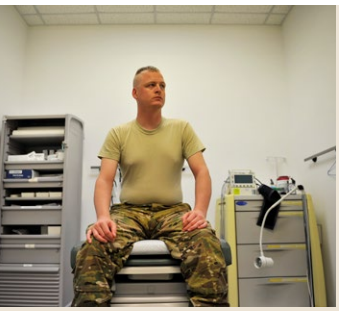
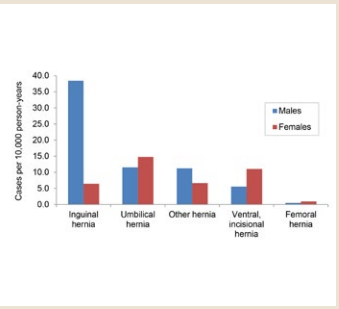
AUGUST 2016

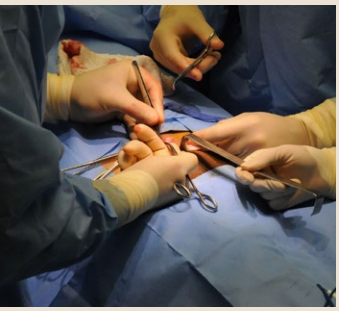
Volume 23
Number 8

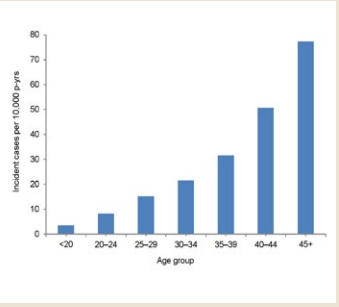
MSMR

MEDICAL SURVEILLANCE MONTHLY REPORT









Incidence of Abdominal Hernias in Service Members, Active Component, U.S. Armed Forces, 2005–2014

Francis L. O'Donnell, MD, MPH (COL, USA, Ret.); Stephen B. Taubman, PhD

From 1 January 2005 through 31 December 2014, a total of 87,480 incident diagnoses of the five types of abdominal hernia (incidence rate 63.3 cases per 10,000 person-years) were documented in the health records of 72,404 active component service members. The overall incidence rate of inguinal hernias among males was six times the rate among females. However, incidence rates of femoral, ventral/incisional, and umbilical hernias were higher among females than males. During the 10-year interval, annual incidence rates for most of the five types of hernia trended downward, but rates increased for umbilical hernias in both males and females and for ventral/incisional hernias among females. For most types of hernia, the incidence rates tended to be higher among the older age groups. Health records documented 35,624 surgical procedures whose descriptions corresponded to the types of hernia diagnoses in the service members. Most repair procedures were performed in outpatient settings. The proportion of surgical procedures performed via laparoscopy increased during the period, but the majority of operations were open procedures. The limitations to the generalizability of the findings in this study are discussed.

An abdominal hernia is an abnormal protrusion of an organ or tissue through a defect in the abdominal wall. Such hernias are diagnosed most frequently in the inguinal, umbilical, and femoral regions, but another category of relatively common hernias of the anterior abdominal wall includes both ventral and incisional hernias. The latter occur at the sites of previous surgical incisions.[1] Estimates of the incidence rates of abdominal hernias in the U.S. population suggest a 5% lifetime risk. Even though not all hernias necessitate surgical intervention, more than 600,000 surgical repairs of hernias occur annually in the U.S.[1–3]

Within the population of military service members, inguinal hernias have been common enough to be among the five most frequent diagnoses of digestive disorders associated with all medical encounters, with male hospitalizations, and with male outpatient encounters.[4–6] Medical accession standards specify that applicants for military service do not meet entrance standards if they have a current hernia (except for a small or asymptomatic umbilical hernia) of the abdominal wall or if they have a history of open or laparoscopic abdominal surgery during the preceding 6 months.[7]

This study explored the incidence of documented diagnoses of the five major categories of abdominal hernia among active component service members, examined the distribution of hernias according to several demographic characteristics, assessed the frequency with which diagnosed cases underwent reparative surgery while in active service, and estimated the frequencies of laparoscopic and open surgical procedures.

METHODS

The surveillance period was 1 January 2005 through 31 December 2014. The surveillance population included all active component service members of the Army, Navy, Air Force, and Marine Corps who served at any time during the surveillance period. Records of both inpatient and outpatient health care documented in the databases of the Defense Medical Surveillance System (DMSS) were searched to ascertain cases of the five types of abdominal hernia categories used in this analysis: inguinal, umbilical, ventral/incisional, femoral, and "other." A case of any of these hernia types was defined by the presence of an ICD-9 code indicative of the subject hernia in any diagnostic position of the record of an inpatient or outpatient encounter **(Table 1)**. The ICD-9 category for "other types" includes the following uncommon types of hernia: ischiatic, ischiorectal, lumbar, obturator, pudendal, retroperitoneal, and sciatic, but these types could not be distinguished from one another in this analysis.

