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ORIGINAL RESEARCH

Utilization of Medical Codes for Hypotension in Shock Patients: A Retrospective Analysis

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Purpose: To evaluate the utilization of hypotension diagnosis codes by shock type and year in known hypotensive patients.

Patients and Methods: Retrospective analysis of the Medicare fee-for-service claims database. Patients with a shock diagnosis code between 2011 and 2017 were identified using the International Classification of Diseases, Ninth and Tenth Revision, Clinical Modification (ICD-9-CM and ICD-10-CM). Based on specific ICD codes corresponding to each shock type, patients were classified into four mutually exclusive cohorts: cardiogenic shock, hypovolemic shock, septic shock, and other/unspecified shock. Annual proportion and counts of cases with at least one hypotension ICD code for each shock cohort were generated to produce 7-year medical code utilization trends. A Cochran-Armitage test for trend was performed to evaluate the statistical significance.

Results: A total of 2,200,275 shock patients were analyzed, 13.3% (n=292,192) of which received a hypotension code. Hypovolemic shock cases were the most likely to receive a hypotension code (18.02%, n=46,544), while septic shock cases had the lowest rate (11.48%, n=158,348). The proportion of patients with hypotension codes for other cohorts were 18.0% (n=46,544) for hypovolemic shock and 16.9% (n=32,024) for other/unspecified shock. The presence of hypotension codes decreased by 0.9% between 2011 and 2014, but significantly increased from 10.6% in 2014 to 17.9% in 2017 ($p < 0.0001$, $Z = -105.05$).

Conclusion: Hypotension codes are remarkably underutilized in known hypotensive patients. Patients, providers, and researchers are likely to benefit from improved hypotension coding practices.

Keywords: blood pressure, clinical coding, data accuracy, International Classification of Diseases

Introduction

Hypotension can be described as decreased blood pressure below accepted values. In the absence of a universal definition, clinical guidelines describe hypotension as systolic blood pressure below 90-mmHg or mean arterial pressure (MAP) below 65-mmHg.[1] Hypotension is the main component of shock, a life-threatening condition of circulatory failure characterized by decreased oxygen delivery and/or increased oxygen consumption. Shock manifests with hypotension and may lead to tissue and cellular hypoxia.[2]

Exposure to hypotension is associated with adverse patient outcomes. A prospective cohort study from a large urban emergency department found an 18% increase in mortality for hypotensive versus non-hypotensive patients.[3] A systematic review comprised of 42 high-quality studies agreed that prolonged

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exposure to hypotension increased the risk for severe kidney injury, myocardial injury, and stroke.[4] Furthermore, a study reported that delayed medical emergency team reviews for hypotensive patients were associated with significantly increased mortality, which suggests timely measurement and tracking of hypotension may lead to improved patient outcomes.[5]

Appropriate documentation of medical records is important to ensure coordination among healthcare providers and accurate provider payments.[6,7] Detailed medical documentation and accurate coding may improve patient care by communicating comprehensive information to the clinicians who provide the subsequent care.[7] Furthermore, accurate coding is necessary for appropriate and timely claims payments for hospitals and physicians.[7] When health conditions are not coded or coded incorrectly, the result is an increase in aggregate healthcare system costs and decreased provider reimbursement. A 2002 study estimated that 6.3% of Medicare spending was improperly paid due to errors in medical coding,[8] and recent estimates show that 75% to 80% of medical bills contain inaccurate charges due to errors in medical coding.[9]

Quality initiatives and retrospective research are dependent upon accurate medical coding, and the utility of claims data is increasing as an efficient, reliable, and inexpensive resource in health services research.[10] Recent quality-of-care initiatives by the Centers for Medicare and Medicaid Services (CMS) heavily rely on the data collected/recorded by clinicians, and the demand for accurate data is likely to increase with a shift towards value-based reimbursement models.[11] CMS recently adopted a quality measure evaluating hypotension, which will likely increase the importance of appropriate documentation in hypotensive patients.[12] Furthermore, epidemiological research utilizing claims datasets is crucial to identify national burden/incidence trends over time for various diseases.[13,14]

Despite its real-world implications, medical coding is a vastly understudied area. To our knowledge, there are no studies investigating medical coding in hypotensive patients. Herein, we present an evaluation of hypotension code utilization and coding trends for known shock patients.

