Supplemental Digital Content for Geographic Disparities in Re-triage Destinations Among Seriously Injured Californians

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Supplementary Digital Content 8. Table 11. illustrates an annual summary on severely injured patients listed as transferred but not subsequently found in a second hospital.

| Data management | Step | Processing logic | Total records |
|---|------|--|----------------|
| Pre-processing | 1 | Records from period 2009-2018 were collected | ED: 41224883 |
| | | | IP: 7,439,260 |
| | 2 | Unique records produced using all fields available | ED: 24,592,353 |
| | | | IP: 4,036,917 |
| Relevant ED record collection or starting point of the re-triage | 3 | ED records for patient of age 18-89 years old having valid record linkage number available AND RISS>15 AND presented to a non-trauma or level III/IV trauma centers with injury diagnosis defined by the ICD-9: 800-904.9, 910-939.0, and 950-959.9 or ICD-10: S00-T19, T33-T34, T79 codes AND discharge dispositions not 'Expired', 'Left against medical advice or discontinued care', or 'Discharged/Transferred to an Inpatient Rehabilitation Facility (IRF) including Rehabilitation Distinct Part Unit of a Hospital with a Planned Acute Care Hospital Inpatient Readmission'. | 55,222 |
| Denominator or universe of all relevant re- triages | 4 | Records after ED discharges where linked (using record linkage number) to inpatient admission record except for Emergency or Elective type inpatient admissions. Admissions up to 1 day after discharge were considered. | 8,882 |
| Numerator or sub-optimal re- triages | 5 | Records with inpatient destination being level III/IV trauma and non-trauma centers. | 2,680 |

Supplemental Digital Content 1. Table 1. Data management is used to produce a universe of relevant re-triages and sub-optimal re-triages.

Supplemental Digital Content 2. Table 2. Annual counts of re-triages and under-triages in the California Department of Healthcare Access and Information (HCAI) ED and inpatient discharge datasets. Re-triages are identified according to the direction: from ED department of sending facility to the inpatient settings of receiving facility (ED-to-PDD) and between ED departments of different facilities (ED-to-ED).

| Triago direction | | Year | | | | | | | | | | | | |
|--------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Triage direction | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| Total re-triages*: | 226 | 487 | 518 | 653 | 698 | 640 | 896 | 838 | 1002 | 899 | 1003 | 1062 | 1307 | 1209 |
| ED-to-PDD | 218 | 464 | 486 | 618 | 669 | 609 | 856 | 804 | 959 | 830 | 935 | 954 | 1183 | 1083 |
| ED-to-ED | 8 | 23 | 32 | 35 | 29 | 31 | 40 | 34 | 43 | 69 | 68 | 108 | 124 | 126 |
| Total under- | 2474 | 2540 | 2924 | 2795 | 3025 | 2990 | 2853 | 3027 | 3243 | 3264 | 3509 | 5257 | 3373 | 3643 |
| triages** | | | | | | | | | | | | | | |
| Total triages | 2692 | 3004 | 3410 | 3413 | 3694 | 3599 | 3709 | 3831 | 4202 | 4094 | 4444 | 6211 | 4556 | 4726 |

*Re-triage was defined as a patient with a RISS>15 who first visited a non-trauma or Level I/II trauma center, but was subsequently taken to another center.

**Under-triage was defined as any patient with an ISS>15 who was never taken to a Level I/II trauma center.

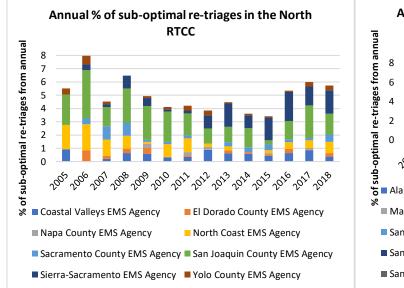
The under-triaged patients are patients that were never re-triaged from the original non-trauma or level III/IV trauma center.