An individual could be considered an incident case for a specific type of hernia just once during the surveillance period. However, individuals could be counted as incident cases of multiple hernia types. For each individual who met the criterion for a case, the date of the first-ever encounter with a diagnosis of that hernia during the surveillance period was considered the incidence date. Individuals who had a case-defining encounter prior to the surveillance period were excluded from the analysis. For all defined incident cases, their healthcare records were searched for documentation of surgical repair of that type of hernia coincident with, or subsequent to, their incident diagnosis. An instance of surgical repair was defined as an inpatient encounter with a procedure (PR) code for

TABLE 1. ICD-9 diagnostic codes for the five types of abdominal hernia and ICD-9 and CPT procedure codes for open and laparoscopic repairs in the inpatient and outpatient settings

		Procedure codes for surgical repair of abdominal hernias			
		Inpatient ICD-9 codes		Outpatient CPT codes	
Type of hernia	ICD-9 diagnostic codes	Open	Laparoscopic	Open	Laparoscopic
Inguinal	550.xx	53.00–53.05, 53.10–53.17	17.11–17.13, 17.21–17.24	49505, 49507, 49520, 49521, 49525	49650, 49651
Femoral	551.0x, 552.0x, 553.0x	53.21, 53.29, 53.31, 53.39		49550, 49553, 49555, 49557	
Umbilical	551.1, 552.1, 553.1	53.41, 53.49	53.42, 53.43	49585, 49587	
Ventral/incisional, etc.	551.2x, 552.2x, 553.2x	53.51, 53.59, 53.61, 53.69	53.62, 53.63	49560, 49561, 49565, 49566, 49568, 49570, 49572, 49590	49652–49653, 49654–49657
Other types	551.8, 551.9, 552.8, 552.9, 553.8, 553.9	53.90		49540	49659

the repair in any position or an outpatient encounter with a Current Procedural Terminology (CPT) code for the hernia repair in any position **(Table 1)**.

Incidence rates for each type of hernia were compared across several demographic characteristics (sex, race/ethnicity, age group, branch of military service, rank, and military occupational field) for the whole surveillance period. The analysis determined the proportion of cases of each type of hernia that eventually underwent surgical repair during the surveillance period. In the search for records documenting surgical repairs, the follow-up period for each case ran from the incidence date of the hernia to the end of the surveillance period or to the service member's departure from active service or death—whichever came first. The specific procedural code had to correspond to the type of hernia. Procedural codes that did not match the type of hernia were excluded. The study also examined the relative frequencies of laparoscopic versus open surgical repair and of inpatient versus outpatient surgical repair. Finally, the analysis examined the specific ICD-9 diagnostic codes to determine, as indicators of relative seriousness of the diagnoses, the numbers and proportions of incident diagnoses whose codes represented hernias with gangrene, obstruction, or neither gangrene nor obstruction.

RESULTS

During the 10-year surveillance period, the records of 72,404 active component service members documented incident diagnoses of at least one of the five types of hernia. Because some affected service members had multiple incident diagnoses of hernias, they accounted for 87,480 incident diagnoses of hernias overall. The frequencies of diagnoses of more than one type of hernia during the surveillance period are depicted in **Table 2.** The overall incidence rate for diagnoses of all types of hernia was 63.3 cases per 10,000 person-years (p-yrs); the rates for males and females were 67.3 and 39.8 cases per 10,000 p-yrs, respectively **(Table 3)**. The rate of diagnosis of any hernia type by unique individuals was 52.4 per 10,000 p-yrs.

The overall incidence rates of the five types of hernia were highest for inguinal hernias and lowest for femoral hernias. There were notable differences between males and females in overall rates and in trends of annual incidence rates of diagnoses **(Table 3, Figures 1–3)**. For example, the overall incidence rate of inguinal hernia diagnoses in males was six times the rate among females; also, the rate of "other hernias" was 69% higher among males than females. On the other hand, rates of femoral and ventral/incisional hernias were nearly twice as high among females than males; and for umbilical hernias, the female rate was 28% higher than that of males **(Figure 1)**.

TABLE 2. Number of service members with one or more hernia diagnoses, active component, U.S. Armed Forces, 2005–2014

No. of different types of incident hernia	No. of service members with the indicated no. of diagnoses	No. of diagnoses
1	58,661	58,661
2	12,484	24,968
3	1,186	3,558
4	72	288
5	1	5
Total	72,404	87,480

During 2005–2014, among males, annual incidence rates declined for inguinal hernias (15%), femoral hernias (39%), and "other hernias" (50%); they increased by 24% for umbilical hernia diagnoses; and they were low and stable for ventral/incisional hernias **(Table 3, Figure 2)**. Among females, annual rates of inguinal, femoral, and "other" hernias fell by 40%, 45%, and 49%, respectively; however, rates of umbilical and ventral/incisional hernias increased by 57% and 15%, respectively **(Table 3, Figure 3)**.

Compared to other race/ethnicity groups, the overall incidence rate of inguinal

TABLE 3. Counts and incidence rates of abdominal hernia diagnoses, by type and sex, active component, U.S. Armed Forces, 2005–2014