Patients and Methods

Data Source

We conducted a retrospective, observational study using the 100% Medicare fee-for-service claims database (Woodlawn, Maryland, US), which contains physician and hospital reimbursement information for the US population aged ≥65-years as well as beneficiaries with certain disabilities (ie end-stage renal disease). Medicare fee-for-service database contains de-identified Health Insurance Portability and Accountability Act (HIPAA) compliant data and therefore is exempt from the need for a review by an institutional review board.

Study Population

Based on the International Classification of Diseases, Ninth and Tenth Revision, Clinical Modification (ICD-9-CM and ICD-10-CM) Systems, the study included patients who received a shock diagnosis code (ICD-9: 785.50, 785.51, 785.52, 785.59; ICD-10: R57.0, R57.1, R57.8, R57.9, R65.21) between 2011 and 2017. Cases with orthostatic hypotension (458, I95.1), chronic hypotension (458.1), and hypotension induced by drugs (I95.2) or hemodialysis (458.21, I95.3) were excluded from the study. Patients were classified into four mutually exclusive cohorts based on shock type using ICD-9 and −10 codes: cardiogenic shock (785.51, R57.0), hypovolemic shock (785.59, R57.1), septic shock (785.52, R65.21), and other/unspecified shock (785.50, R57.8, R57.9).

Outcomes and Analyses

We calculated the proportion and counts of cases with at least one hypotension code (ICD-9: 458.29, 458.8, 458.9; ICD-10: I95.0, I95.81, I95.89, I95.9) from 2011 to 2017 for each shock cohort. Descriptive statistics, as well as *t*-tests and chi-squared tests, were used to characterize variation in patient demographics (ie age, sex, race, region) based on the presence of a hypotension code across each shock cohort. We also investigated the 7-year trends in hypotension and shock code utilization. A Cochran-Armitage test was performed to evaluate the statistical significance of the trend in hypotension code use.

Results

Patient Characteristics

A total of 2,200,275 patients met study inclusion and exclusion criteria and were divided into four cohorts based upon the shock type. Septic shock was the largest cohort (n=1,379,564, 63%), and other/unspecified shock was the smallest cohort (n=189,791, 9%) (Figure 1). The average age (standard deviation) for all patients was 72.2

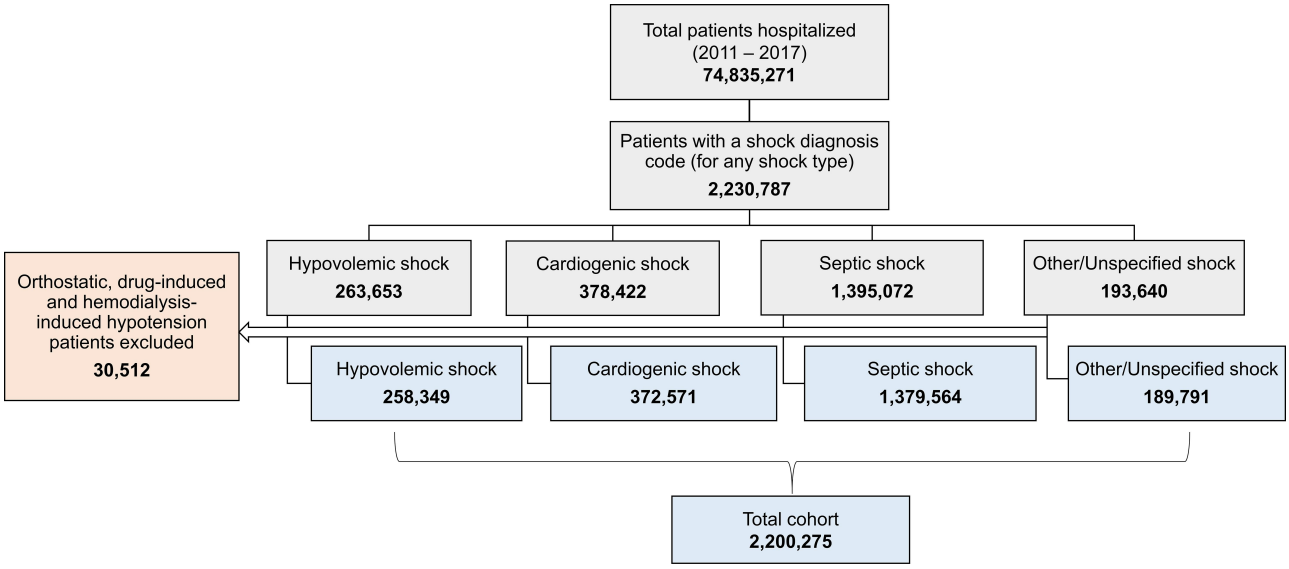

Figure 1 Patient attrition diagram.
Note: The patient counts included in the study and within each cohort are in bold for emphasis.

