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Exploring Vulnerability to Patient Safety Events along the Age Continuum

Authors

Cynthia Field, BSN, RN, NE-BC, CPHQ

Senior Patient Safety Analyst, Pennsylvania Patient Safety Authority

Edward Finley, BS

Data Analyst, Pennsylvania Patient Safety Authority

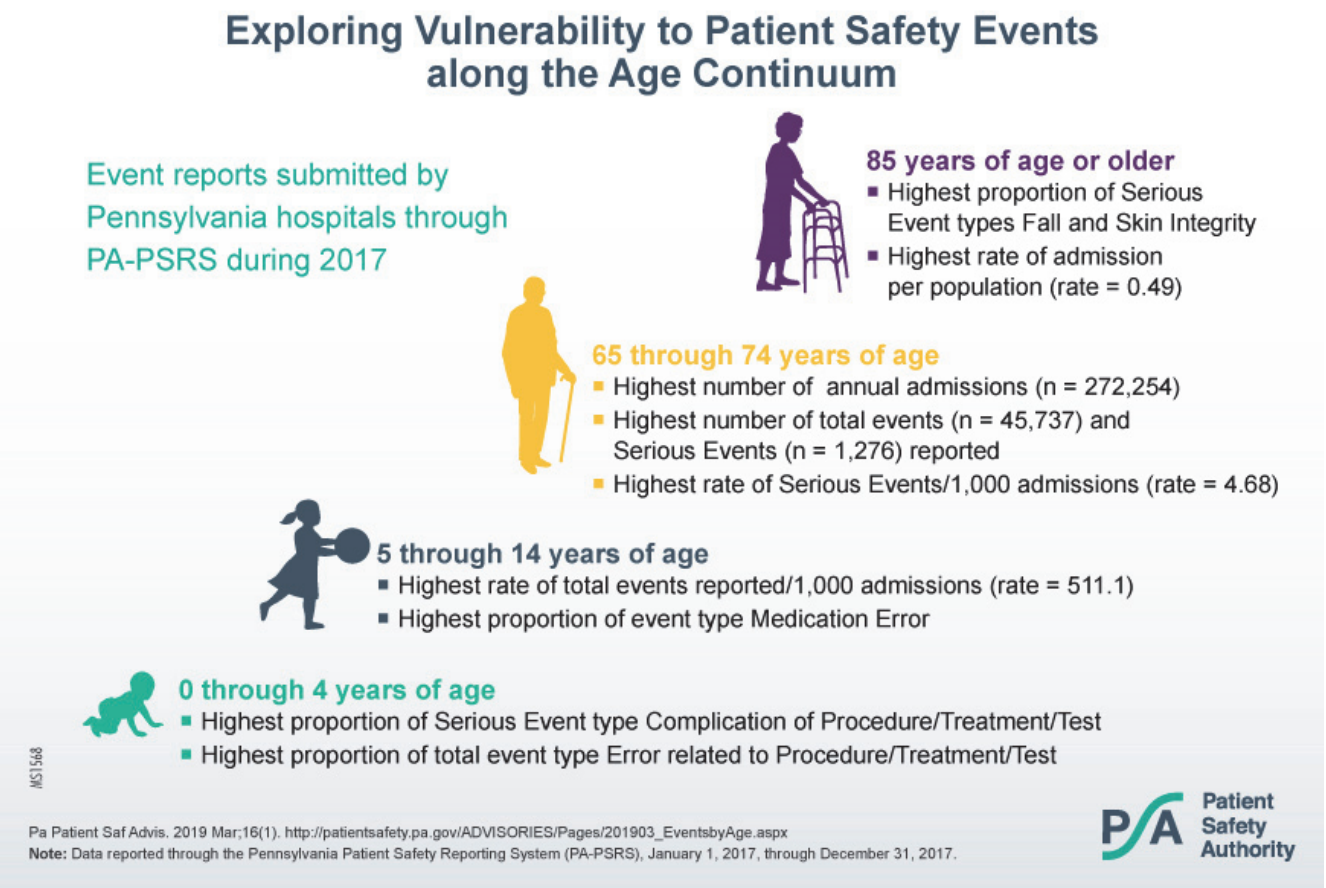
Ellen S. Deutsch, MD, MS, FACS, FAAP, CPPS