	Total		2005		2006		2007		2008	
Active component	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total										
Inguinal hernia	46,700	33.8	5,133	37.3	5,121	37.5	4,765	35.0	4,517	32.9
Femoral hernia	794	0.6	104	0.8	105	0.8	93	0.7	76	0.6
Umbilical hernia	16,574	12.0	1,442	10.5	1,497	11.0	1,514	11.1	1,497	10.9
Ventral/incisional hernia	8,800	6.4	836	6.1	845	6.2	847	6.2	807	5.9
Other hernia	14,612	10.6	2,100	15.3	1,988	14.6	1,582	11.6	1,472	10.7
Total	87,480	63.3	9,615	69.8	9,556	69.9	8,801	64.7	8,369	60.9
Male										
Inguinal hernia	45,408	38.5	4,971	42.3	4,956	42.4	4,633	39.8	4,361	37.0
Femoral hernia	601	0.5	75	0.6	79	0.7	68	0.6	57	0.5
Umbilical hernia	13,613	11.5	1,206	10.3	1,276	10.9	1,252	10.7	1,254	10.6
Ventral/incisional hernia	6,582	5.6	639	5.4	642	5.5	651	5.6	614	5.2
Other hernia	13,277	11.2	1,933	16.4	1,823	15.6	1,449	12.4	1,312	11.1
Total	79,481	67.3	8,824	75.1	8,776	75.2	8,053	69.1	7,598	64.4
Female										
Inguinal hernia	1,292	6.4	162	8.0	165	8.3	132	6.7	156	8.0
Femoral hernia	193	1.0	29	1.4	26	1.3	25	1.3	19	1.0
Umbilical hernia	2,961	14.7	236	11.7	221	11.1	262	13.4	243	12.4
Ventral/incisional hernia	2,218	11.0	197	9.8	203	10.2	196	10.0	193	9.9
Other hernia	1,335	6.6	167	8.3	165	8.3	133	6.8	160	8.2
Total	7,999	39.8	791	39.3	780	39.3	748	38.2	771	39.4

	2009		2010		2011		2012		2013		2014	
Active component	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total												
Inguinal hernia	4,841	34.5	4,750	33.5	4,641	32.8	4,521	32.5	4,243	31.0	4,168	31.1
Femoral hernia	78	0.6	80	0.6	82	0.6	64	0.5	52	0.4	60	0.4
Umbilical hernia	1,601	11.4	1,688	11.9	1,879	13.3	1,868	13.4	1,772	12.9	1,816	13.6
Ventral/incisional hernia	915	6.5	913	6.4	954	6.7	941	6.8	879	6.4	863	6.4
Other hernia	1,386	9.9	1,384	9.8	1,324	9.4	1,224	8.8	1,131	8.3	1,021	7.6
Total	8,821	62.9	8,815	62.2	8,880	62.7	8,618	62.0	8,077	58.9	7,928	59.2
Male												
Inguinal hernia	4,735	39.4	4,632	38.2	4,537	37.5	4,386	36.9	4,126	35.3	4,071	35.8
Femoral hernia	63	0.5	67	0.6	62	0.5	46	0.4	40	0.3	44	0.4
Umbilical hernia	1,313	10.9	1,401	11.5	1,512	12.5	1,510	12.7	1,444	12.4	1,445	12.7
Ventral/incisional hernia	701	5.8	677	5.6	695	5.7	681	5.7	647	5.5	635	5.6
Other hernia	1,261	10.5	1,265	10.4	1,191	9.8	1,095	9.2	1,013	8.7	935	8.2
Total	8,073	67.1	8,042	66.2	7,997	66.1	7,718	65.0	7,270	62.3	7,130	62.7
Female												
Inguinal hernia	106	5.3	118	5.8	104	5.1	135	6.7	117	5.8	97	4.8
Femoral hernia	15	0.7	13	0.6	20	1.0	18	0.9	12	0.6	16	0.8
Umbilical hernia	288	14.4	287	14.1	367	17.9	358	17.6	328	16.1	371	18.4
Ventral/incisional hernia	214	10.7	236	11.6	259	12.6	260	12.8	232	11.4	228	11.3
Other hernia	125	6.2	119	5.8	133	6.5	129	6.4	118	5.8	86	4.3
Total	748	37.4	773	38.0	883	43.1	900	44.4	807	39.7	798	39.5

[a]Cases per 10,000 person-years

FIGURE 1. Overall incidence rates for abdominal hernia, by type and sex, active component, U.S. Armed Forces, 2005–2014

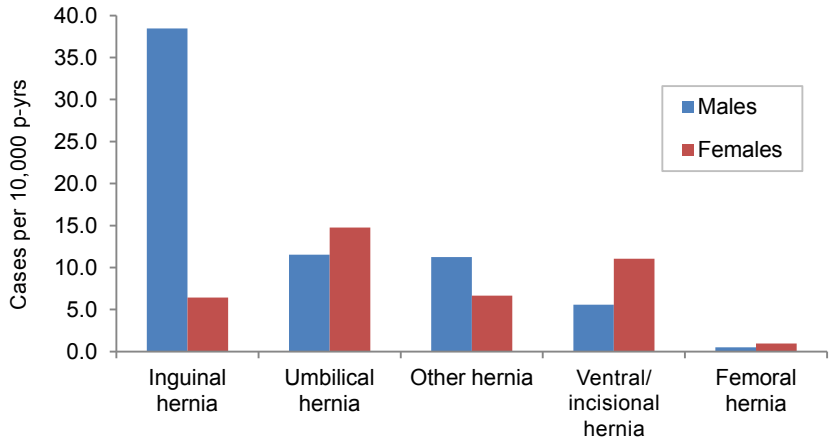


FIGURE 2. Annual incidence rates for types of abdominal hernia, male service members, active component, U.S. Armed Forces, 2005–2014