(12.5) years; 47.9% were female, and 81.0% were Caucasian. The majority of patients received care in the South (40.6%) or Midwest (22.9%) census regions of the US. Detailed demographic characteristics of study cohorts are provided in Table 1.

Hypotension Code Utilization

The counts and proportion of shock cases with at least one hypotension code, by shock type, are presented in Table 2. Of the 2,200,275 shock cases, 13.3% (n=292,192) received at least one hypotension code. Hypotension codes were included in claims for 18.0% (n=46,544) of hypovolemic shock cases, 16.9% (n=32,024) of other/unspecified shock cases, 14.8% (n=55,276) of cardiogenic shock cases, and 11.5% (n=158,348) of septic shock cases.

Code Utilization Trends 2011–2017

Shock and hypotension code utilization trends are illustrated in Figure 2. Hypotension code utilization for shock patients decreased initially from 11.5% (2011) to 10.6% (2014), however, it increased in each subsequent year to 17.9% by 2017 ($p < 0.0001$, $Z = -105.0520$; years 2011–2017). The surge in hypotension code utilization was significant for all shock types based on a Cochran-Armitage trend test (Table 3). The presence of shock codes trended upwards, with an 18.9% overall increase in the number of reported cases between 2011 (n=286,354) and 2017 (n=340,544).

Discussion

This analysis revealed an overall low utilization of hypotension codes among known hypotensive cases. Only 13.3% of all shock cases included a hypotension code. The lack of a single, standardized definition of hypotension may partly explain the underutilization of these codes.[15] Clear guidance and thresholds regarding the diagnosis of hypotension might increase the use of appropriate diagnosis codes.

Despite being the most prevalent shock type, the septic shock had the lowest hypotension code rate. The difference between septic shock and other shock types can be partially explained by the Surviving Sepsis guidelines, which provides a detailed evaluation of sepsis, including a MAP <65-mmHg threshold for diagnosing septic shock.[16] Physicians may be documenting hypotension relatively less in septic shock patients due to the MAP criterion in the diagnosis of septic shock. In contrast, the hypotensive patients with other shock types, which lack a similar guideline, may be more likely to receive a separate hypotension code. However, the differences among shock diagnosis guidelines (ie the presence of MAP criteria) do not explain the overall low utilization for hypotension across shock types.

We showed a significant increasing trend in hypotension code utilization, most notably after 2014, while the presence of the shock codes consistently increased across all study years (2011 to 2017). The increase in the presence of both hypotension and shock codes after 2014

Table 1 Descriptive Statistics by Shock Cohort Based on Hypotension Code Assignment