Medical Director, Pennsylvania Patient Safety Authority

Corresponding Author

Cynthia Field

Abstract



To identify age-related patterns of events that could have or did result in unanticipated patient harm, the Pennsylvania Patient Safety Authority developed a data snapshot from more than 260,000 event reports submitted by Pennsylvania hospitals through the Pennsylvania Patient Safety Reporting System during 2017. For almost all age cohorts, the most common event type was Error related to Procedure/Treatment/Test while among Serious Event reports (i.e., event resulting in harm), the most common event type was Complication of Procedure/Treatment/Test. Differences in event report patterns for children, adolescents, and young adults compared with events involving adults and elderly patients were noted. For adults 75 years or older, the number of event reports decreased, while the rate of involvement in a patient safety event report relative to estimated population increased as patient age increased. For adults 25 years or older, the number of reports involving two event types—Fall and Skin Integrity—increased with advancing age. Although the increased rate of total event reports at the extremes of age relative to estimated population was unsurprising, the decreased rate of Serious Events in the very elderly, and the increased rate of total and Serious Events in the age cohort of 5 to 14 years relative to number of admissions were unanticipated. Attention to the event types and patterns of vulnerability that predominate in specific age cohorts may help facilities prioritize interventions.

Introduction

The rate of admissions by estimated population increases at the extremes of age, but the relationship of age to patient safety events bears exploration. For example, only a few reports may involve patients 85 years or older, but a greater proportion of these elderly patients may be involved in patient safety events.

To develop a data snapshot of the rates and types of hazards encountered by patients throughout the age continuum, analysts reviewed and categorized events submitted by Pennsylvania hospitals through the Pennsylvania Patient Safety Reporting System (PA-PSRS), and calculated event rates using statewide estimated population and admission data as denominators.

Methods

Analysts queried the PA-PSRS database for all events and event types from Pennsylvania hospitals that resulted or could have resulted in unanticipated harm submitted from January 1, 2017, through December 31, 2017. The Medical Care Availability and Reduction of Error (MCARE) Act of 2002 mandates that hospitals and certain other facilities report incidents and serious events, ranging from unsafe conditions to death, through PA-PSRS,[1] which may be the most comprehensive state-based collection of patient safety events in the United States.[2]

The query identified 263,320 events of which 63 (0.02%) events were excluded for lack of an identified age. The remaining 263,257 events were categorized by event type and age cohort, using increments of 10 years (e.g., 5 to 14 years,15 to 24 years) with the exception of age cohorts of 0 to 4 years and 85 years or older. The age cohorts were selected to correspond to the age ranges provided in state population and Pennsylvania Health Care Cost Containment Council (PHC4)* admission data. State population data for 2017 were estimated by extrapolation from 2010 through 2016 data using estimates provided through the U.S. Census Bureau.[3] Admissions (equivalent to discharges from Pennsylvania hospitals) data for 2017 were obtained from PHC4.

Event types in PA-PSRS are as follows[4]:

- Medication error

- Adverse drug reaction
- Equipment/supplies/devices
- Fall
- Error related to procedure/treatment/test
- Complication of procedure/treatment/test
- Transfusion
- Skin integrity
- Patient self-harm
- Other/miscellaneous

The rates of admissions to estimated population were calculated by dividing the number of admissions by the estimated population for each age cohort. These rates were compared with 2010 data reported by the Centers for Disease Control and Prevention (CDC).[5]

Event report rates were calculated by dividing the number of event reports by Pennsylvania estimated population (i.e., number of events per 100,000 persons) and by the number of admissions (i.e., number of events per 1,000 admissions), respectively, for each age cohort. Rates were computed for both the total number of reports (Incidents and Serious Events combined) and the number of reports of Serious Events as defined in the MCARE Act.[1]

Events by type were also analyzed in proportion to the total number of reports for both total events and Serious Events (i.e., the percentage of the total number of reports for each event type category per age cohort).

