0.89; 0.97]	0.99	[0.98;0.99]
3-sequence limited to 3 days	0.98	[0.96; 0.99]	0.94	[0.88; 0.97]	0.99	[0.98;0.99]
4-sequence is unlimited	0.98	[0.96; 0.99]	0.94	[0.88; 0.97]	0.99	[0.98;0.99]
2) Emergency visit without hospitalisation						
1-sequence limited to 1 day	0.93	[0.89; 0.95]	0.87	[0.78; 0.92]	0.95	[0.90; 0.97]
2-sequence limited to 2 days	0.95	[0.92; 0.97]	0.95	[0.89; 0.97]	0.84	[0.76; 0.90]
3-sequence limited to 3 days	0.93	[0.90; 0.95]	0.92	[0.86; 0.95]	0.82	[0.73; 0.88]
4-sequence is unlimited	0.92	[0.89; 0.94]	0.91	[0.85; 0.95]	0.82	[0.73; 0.88]

The comparisons are done at hospital level: 57 hospitals

CCC: coefficient de corrélation de concordance, ED: emergency department, RSU: Registre de la salle d'urgence, RAMQ: Régie de l'assurance maladie du Québec, Med-Écho: Maintenance et exploitation des données pour l'étude de la clientèle hospitalière.

* Includes 10 small EDs

The definitions associated with a better agreement are highlighted in yellow

Table 3: Mean daily of the difference between number of visits using RSU and RAMQ/Med-Écho database by different group of ED (2004-05: adult patients)

		1	2	
	Overall (n=57)	Large ED (n=26)	Medium or small ED (n=31*)	t-test
ED visit	Mean (sd)	Mean (sd)	Mean (sd)	p-value
<u>1) Visits with hospitalization</u>				
RSU:daily mean	12.5	18.0	7.8	
Difference between RSU and RAMQ/Med-Écho - 1 day sequence	0.8(1.1)	1.4(1.4)	0.4(0.5)	0.001
Difference between RSU and RAMQ/Med-Écho - 2 day sequence	0.9(1.2)	1.5(1.4)	0.4(0.6)	0.001
Difference between RSU and RAMQ/Med-Écho - 3 day sequence	0.9(1.2)	1.5(1.4)	0.4(0.6)	0.001
Difference between RSU and RAMQ/Med-Écho - unlimited sequence	0.9(1.2)	1.5(1.4)	0.4(0.6)	<0.001
<u>2) Visit without hospitalisation</u>				
RSU:daily mean	70.0	86.0	56.7	
Difference between RSU and RAMQ/Med-Écho - 1 day sequence	-5.7(9.5)	-13.1(8.4)	0.5(4.7)	<0.001
Difference between RSU and RAMQ/Med-Écho - 2 day sequence	6.9(4.5)	6.7(5.3)	7.0(3.7)	0.776
Difference between RSU and RAMQ/Med-Écho - 3 day sequence	8.3(4.5)	9.1(5.3)	7.7(3.7)	0.263
Difference between RSU and RAMQ/Med-Écho - unlimited sequence	8.7(4.6)	9.8(5.3)	7.8(3.7)	0.108

RSU: Registre de la salle d'urgence. RAMQ: Régie de l'assurance maladie du Québec. Med-Écho:

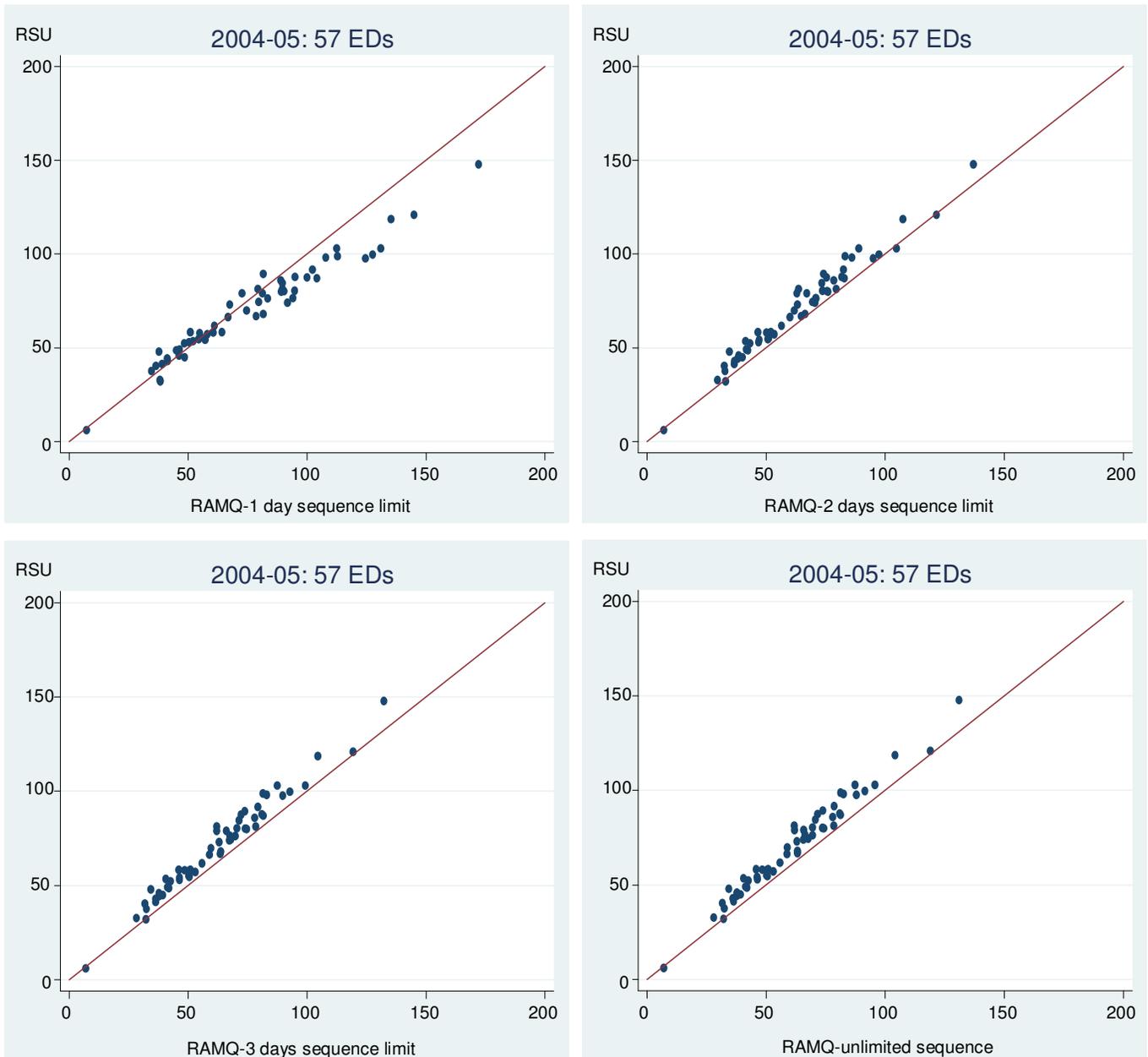
Maintenance et exploitation des données pour l'étude de la clientèle hospitalière.

Positive value = RAMQ/Med-Écho underestimates the number of ED visits compared to the RSU

sd:standard deviation, ED: emergency department

* Contains 10 small EDs

Figure 1: Scatterplots of the daily mean number of ED visits without hospitalization of RSU and RAMQ/Med-Écho database according to different definitions