Variable	Variable Type	Presence of Hypotension Code by Shock Cohort N (%)											
		Hypovolemic Shock N=258,349			Cardiogenic Shock N=372,571			Septic Shock N=1,379,564			Other/Unspecified Shock N=189,791		
		Yes N=46,544	No N=211,805	*p*-value	Yes N=55,276	No N=317,295	*p*-value	Yes N=158,348	No N=1,221,216	*p*-value	Yes N=32,024	No N=157,767	*p*-value
Age at Admission (years)[a]	Mean (SD)	71.81 (12.11)	72.00 (12.37)	0.0024	72.62 (11.49)	72.63 (11.50)	0.7895	71.82 (12.58)	72.36 (12.83)	<0.0001	71.46 (12.27)	71.56 (12.46)	0.1753
Female[b]	N (%)	22,547 (48.47)	101,529 (47.98)	0.0542	23,688 (42.88)	133,207 (42.02)	0.0002	78,104 (49.38)	601,887 (49.33)	0.76	15,647 (48.92)	76,387 (48.46)	0.1336
Race[b]	Asian	699 (1.55)	3,901 (1.90)	<0.0001	962 (1.80)	6,672 (2.17)	<0.0001	2,756 (1.80)	28,563 (2.41)	<0.0001	508 (1.64)	2,891 (1.89)	<0.0001
	Black	5,665 (12.53)	28,153 (13.69)		7,168 (13.38)	40,438 (13.16)		21,874 (14.26)	168,384 (14.23)		4,257 (13.72)	22,797 (14.88)	
	Caucasian	38,015 (84.05)	168,763 (82.04)		44,393 (82.90)	253,231 (82.39)		125,020 (81.49)	949,474 (80.23)		25,655 (82.66)	123,927 (80.89)	
	Hispanic	848 (1.87)	4,890 (2.38)		1,030 (1.92)	7,025 (2.29)		3,768 (2.46)	37,061 (3.13)		615 (1.98)	3,597 (2.35)	
Region[b]	Midwest	12,440 (26.81)	51,137 (24.26)	<0.0001	13,966 (25.34)	75,238 (23.83)	<0.0001	39,902 (25.28)	264,041 (21.75)	<0.0001	8,053 (25.22)	36,257 (23.06)	<0.0001
	Northeast	7,983 (17.20)	36,658 (17.39)		9,896 (17.96)	56,066 (17.76)		28,824 (18.27)	231,717 (19.08)		4,849 (15.19)	23,384 (14.87)	
	South	19,075 (41.11)	84,785 (40.22)		22,617 (41.04)	126,750 (40.14)		65,653 (41.60)	485,802 (40.01)		13,978 (43.78)	70,000 (44.51)	
	West	6,906 (14.88)	38,231 (18.14)		8,635 (15.67)	57,682 (18.27)		23,431 (14.85)	232,674 (19.16)		5,045 (15.80)	27,619 (17.56)	

Notes: Test for significance by presence of hypotension code, [a]t-test (with equal or unequal variances, as appropriate). [b]Chi-squared test.
Abbreviation: SD, standard deviation.

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Table 2 Counts and Percentages of Cases with Hypotension Codes by Shock Type

Description	Total Cases	Cases with a Hypotension Code	
		Counts	Percentage
Hypovolemic Shock	258,349	46,544	18.02%
Cardiogenic Shock	372,571	55,276	14.84%
Septic Shock	1,379,564	158,348	11.48%
Other/Unspecified Shock	189,791	32,024	16.87%
Total	2,200,275	292,192	13.28%

overlaps with the transition from ICD-9-CM to ICD-10-CM coding systems, which likely improved overall coding practices. The 2012 Surviving Sepsis Guidelines boosted shock awareness considerably among the medical community and may have contributed to the isolated increase in shock code utilization before 2014. Efforts to increase awareness and education among clinicians and medical coders may lead to increased use of appropriate codes.[17]

Exposure to hypotension is harmful to patients and may lead to significant mortality and morbidity.[3,4] Accurate inclusion of hypotension in medical records may have positive downstream impacts on patient care by supporting quality monitoring/improvement initiatives as well as informing program development and patient identification for payer-based population health initiatives (ie care management).[18] The importance of record-keeping is likely to increase as CMS is currently testing the submission of quality measure data through electronic health records (EHR).[11] A quality measure evaluating hypotension was recently adopted by CMS, which will impact payments to providers in the Merit-based Incentive Payment System.[12] As payers increase data requirements from the providers, clear documentation of major and comorbid conditions may have a more significant impact in the future pay-for-performance programs.[7] Clearly defined hypotension codes could reduce the burden of reporting.

Accurate coding of hypotension may lead to higher quality retrospective research and improved accuracy for a national burden estimate, which could increase funding for research, education, and treatment for hypotensive patients.[13] Despite its widely-known shortcomings (ie delay in availability, limited clinical information, sensitivity), claims data is increasingly being used in health services research as an efficient and relatively low-cost data source.[10,19–21] Moreover, claims databases provide a combination of clinical and reimbursement-related information for almost all health encounters, which is especially beneficial when high-volume and long-term follow-up is important to the research.[19] Information from the claims data may also be used to complement other data. The Food and Drug Administration previously established national strategies by combining information from registries, EHR, and claims databases.[19] Furthermore, Hlatky et al and Brennan et al suggested that claims data can be used to evaluate outcomes of participants with reasonable accuracy in later phases of large pragmatic clinical trials and medical device surveillance systems, respectively.[19,20]

Our results suggest a remarkably low use of hypotension codes among known hypotensive patients and differing rates