Relative risk (RR) was calculated by dividing each cohort's Serious Event rate by an index cohort's Serious Event rate, defined as the largest cohort by estimated population or number of admissions. The reference group for the RR calculation by estimated population was the 55- to 64-year cohort while the reference group for the RR calculation by number of admissions was the 65- to 74-year cohort.

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* The Pennsylvania Health Care Cost Containment Council (PHC4) is an independent state agency responsible for addressing the problem of escalating health costs, ensuring the quality of health care, and increasing access to health care for all citizens regardless of ability to pay. PHC4 has provided data to this entity in an effort to further PHC4's mission of educating the public and containing health care costs in Pennsylvania.

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This analysis was not prepared by PHC4. This analysis was done by the Pennsylvania Patient Safety Authority. PHC4, its agents and staff, bear no responsibility or liability for the results of the analysis, which are solely the opinion of this entity.

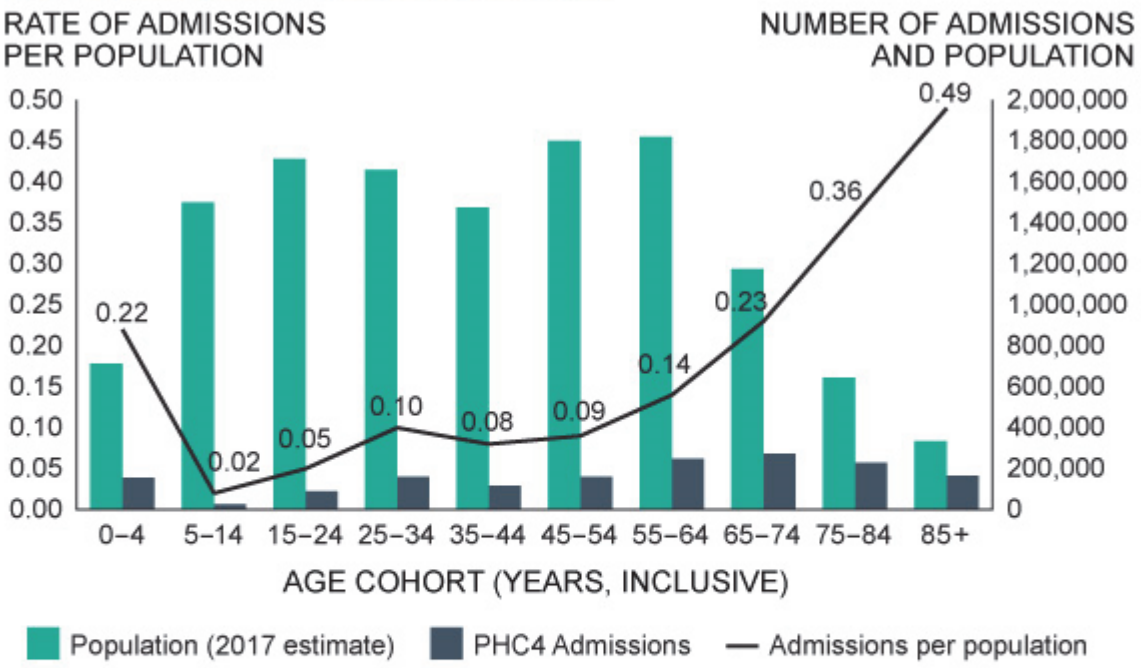
Results

Admission to Estimated Population Rate

Figure 1 compares the number of admissions (actual) and population (estimated) in Pennsylvania for 2017 and shows the rate of admissions to estimated population by age cohort. Although the 55- to 64-year cohort was estimated to be the most populous (n = 1,819,252; 14.2% of the total estimated state population), the 65- to 74-year cohort had the largest number of admissions (n = 272,254) in 2017.