| | Re-triages | Sub-optimal | Optimal |
|----------------------------------|-------------------|---------------------------|---------------------------|
| Sending center location by LEMSA | N=8,882 (%) | re-triages N=2,680 (%) | re-triages N=6,202 (%) |
| | North Reg | ion | |
| Coastal Valleys | 385 (4.3) | 51 (1.9) | 334 (5.4) |
| El Dorado County | 40 (0.5) | 15 (0.6) | 25 (0.4) |
| Japa County | 63 (0.7) | 8 (0.3) | 55 (0.9) |
| forCal | 30 (0.3) | 0 (0) | 30 (0.5) |
| orth Coast | 292 (3.3) | 44 (1.6) | 248 (4) |
| acramento County | 113 (1.3) | 24 (0.9) | 89 (1.4) |
| an Joaquin County | 352 (4) | 139 (5.2) | 213 (3.4) |
| ierra-Sacramento | 570 (6.4) | 113 (4.2) | 457 (7.4) |
| Tolo County | 37 (0.4) | 20 (0.7) | 17 (0.3) |
| | Bay Area Re | egion | |
| lameda County | 471 (5.3) | 201 (7.5) | 270 (4.4) |
| ontra Costa County | 475 (5.3) | 89 (3.3) | 386 (6.2) |
| Iarin County | 59 (0.7) | 55 (2.1) | 4 (0.1) |
| lonterey County | 47 (0.5) | 15 (0.6) | 32 (0.5) |
| an Benito County | 36 (0.4) | 6 (0.2) | 30 (0.5) |
| inta Clara County | 127 (1.4) | 63 (2.4) | 64 (1) |
| anta Cruz County | 33 (0.4) | 9 (0.3) | 24 (0.4) |
| an Francisco County | 108 (1.2) | 65 (2.4) | 43 (0.7) |
| an Mateo County | 51 (0.6) | 44 (1.6) | 7 (0.1) |
| olano County | 192 (2.2) | 53 (2) | 139 (2.2) |
| | Central Reg | gion | |
| entral California | 1006 (11.3) | 31 (1.2) | 975 (15.7) |
| ern County | 199 (2.2) | 113 (4.2) | 86 (1.4) |
| lerced County | 175 (2) | 2 (0.1) | 173 (2.8) |
| ountain Valley | 273 (3.1) | 36 (1.3) | 237 (3.8) |
| uolumne County | 161 (1.8) | 6 (0.2) | 155 (2.5) |
| | South-East R | Region | |
| land Counties | 525 (5.9) | 108 (4) | 417 (6.7) |
| nperial County | 293 (3.3) | 8 (0.3) | 285 (4.6) |
| | 2 98 (8.8) | 0 (0.2) | 200 (110 |

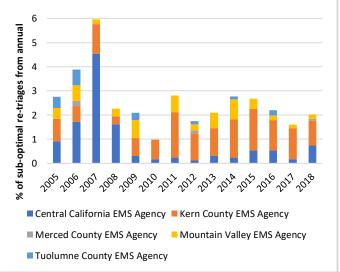
Supplemental Digital Content 3. Table 3. Re-triages by Sending Center LEMSA of Seriously Injured Patients in California from 2009-2018.

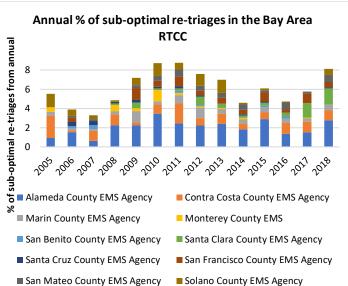
| Riverside County | 549 (6.2) | 220 (8.2) | 329 (5.3) |
|------------------------|--------------|------------|-----------|
| San Diego County | 669 (7.5) | 75 (2.8) | 594 (9.6) |
| | South-West R | Region | |
| Los Angeles County | 903 (10.2) | 760 (28.4) | 143 (2.3) |
| Orange County | 326 (3.7) | 107 (4) | 219 (3.5) |
| San Luis Obispo County | 165 (1.9) | 145 (5.4) | 20 (0.3) |
| Santa Barbara County | 68 (0.8) | 2 (0.1) | 66 (1.1) |
| Ventura County | 89 (1) | 53 (2) | 36 (0.6) |

Supplemental Digital Content 4. Figure 1. Annual sub-optimal re-triages of Seriously Injured Patient in California from 2009-2019 in each local emergency medical services agencies (LEMSA)segregated by regional trauma coordination center (RTCC)