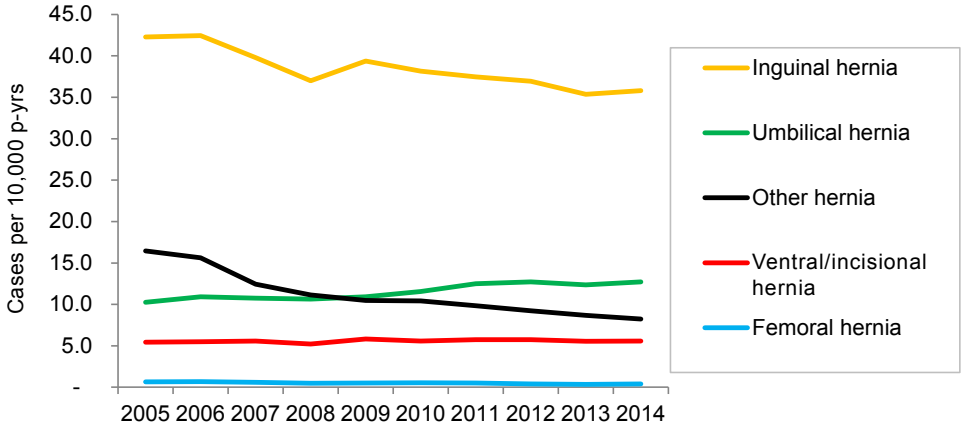
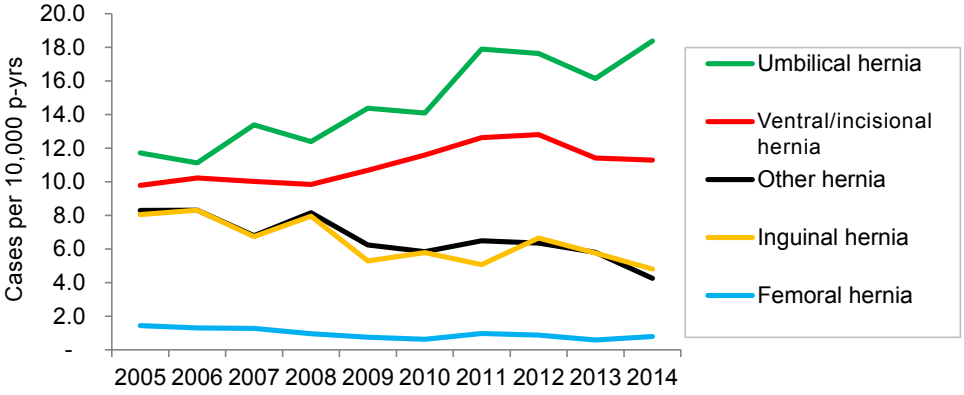


FIGURE 3. Annual incidence rates for types of abdominal hernia, female service members, active component, U.S. Armed Forces, 2005–2014



hernias was notably higher among white, non-Hispanic service members, and the rates of umbilical and ventral/incisional hernias were highest among black, non-Hispanic service members. Incidence rates of each type of hernia and of all types together were lowest among Asian/Pacific Islander service members. For most types of hernia, the incidence rates tended to be higher in the older age groups, although incidence rates for femoral and umbilical hernias in females did not exhibit clear-cut relationships with advancing age **(Table 4, Figures 4–8)**.

Among the services, rates of inguinal hernias were highest among Marine Corps members, whereas rates of umbilical, ventral/incisional, "other hernias," and all types combined were highest among Army soldiers. Compared to other service members, those in combat-specific occupations had slightly higher rates of inguinal hernias, and healthcare personnel had modestly higher incidence rates for femoral, umbilical, and ventral/incisional hernias **(Table 4)**.

Specific ICD-9 diagnostic codes recorded on medical records indicated that 0.37% of incident hernias were complicated by gangrene, and 3.05% were complicated by obstruction (or incarceration, irreducibility, or strangulation). However, the proportions of cases with complications markedly varied across hernia types; for example, records indicate that more than 10% of incident cases of femoral and ventral/incisional hernias were complicated by gangrene or obstruction **(Table 5)**.

For the 87,480 incident diagnoses of hernias of all types, service members' records documented the performance of 35,624 surgical repairs **(Table 6)**. Of the 4,971 diagnoses of inguinal hernia recorded for males in 2005, a total of 3,038 of the cases (61.1%) underwent inguinal hernia surgery at some point during the rest of the surveillance period. The 46,700 incident diagnoses of inguinal hernia in both sexes were associated with 25,344 contemporaneous or subsequent surgeries (54.3% of cases) identified as specific to inguinal hernia during the surveillance period. Although it was expected that the proportions of cases who underwent surgery would decrease as the durations of follow-up diminished with each successive year in the surveillance period, the proportions did not fall as sharply as might have been expected **(Table 6, Figure 9, Figure 10)**.