The rate of admissions by estimated population was 0.22 admissions per estimated population (22 admissions for every 100 persons) for the 0- to 4-year cohort; the rate dropped 10-fold (rate = 0.02) for the 5- to 14-year cohort. However, the rate of admissions per person after the 5- to 14-year cohort climbed steadily through subsequent cohorts, with the cohort age 85 years or older having the highest rate, at 0.49 per person (49 admissions for every 100 persons). These rates correspond to 2010 data reported by CDC.[5]

Figure 1. Admissions and Population in Pennsylvania



Sources: Community facts. In: American FactFinder [internet]. Washington (DC): U.S. Census Bureau [accessed 2018 Sep 27]. [1 p]. Available: https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml; Inpatient utilization report by county. [internet]. Harrisburg (PA): Pennsylvania Health Care Cost Containment Council, Commonwealth of Pennsylvania; [accessed 2018 Sep 27]. [2 p]. Available: http://www.phc4.org/reports/utilization/inpatient/.

Note: Pennsylvania population data for 2017 were estimated by extrapolation from 2010 through 2016 data and estimates provided through the U.S. Census Bureau. Admissions (equivalent to discharges from Pennsylvania hospitals) data for 2017 were obtained from Pennsylvania Health Care Cost Containment Council (PHC4).

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Event Rates by Age Cohort

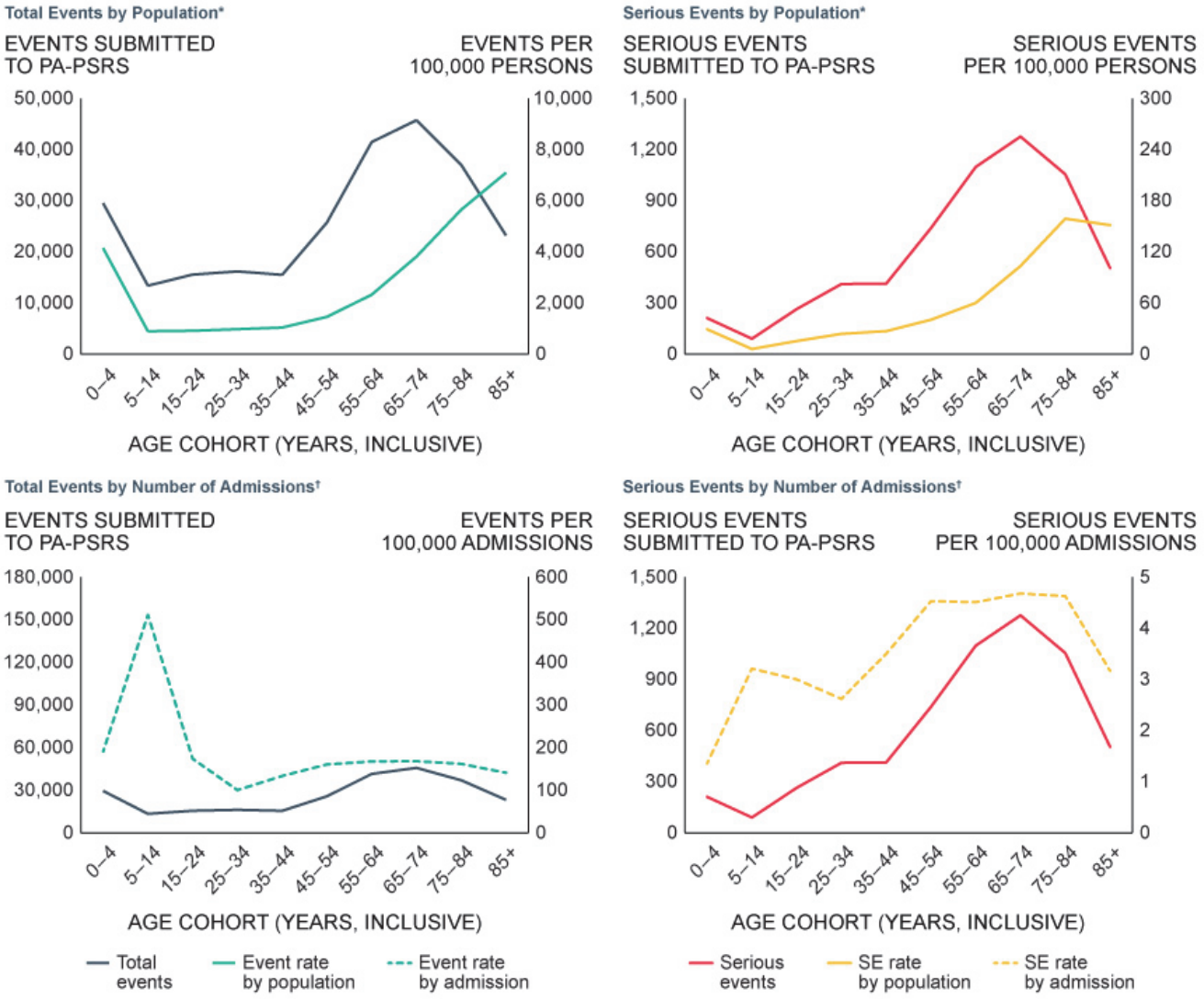
Figure 2 shows the number and rate of total events and Serious Events by estimated population and number of admissions per age cohort. Analysis of the 263,257 event reports submitted during 2017 identified that the 65- to 74-year cohort had the largest number of total events (n = 45,737) as well as the largest number of Serious Events (n = 1,276).