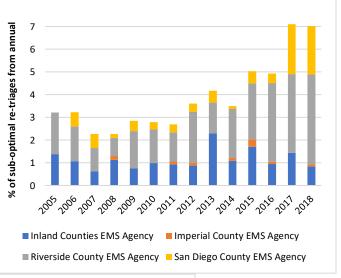


Annual % of sub-optimal re-triages in the Central RTCC

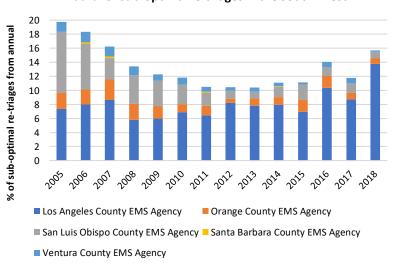




Annual % of sub-optimal re-triages in the South-East



Annual % of sub-optimal re-triages in the South-West



| RTCC | The total population during 2009-2018, Average ± SD | The annual average number of Level I/II trauma centers | The annual average number of Level III/IV & non- trauma | Level I/II trauma centers per 1,000,000 residents | Level I/II trauma centers per 100 Level III/IV & non-trauma |
|------------|---|--|--|---|---|
| North | $4,\!787,\!666 \pm 110,\!911$ | 6.0 | 85.5 | 1.25 | 7.0 |
| Bay Area | $7,558,614 \pm 247,741$ | 6.4 | 85.3 | 0.85 | 7.5 |
| Central | $3{,}541{,}876 \pm 93{,}750$ | 4.0 | 50.6 | 1.13 | 7.9 |
| South-East | $7,\!793,\!012 \pm 241,\!303$ | 8.8 | 71.8 | 1.13 | 12.3 |
| South-West | $14,\!708,\!537 \pm 290,\!637$ | 12.1 | 162.6 | 0.82 | 7.4 |

Supplemental Digital Content 5. Table 4. Capacity and demand of trauma care by RTCC.

Supplemental Digital Content 6. Table 5. The length of stay and discharge disposition in receiving center from sub-optimal versus optimal re-triaged seriously injured patients in California 2009-2018.

| Do triogo | Total N | Length of stay, days | | | | |
|------------------|---------|------------------------------|------------------------------|--|--|--|
| Re-triage | Total N | Average ± Standard Deviation | Median (Interquartile Range) | | | |
| Sub-optimal | 2677 | 11.2 ± 15.3 | 4 (1-13.5) | | | |
| Optimal | 6205 | 16.2 ± 26.9 | 4 (1-15.5) | | | |

Supplemental Digital Content 6. Table 6. Unadjusted rates of discharge disposition from sub-optimal versus optimal re-triaged seriously injured patients in California 2009-2018.

| | Discharge disposition n(%) | | | | | | | |
|-------------|-----------------------------------|-------------|-----------|-----------------------------------|-----------------|--|--|--|
| Re-triage | Total N | Home | Died | Short-term Acute Care Hospital | Post-acute care | | | |
| Sub-optimal | 2680 (100) | 1650 (61.6) | 164 (6.1) | 141 (5.3) | 725 (27.1) | | | |
| Optimal | 6202 (100) | 3794 (61.2) | 410 (6.6) | 217 (3.5) | 1781 (28.7) | | | |

Supplemental Digital Content 6. Table 7. Odds ratio estimated (using logistic regression) for expected discharge disposition outcome after suboptimally re-triaged versus optimally re-triaged patients

| Discharge Disposition of Re-triaged | Odds Ratio | Std Err | p-value | [95% Conf. Interval] |
|-------------------------------------|-------------------|---------|---------|----------------------|
| Home* | 1.02 | 0.05 | 0.727 | [0.93 - 1.12] |
| Died* | 0.92 | 0.09 | 0.387 | [0.76 - 1.11] |
| Short-term Acute Care Hospital* | 1.53 | 0.17 | <0.0001 | [1.23 - 1.90] |
| Post-acute care* | 0.92 | 0.05 | 0.110 | [0.83- 1.02] |

*See Supplemental Digital Content 6 Table 8 for the definition of the category.