Of the 25,344 repair procedures for inguinal hernias during the surveillance period, the recorded procedure codes indicated that almost 92% were performed in outpatient settings. High proportions of outpatient procedures were also found for repairs of umbilical (93%), ventral/incisional (78%), and femoral (76%) hernias **(data not shown)**. Because current coding systems do not have some procedural codes for laparoscopic repairs of femoral, umbilical, and

TABLE 4. Incident abdominal hernia diagnoses, by type and demographic characteristics, active component, U.S. Armed Forces, 2005–2014

	Inguinal hernia		Femoral		Umbilical		Ventral/incisional		Other hernia		All hernia diagnoses	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Total rate[a]
Total	46,700	33.8	794	0.57	16,574	12.0	8,800	6.4	14,612	10.6	87,480	63.3
Sex												
Male	45,408	38.5	601	0.51	13,613	11.5	6,582	5.6	13,277	11.2	79,481	67.3
Female	1,292	6.4	193	0.96	2,961	14.7	2,218	11.0	1,335	6.6	7,999	39.8
Race/ethnicity												
White, non-Hispanic	33,056	38.7	496	0.58	9,954	11.7	5,276	6.2	9,837	11.5	58,619	68.7
Black, non-Hispanic	5,863	25.9	150	0.66	3,839	17.0	2,178	9.6	2,352	10.4	14,382	63.6
Hispanic	4,676	29.1	96	0.60	1,709	10.6	829	5.2	1,456	9.1	8,766	54.6
Asian/Pacific Islander	809	15.3	11	0.21	226	4.3	108	2.0	254	4.8	1,408	26.6
American Indian/ Alaska Native	303	18.8	7	0.43	105	6.5	59	3.7	99	6.1	573	35.5
Other/unknown	1,993	27.6	34	0.47	741	10.3	350	4.9	614	8.5	3,732	51.8
Age (males)												
<20	2,933	39.1	21	0.28	279	3.7	185	2.5	993	13.2	4,411	58.8
20–24	13,108	34.2	164	0.43	2,123	5.5	1,283	3.4	3,560	9.3	20,238	52.9
25–29	9,108	33.1	139	0.51	2,563	9.3	1,324	4.8	2,694	9.8	15,828	57.6
30–34	6,492	36.6	99	0.56	2,356	13.3	1,007	5.7	1,973	11.1	11,927	67.2
35–39	6,077	42.8	75	0.53	2,667	18.8	1,166	8.2	1,915	13.5	11,900	83.9
40–44	4,595	53.7	65	0.76	2,245	26.2	939	11.0	1,285	15.0	9,129	106.7
45+	3,095	72.4	38	0.89	1,380	32.3	678	15.9	857	20.1	6,048	141.6
Age (females)												
<20	101	6.9	20	1.37	73	5.0	25	1.7	67	4.6	286	19.6
20–24	406	6.0	60	0.88	733	10.8	461	6.8	347	5.1	2,007	29.4
25–29	316	6.4	46	0.92	871	17.5	588	11.8	315	6.3	2,136	42.9
30–34	178	6.1	25	0.85	633	21.6	471	16.0	249	8.5	1,556	53.0
35–39	147	7.2	20	0.98	387	18.9	362	17.7	189	9.2	1,105	54.0
40–44	89	7.6	17	1.45	194	16.5	204	17.4	109	9.3	613	52.2
45+	55	8.2	5	0.74	70	10.4	107	15.9	59	8.8	296	44.0
Service												
Army	18,918	35.8	327	0.62	7,335	13.9	3,952	7.5	6,659	12.6	37,191	70.4
Navy	9,337	28.4	162	0.49	3,779	11.5	1,707	5.2	2,481	7.5	17,466	53.1
Air Force	10,849	32.7	211	0.64	3,855	11.6	2,215	6.7	3,104	9.3	20,234	60.9
Marine Corps	7,596	39.5	94	0.49	1,605	8.4	926	4.8	2,368	12.3	12,589	65.5
Rank												
Enlisted	38,317	33.3	659	0.57	13,545	11.8	7,359	6.4	12,336	10.7	72,216	62.8
Officer	8,383	36.3	135	0.58	3,029	13.1	1,441	6.2	2,276	9.9	15,264	66.1
Occupation												
Combat-specific	7,896	39.2	100	0.50	2,354	11.7	1,190	5.9	2,341	11.6	13,881	68.9
Armor/motor transport	1,382	32.9	21	0.50	513	12.2	253	6.0	446	10.6	2,615	62.3
Pilot/air crew	1,831	35.0	25	0.48	574	11.0	226	4.3	428	8.2	3,084	59.0
Repair/engineer	13,589	34.0	212	0.53	4,548	11.4	2,317	5.8	3,886	9.7	24,552	61.4
Communications/ intelligence	9,036	29.3	187	0.61	3,961	12.8	2,275	7.4	3,148	10.2	18,607	60.4
Health care	3,789	32.1	86	0.73	1,946	16.5	1,091	9.2	1,200	10.2	8,112	68.8
Other/unknown	9,177	35.4	163	0.63	2,678	10.3	1,448	5.6	3,163	12.2	16,629	64.1

[a]Cases per 10,000 person-years

FIGURE 4. Incidence rates of inguinal hernia, by age and sex, active component, U.S. Armed Forces, 2005–2014