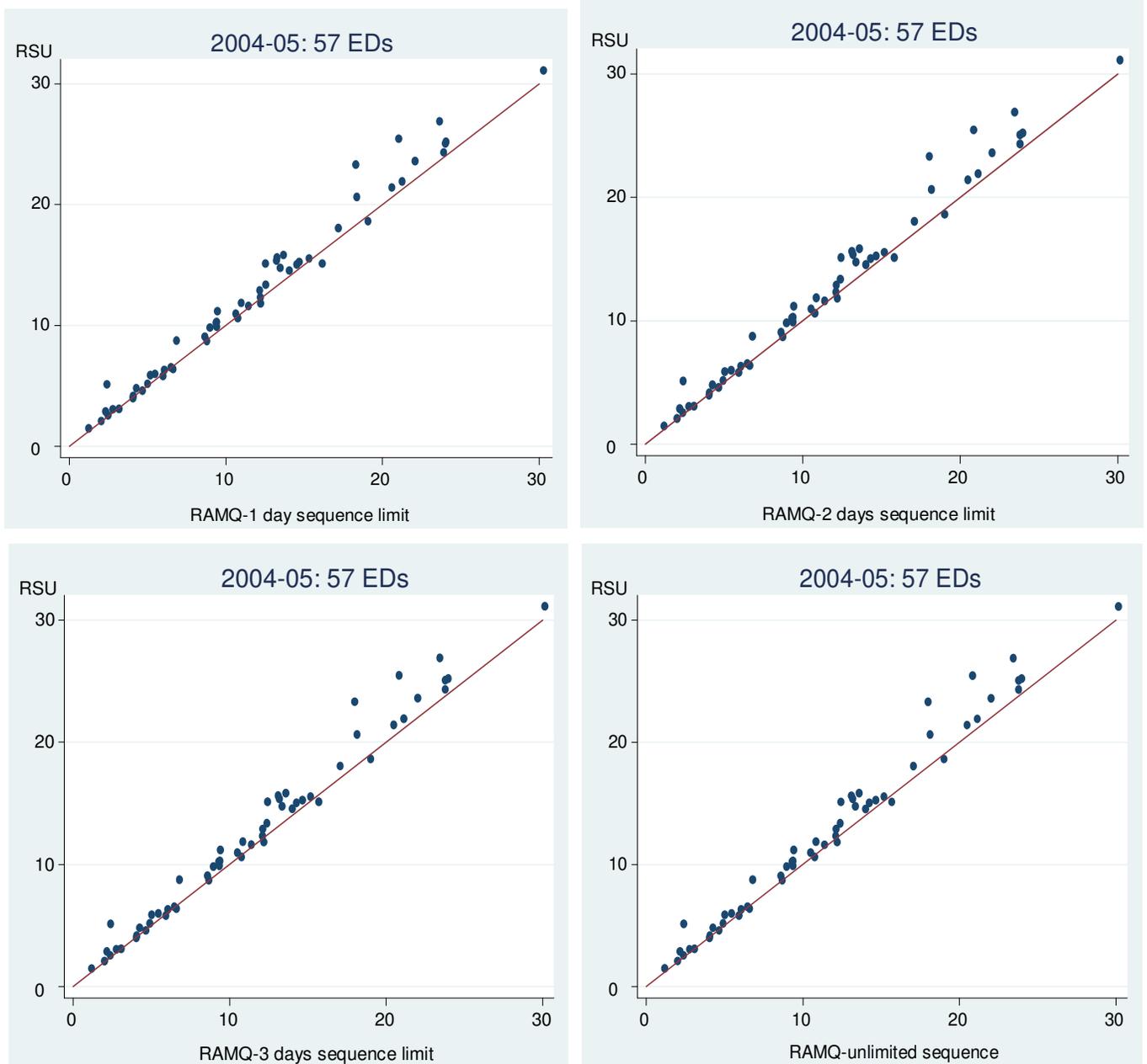
Red ligne=perfect agreement

RSU: Registre de la salle d'urgence. RAMQ: Régie de l'assurance maladie du Québec.

Med-Écho: Maintenance et exploitation des données pour l'étude de la clientèle hospitalière.

ED : Emergency department

Figure 2: Scatterplots of the daily mean number of ED visits with hospitalisation of RSU and RAMQ/Med-Écho database according to different definitions



Red ligne=perfect agreement

RSU: Registre de la salle d'urgence. RAMQ: Régie de l'assurance maladie du Québec.

Med-Écho: Maintenance et exploitation des données pour l'étude de la clientèle hospitalière.

ED : Emergency department

APPENDIX: COURSE OF A VISIT TO AN ED

To orient the reader, this section will describe what usually happens during an ED visit to understand how ED users are managed from an administrative point of view. A patient who arrives at an ED generally follows the following course:

- 1) Meets a triage nurse who, based on the patient's reasons for consulting the ED, assigns a triage code establishing the patient's priority for receiving treatment.
- 2) The patient then registers with the ED^{**}, using his or her RAMQ registration number.
- 3) The patient may be redirected from triage outside of the ED, either within or outside the establishment. If this happens, no medical service is billed to the RAMQ.
- 4) With the exception of those requiring immediate care, the patients wait for medical evaluation. Ambulatory patients sit in a waiting room, while stretcher patients wait on stretchers.
- 5) Some patients may leave before medical evaluation. If this happens, no service is billed to the RAMQ, though the RSU records will indicate a visit.
- 6) The patient will be evaluated by an ED physician who bills the RAMQ for services rendered.
- 7) Patients who continue their visit to the ED may be reevaluated by a number of ED doctors, each of whom will bill the RAMQ for their services.
- 8) Depending on the complexity of the case, several doctors in various specialties may be called in for consultation. In such cases, the patient will be evaluated by one or more specialist doctors, each of whom will bill the RAMQ for services rendered.
- 9) If it is deemed necessary, one of the doctors may request that the patient be admitted to hospital. In such a case, the patient waits for admission until a hospital bed is allocated, whereupon the patient ends his or her ED visit, and a period of hospitalization begins.
- 10) At any moment following the initial medical assessment, a patient may be released, admitted, or — if the care the patient needs is not available in the current establishment, or for some other reason — transferred to another establishment. The patient may also die in the ED or leave without medical authorization.

^{**} In 2004, some EDs registered the patient BEFORE priority assignment