Supplemental Digital Content 6. Table 8. Value sets used to group discharge disposition (disp) variable into categories.

| Value sets for the period 2009-2014 | Value sets for the period 2015-2018 | | | |
|-------------------------------------|--|--|--|--|
| | Home | | | |
| 12 = Home Health Service | 01 = Discharged to home or self-care (routine discharge) | | | |
| 01 = Routine (home) | 06 = Discharged/transferred to home under the care of an organized home health service organization in anticipation of covered skilled care | | | |
| 08 = Residential Care Facility | 50 = Hospice - Home | | | |
| | 51 = Hospice - Medical facility (certified) providing hospice level of care | | | |
| | 81 = Discharged to home or self-care with a planned acute care hospital inpatient readmission 65 = Discharged/transferred to a psychiatric hospital or psychiatric distinct part unit of a hospital | | | |

| 10 = Left Against Medical Advice | 07 = Left against medical advice or discontinued care |
|---|--|
| 09 = Prison/Jail | 21 = Discharged/transferred to court/law enforcement |
| | 43 = Discharged/transferred to a federal healthcare facility |
| | Died |
| 11 = Died | 20 = Expired |
| | Short-term Acue Hospital |
| 02 = Acute Care within the admitting hospital | 02 = Discharged/transferred to a short-term general hospital for inpatient care |
| 05 = Acute Care at another hospital | 82 = Discharged/transferred to a short-term general hospital for inpatient care with a planned acute care hospital inpatient readmission |
| | Post-acute care |
| 06 = Other Care (not SN/IC) at another | 90 = Discharged/transferred to an inpatient rehabilitation facility (IRF) including rehabilitation |
| hospital | distinct part unit of a hospital with a planned acute care hospital inpatient readmission |
| 03 = Other Care within the admitting hospital | 70 = Discharged/transferred to another type of health care institution not defined elsewhere in this code list |
| | 04 = Discharged/transferred to a facility that provides custodial or supportive care (includes Intermediate Care Facility) |
| | 05 = Discharged/transferred to a designated cancer center or children's hospital |
| | 62 = Discharged/transferred to an inpatient rehabilitation facility (IRF) including a rehabilitation distinct part unit of a hospital |
| | 63 = Discharged/transferred to a Medicare-certified long-term care hospital (LTCH) |
| | 66 = Discharged/transferred to a Critical Access Hospital (CAH) |
| | 61 = Discharged/transferred to a hospital-based Medicare-approved swing bed |
| 07 = Skilled Nursing / Intermediate Care (SN/IC) at another facility | 83 = Discharged/transferred to a skilled nursing facility (SNF) with Medicare certification with a planned acute care hospital inpatient readmission |
| 04 = Skilled Nursing / Intermediate Care (SN/IC) within the admitting hospital | 03 = Discharged/transferred to a skilled nursing facility (SNF) with Medicare certification in anticipation of skilled care |
| | 64 = Discharged/transferred to a nursing facility certified under Medicaid (Medi-Cal), but not certified under Medicare |

Supplementary Digital Content 7. Table 9. Re-admission after discharge from sub-optimal versus optimal re-triage destination among seriously injured patients in California 2009-2018.

| | | Re-admission, n (%) | | | |
|-----------------------|---------|---------------------|------------|-------------|--|
| Survivor Re-admission | total N | <=10 days | <=30 days | <=60 days | |
| Sub-optimal | 2584 | 168 (6.5) | 273 (10.6) | 326 (12.6) | |
| Optimal | 5933 | 305 (5.1) | 516 (8.7) | 615 (10.4) | |

Supplementary Digital Content 7. Table 10. Odds ratio estimated (using logistic regression) for re-admission after discharge from sub-optimal versus optimal re-triage destination among seriously injured patients in California 2009-2018.

| Re-admission | Odds Ratio | Std Err | p-value | [95% Conf. Interval] |
|------------------------|-------------------|---------|---------|----------------------|
| ≤10 days | 1.28 | 0.13 | 0.012 | [1.06 - 1.56] |
| $\leq 30 \text{ days}$ | 1.24 | 0.10 | 0.006 | [1.06 - 1.45] |
| ≤60 days | 1.25 | 0.09 | 0.002 | [1.08 - 1.44] |

Supplementary Digital Content 8. Table 11. Annual summary on severely injured patients listed as transferred but not subsequently found in a second hospital.

| Year | Patients listed as transferred but not subsequently found in a second hospital |
|------|---|
| 2009 | 202 |
| 2010 | 205 |
| 2011 | 233 |
| 2012 | 236 |
| 2013 | 236 |
| 2014 | 249 |
| 2015 | 216 |
| 2016 | 153 |
| 2017 | 390 |
| 2018 | 387 |