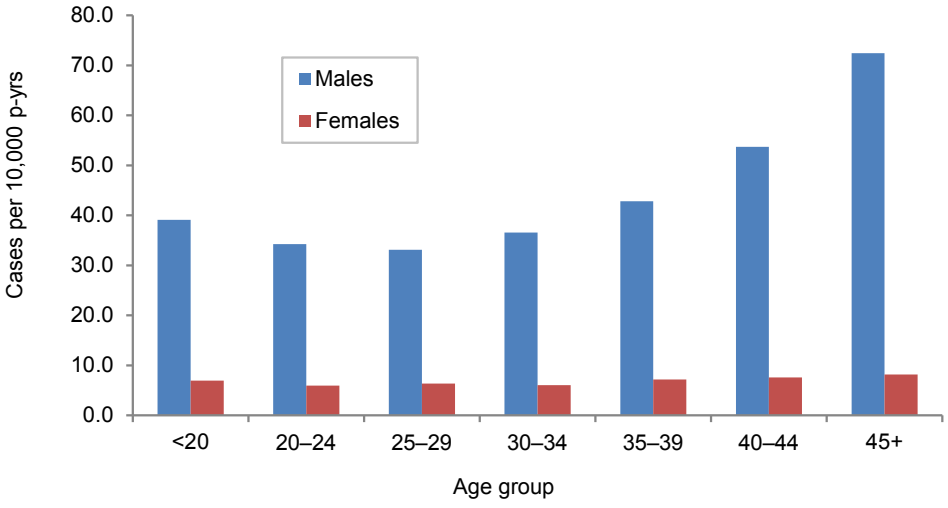


FIGURE 5. Incidence rates of femoral hernia, by age and sex, active component, U.S. Armed Forces, 2005–2014

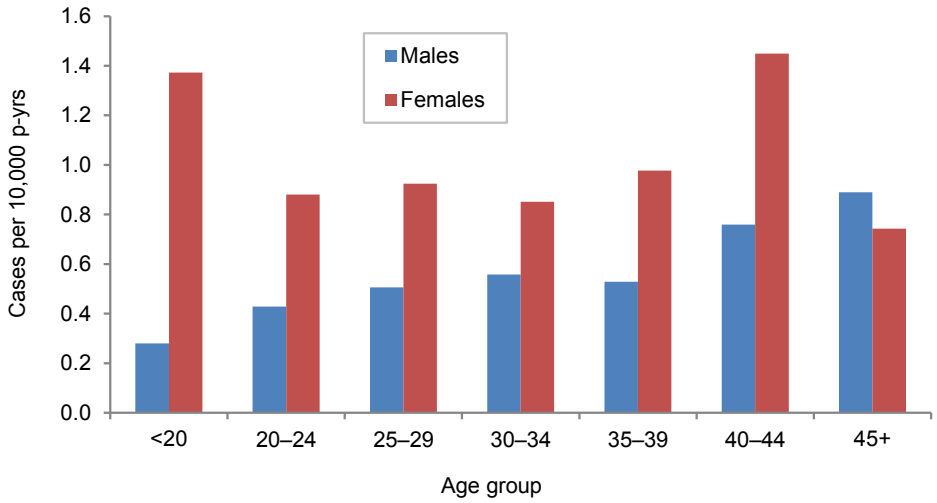
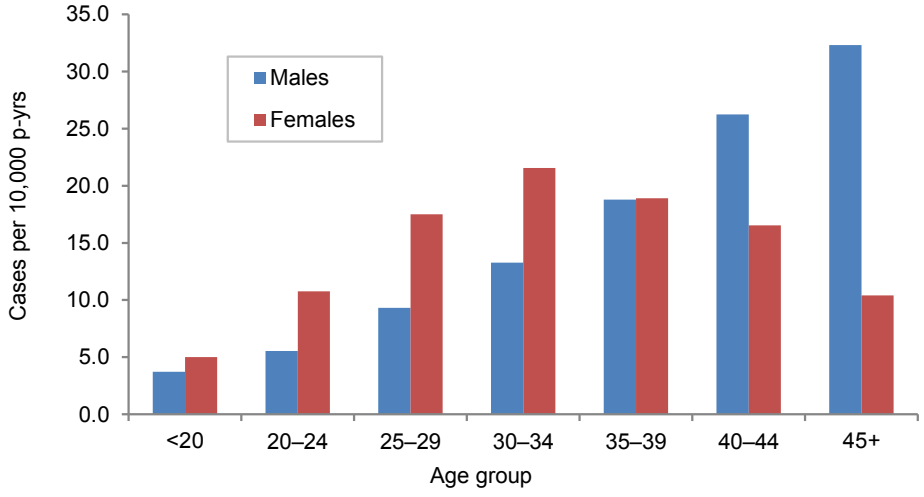


FIGURE 6. Incidence rates of umbilical hernia, by age and sex, active component, U.S. Armed Forces, 2005–2014



"other" hernias, the frequency of laparoscopy was examined for only inguinal and ventral/incisional hernias **(Table 1)**. Overall, surgery was performed via laparoscopy for 32.8% of inguinal hernia repairs and 13.8% of ventral/incisional hernia repairs. From 2005 to 2014, the use of laparoscopy rose from 15.7% to 43.9% of inguinal hernia repairs and from 0.3% to 19.3% of ventral/incisional repairs **(data not shown)**.

EDITORIAL COMMENT

This analysis found that, from 2005 to 2014, the annual incidence of diagnoses of all types of hernia decreased slightly in male service members but remained stable among females. However, trends in the annual rates of hernia diagnoses varied by both sex and type of hernia. As expected, the incidence of inguinal hernia was far greater in males than females. Advancing age was associated most clearly with increasing incidence rates of inguinal, umbilical, and ventral/incisional hernias. The frequency of surgical repair of diagnosed hernias varied by type of hernia, ranging from highs of 54.7% of inguinal hernias in males and 41.6% of umbilical hernias in females to less than 1% of "other types" in both males and females.