Analysis of events by estimated population shows patients 0 to 4 years of age had a higher rate of overall events than other cohorts, up to the 65- to 74-year cohort; the lowest rate was for the 5- to 14-year cohort (892.25 events per 100,000 persons), then rose with each subsequent cohort, peaking at the rate of 7,093.66 events per 100,000 persons for the 85 years or older group.

The Serious Event rate by estimated population was lowest in the 5- to 14-year cohort (5.94 Serious Events per 100,000 persons) and generally increased with advancing age, with the highest rate in the 75- to 84-year cohort (158.87 Serious Events per 100,000 persons).

The highest total event rate per admission was found in the 5- to 14-year cohort (511.12 events per 1,000 admissions) with much lower rates in other cohorts. However, Serious Event rates per admission were highest in the 45- to 54-year cohort through the 75- to 84-year cohort, with more than 4 Serious Events per 1,000 admissions for all four cohorts.

Figure 2. Number and Rate of Events by Population and Number of Admissions, by Age Cohort



Sources: Community facts. In: American FactFinder [internet]. Washington (DC): U.S. Census Bureau [accessed 2018 Sep 27]. [1 p]. Available: https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml; Inpatient utilization report by county. [internet]. Harrisburg (PA): Pennsylvania Health Care Cost Containment Council, Commonwealth of Pennsylvania; [accessed 2018 Sep 27]. [2 p]. Available: http://www.phc4.org/reports/utilization/inpatient/.

Note: Data reported through the Pennsylvania Patient Safety Reporting System, January 1, 2017, through Decempber 31, 2017. Pennsylvania population data for 2017 were estimated by extrapolation from 2010 through 2016 data and estimates provided through the U.S. Census Bureau. Admissions (equivalent to discharges from Pennsylvania hospitals) data for 2017 were obtained from Pennsylvania Health Care Cost Containment Council (PHC4).

PA-PSRS, Pennsylvania Patient Safety Reporting System; SE, Serious Event.

* Proportion of y-axes is 5 to 1.

† Proportion of y-axes is 300 to 1.