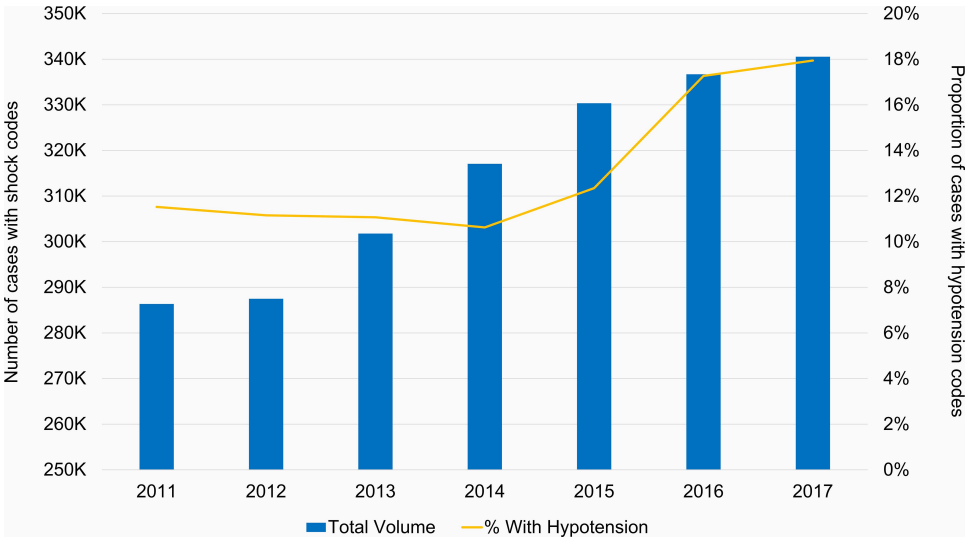

Figure 2 Seven-year trends in the shock and hypotension diagnosis code utilization.

Table 3 Cochran-Armitage Trend Test Analysis by Shock Cohort Between 2011 and 2017

Shock Cohort	Percentages of Shock Cases with Hypotension Codes by Year							Cochran-Armitage Test Statistic	*p*-value
	2011	2012	2013	2014	2015	2016	2017		
Hypovolemic shock	15.11%	14.42%	14.80%	14.02%	16.47%	27.35%	28.28%	−58.0582	<0.0001
Cardiogenic shock	12.78%	12.50%	12.34%	11.53%	13.03%	20.02%	20.68%	−49.4383	<0.0001
Septic shock	10.15%	9.77%	9.60%	9.23%	10.73%	14.70%	15.24%	−71.3401	<0.0001
Other/Unspecified shock	14.52%	14.06%	13.87%	13.88%	16.97%	20.06%	20.32%	−29.2167	<0.0001

by shock types. Despite current studies suggesting significant real-world implications of inappropriate medical coding practices, the specific impact of underutilization of diagnosis codes on patient care, financial efficiency, and quality of retrospective research is yet to be studied.

Limitations

A strength of this study is the large sample size; however, it is not without limitations. As previously discussed, claims databases are designed for administrative purposes and have inherent limitations regarding retrospective research. There are restrictions on the number of diagnosis codes that are recorded on claims forms; therefore, our study may have underestimated the shock/hypotension code utilization, particularly given the older population present in the Medicare claims database, which is more likely to receive multiple diagnosis codes corresponding to various comorbid conditions. Additionally, as previously shown by Menon et al, a small yet significant subset of cardiogenic shock patients (5%) may present with hypoperfusion but not hypotension, or what is known as non-hypotensive cardiogenic shock.[22]

Conclusion

Hypotension codes appear to be underutilized in known hypotensive patients. Establishing clear guidelines to identify and classify hypotension, as well as improving education/training for clinicians and medical coders, is likely to improve coding practices, which has potential benefits for patients, providers, and the research community. Accurate coding is likely to improve health services research and quality initiatives, which may consequently improve patient outcomes. Further research is required to establish the causal relationship between the utilization of hypotension codes and improvements in patient outcomes.

Abbreviations

MAP, mean arterial pressure; CMS, Centers for Medicare and Medicaid Services; HIPAA, Health Insurance Portability and Accountability Act; ICD-9-CM, International Classification of Diseases Ninth Revision Clinical Modification; ICD-10-CM, International Classification of Diseases Tenth Revision Clinical Modification; EHR, electronic health records.

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