This study is based on data that reflect the incidence of diagnoses of abdominal hernias in a large population for whom most healthcare encounters are reliably captured in the electronic records of care in military treatment facilities and civilian sources of care (reimbursed care). This circumstance differs from much of the published literature about abdominal hernias because those aggregated data are most often based on care provided to individuals who underwent surgical treatment or were considered candidates for surgery. Usually the demographic characteristics of the civilian populations from which surgical patients come are not well defined, although there are exceptions.[3] In contrast, the findings of this study can be described as population based.

Nevertheless, there are limitations to the generalizability of the results because of the unique characteristics of the population of active component service members. Service members are medically screened at the time of entry into service, so those who meet the physical standards—which include the

absence of any hernia except a small umbilical hernia—are likely at lower risk of being diagnosed with a significant abdominal hernia than the general population of the same age distribution. Moreover, the overall age distribution of the military population differs greatly from that of the general U.S. population. There are no service members younger than 17 years of age and previous reports have documented that 95.9% of male service members and 96.4% of female service members were younger than 45 years of age. In contrast, 22.4% of the 2011 U.S. civilian population was younger than 17 years of age and the proportions of men and women aged 17–44 years were 38.7% and 36.9%, respectively.[8]

FIGURE 7. Incidence rates of ventral/incisional hernias, by age and sex, active component, U.S. Armed Forces, 2005–2014

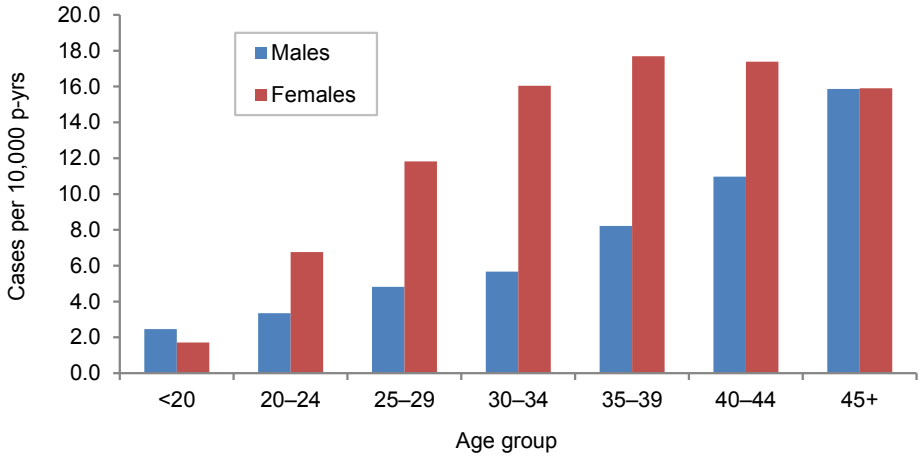
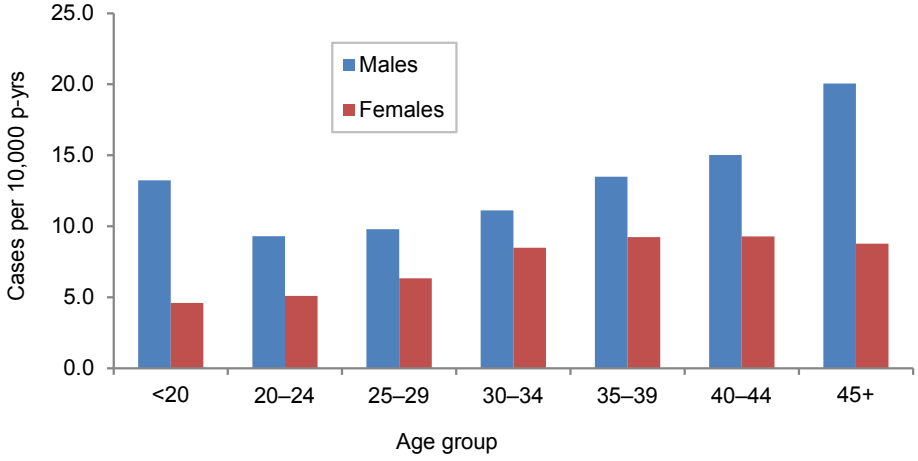


FIGURE 8. Incidence rates of all other hernia types, by age and sex, active component, U.S. Armed Forces, 2005–2014



This study found that advancing age is correlated with increasing incidence rates of several of the types of hernia examined but was unable to document hernia incidence rates associated with the older age groups (50 years and older) among whom the incidence of hernias and their complications are reported to be even more common.[1] Accordingly, the findings of this study that differ from the published literature must be interpreted in light of the differing characteristics of the population of active component military service members when compared to the general U.S. population.

Malangoni and Rosen have stated that men are 25 times more likely to have a groin hernia (mostly inguinal hernias) than women and that inguinal hernias are the most common hernias in women.[1] In contrast, this study of relatively young service members found that the rate of inguinal hernias in males was six times that of females, and that both umbilical and ventral/incisional hernias were much more common than inguinal hernias in females. Because the prevalence of hernia is said to increase with age, especially inguinal, umbilical, and femoral hernias, the overall lifetime incidence of hernias is only partially described by the findings of this study.