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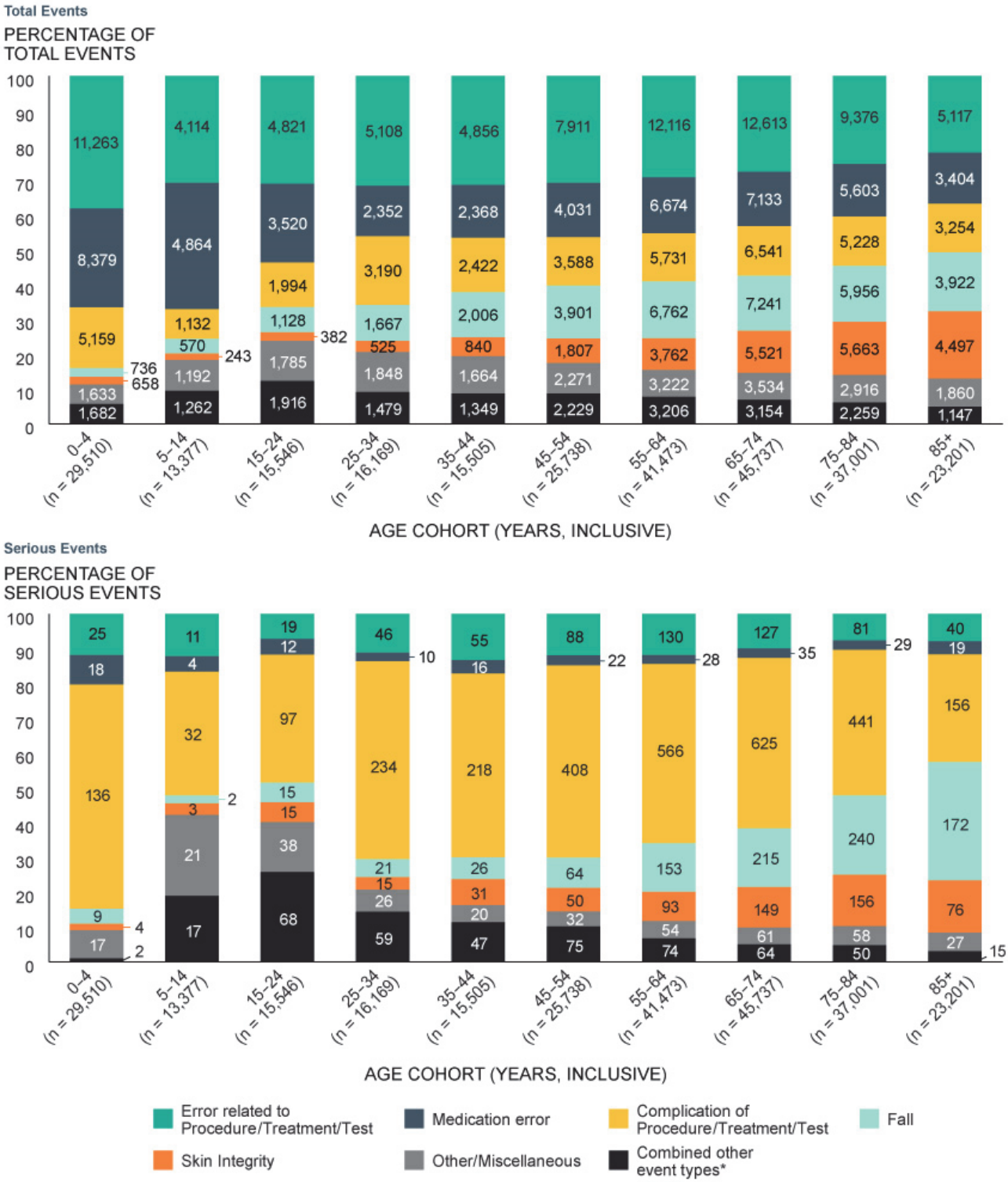
Event Types by Age Cohort

Figure 3 shows the number and proportion of events to the total number of reports, for both total events and Serious Events, by event type and age cohort.

Among all cohorts, with the exception of the 5- to 14-year group, the event type Error related to Procedure/Treatment/Test was the most common event type. The proportion of event reports related to Medication Errors was largest in children, adolescents, and young adults, yet the number of medication error events varied along the age cohort continuum.

In comparison, the event type Complication related to Procedure/Treatment/Test predominated in Serious Event reports for all age cohorts except for the cohort 85 years or older. The number and proportion of Serious Event reports involving Fall and Skin Integrity increased with advancing age.

Figure 3. Number and Proportion of Events by Event Type and Age Cohort



Note: Data reported through the Pennsylvania Patient Safety Reporting System, January 1, 2017, through December 31, 2017.

* Comprises event types Adverse Drug Reaction (not a medication error), Equipment/Supplies/Devices, Patient Self-Harm, and Transfusion.

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Relative Risk

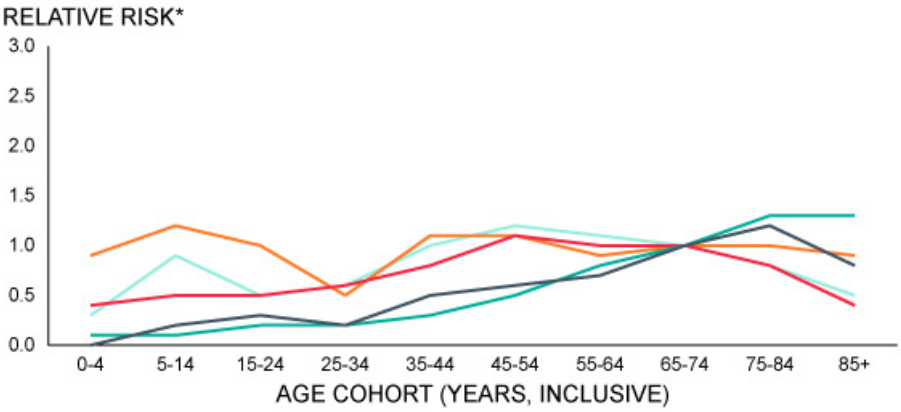
Figure 4 shows relative risk (RR) of Serious Event by the top five event types and age cohort, relative to the cohort with the highest estimated state population (i.e., 55 to 64) and relative to the cohort with the highest number of admissions in Pennsylvania (i.e., 65 to 74).

Relative risk (RR) of a Serious Event in all event types by estimated population was lower in all age groups younger than the index group, with the exception of medication errors for the 0- to 4-year cohort, which had a 61% increased risk (RR = 1.61). Age cohorts 65 to 74 years or older had higher RRs than the index cohort for all event types. The RR of Serious Fall Events increased by more than 100% for cohorts older than the 55- to 64-year cohort, with the cohort 85 years or older having an RR six times the estimated population index cohort.

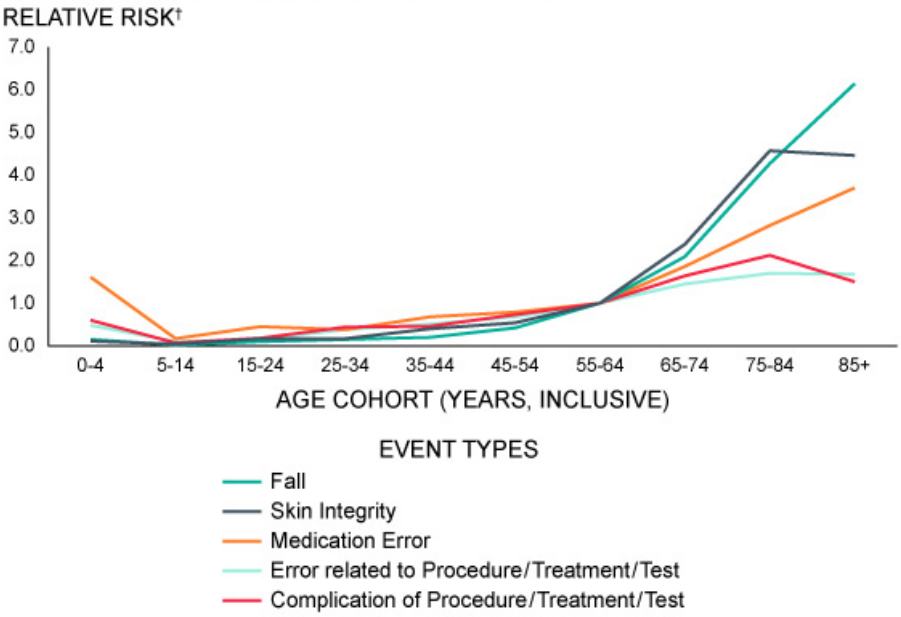
Overall RR for a Serious Event had limited variability when adjusted for admissions.

Figure 4. Relative Risk of Serious Event by Top Five Event Types and Age Cohort

Relative to Number of Admissions and Index Age Cohort (65 to 74)



Relative to Population and Index Age Cohort (55 to 64 years)



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Note: Data reported through the Pennsylvania Patient Safety Reporting System, January 1, 2017, through December 31, 2017. Pennsylvania population data for 2017 was estimated by extrapolation from 2010 through 2016 data and estimates provided through the U.S. Census Bureau. Admissions (equivalent to discharges from Pennsylvania hospitals) data for 2017 were obtained from Pennsylvania Health Care Cost Containment Council (PHC4).

* Admissions RR = SE per 100 admissions for age cohort / SE per 100 admissions for age cohort with most admissions (65 through 74 years).

† Population RR = SE per 100,000 population for age cohort / SE per 100,000 population for age cohort with largest population (55 through 64 years).

RR, Relative risk; SE, Serious Event.

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Discussion

Two patterns emerged from this data snapshot. In adults, the rate of total events and Serious Events relative to estimated population generally increased with increasing age; however, the rate of Serious Events relative to the number of admissions peaked in the 45- to 84-year cohorts and then declined sharply for the cohort of very elderly patients (older than 85 years). It may be assumed that very elderly patients are more frail, but the relationship between frailty and unanticipated harm is unknown.[6-8]

Conversely, at the other end of the age spectrum, both the total number of event reports and the rate of reports by estimated population were increased for patients younger than 5 years of age. The relatively large proportion of medication events in pediatric patients may be related to the need for patient-specific, weight-based calculations.[9] The patterns of Serious Event type proportions for the 5- to 24-year cohorts were inconsistent with other age cohorts.

The increase in the rate of total events and Serious Event reports per admission in the 5- to 14-year cohort was unanticipated and offers an opportunity for further analysis. Identifying the types and patterns of event reports by age may help providers prioritize which interventions may be of the most value for individual patients.

Limitations

Despite the mandatory reporting requirement in Pennsylvania,[1] the type, quantity, and quality of reports depends on the reporter as well as the design and implementation of the reporting system. The reporting cultures and patterns in each hospital and their interpretations of what occurrences are reportable can lead to reporting variations.

This analysis did not include hospitals' reports of healthcare-associated infections in Pennsylvania, which are submitted through CDC's National Healthcare Safety Network[10] and may disproportionately impact patients at different ages.

Although some Pennsylvanians may seek hospital care outside of Pennsylvania, and some individuals who are not residents of Pennsylvania may seek care inside Pennsylvania, use of a statewide database allowed analysis of event reports aggregated from 237 hospitals,[11] which helps provide information relative to the entire population of the Commonwealth.

Conclusion

This data snapshot, based on more than 260,000 event reports submitted through PA-PSRS during 2017, identified age-related patterns of events that could have or did result in unanticipated patient harm. Although the increased rate of total event reports at the extremes of age relative to estimated population was unsurprising, the decreased rate of Serious Events in the very elderly, and the increased rate of total and Serious Events in the 5- to 14-year cohort relative to number of admissions were unanticipated. Attention to the event types and patterns of vulnerability that predominate in specific age cohorts may help facilities prioritize interventions.

Notes

1. Medical Care Availability and Reduction of Error (MCARE) Act of March 20, 2002, P.L. 154, No. 13, Cl. 40. Available: http://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2002&sessInd=0&act=13 (http://www.legis.state.pa.us/cfdocs/legis/li/uconsCheck.cfm?yr=2002&sessInd=0&act=13).
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