The criteria for performing surgery on abdominal hernias vary according to the type. In general, the occurrence of, or the likelihood of, strangulation is the most clear-cut indication. The risk of strangulation in femoral hernias is said to be sufficiently high to warrant the surgical correction of all femoral hernias.[1] In this study, more than 10% of initial diagnoses of femoral hernia were

TABLE 5. Distribution of incident diagnoses of abdominal hernia by ICD-9 coding indicating the presence of gangrene, obstruction, or neither, by type of hernia, active component, U.S. Armed Forces, 2005–2014

	Inguinal		Femoral		Umbilical		Ventral/incisional		Other		All types of hernia	
	No. of cases	% of total	No. of cases	% of total	No. of cases	% of total	No. of cases	% of total	No. of cases	% of total	No. of cases	% of total
Total	46,700		794		16,574		8,800		14,612		87,480	
With gangrene	231	0.5%	23	2.9%	20	0.1%	23	0.3%	23	0.2%	320	0.4%
With obstruction	565	1.2%	59	7.4%	842	5.1%	1,020	11.6%	183	1.3%	2,669	3.1%
Without gangrene, obstruction	45,904	98.3%	712	89.7%	15,712	94.8%	7,757	88.1%	14,406	98.6%	84,491	96.6%

TABLE 6. Numbers of abdominal hernia cases per year, the number of each year's cases that had subsequent surgery, and the proportion of each year's cases that had surgery, by hernia type, year of incident diagnosis, and sex, active component, U.S. Armed Forces, 2005–2014

Male		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Inguinal	Incident diagnoses in year	4,971	4,956	4,633	4,361	4,735	4,632	4,537	4,386	4,126	4,071	45,408
	Subsequent repair (any year)	3,038	2,938	2,604	2,404	2,524	1,945	2,359	2,556	2,372	2,082	24,822
	Proportion (%) with repairs	61.1	59.3	56.2	55.1	53.3	42.0	52.0	58.3	57.5	51.1	54.7
Femoral	Incident diagnoses in year	75	79	68	57	63	67	62	46	40	44	601
	Subsequent repair (any year)	5	4	3	4	2	1	2	-	2	3	26
	Proportion (%) with repairs	6.7	5.1	4.4	7.0	3.2	1.5	3.2	-	5.0	6.8	4.3
Umbilical	Incident diagnoses in year	1,206	1,276	1,252	1,254	1,313	1,401	1,512	1,510	1,444	1,445	13,613
	Subsequent repair (any year)	703	732	699	639	584	483	642	746	724	594	6,546
	Proportion (%) with repairs	58.3	57.4	55.8	51.0	44.5	34.5	42.5	49.4	50.1	41.1	48.1
Ventral/ incisional	Incident diagnoses in year	639	642	651	614	701	677	695	681	647	635	6,582
	Subsequent repair (any year)	203	194	192	159	194	144	181	210	225	159	1,861
	Proportion (%) with repairs	31.8	30.2	29.5	25.9	27.7	21.3	26.0	30.8	34.8	25.0	28.3
Other	Incident diagnoses in year	1,933	1,823	1,449	1,312	1,261	1,265	1,191	1,095	1,013	935	13,277
	Subsequent repair (any year)	3	2	3	3	5	2	-	5	1	2	26
	Proportion (%) with repairs	0.2	0.1	0.2	0.2	0.4	0.2	-	0.5	0.1	0.2	0.2
Female		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Inguinal	Incident diagnoses in year	162	165	132	156	106	118	104	135	117	97	1,292
	Subsequent repair (any year)	64	77	60	58	45	31	50	53	51	33	522
	Proportion (%) with repairs	39.5	46.7	45.5	37.2	42.5	26.3	48.1	39.3	43.6	34.0	40.4
Femoral	Incident diagnoses in year	29	26	25	19	15	13	20	18	12	16	193
	Subsequent repair (any year)	4	2	1	3	2	1	1	-	1	1	16
	Proportion (%) with repairs	13.8	7.7	4.0	15.8	13.3	7.7	5.0	-	8.3	6.3	8.3
Umbilical	Incident diagnoses in year	236	221	262	243	288	287	367	358	328	371	2,961
	Subsequent repair (any year)	121	91	134	94	109	79	147	164	137	155	1,231
	Proportion (%) with repairs	51.3	41.2	51.1	38.7	37.8	27.5	40.1	45.8	41.8	41.8	41.6
Ventral/ incisional	Incident diagnoses in year	197	203	196	193	214	236	259	260	232	228	2,218
	Subsequent repair (any year)	62	64	53	60	45	46	71	61	56	48	566
	Proportion (%) with repairs	31.5	31.5	27.0	31.1	21.0	19.5	27.4	23.5	24.1	21.1	25.5
Other	Incident diagnoses in year	167	165	133	160	125	119	133	129	118	86	1,335
	Subsequent repair (any year)	-	-	1	-	1	2	1	1	-	2	8
	Proportion (%) with repairs	-	-	0.8	-	0.8	1.7	0.8	0.8	-	2.3	0.6

coded to indicate the presence of either gangrene or obstruction (manifestations of strangulation). Interestingly enough, the health records of fewer than 10% of all service members with diagnoses of femoral hernia contained documentation of surgical repairs. However, the records of nearly another 10% of femoral hernia patients contained documentation of another type of hernia repair. This observation is indicative of the potential for undercounting of corrective surgery procedures for abdominal hernias. The advent of laparoscopic surgery has made it not only possible, but also advantageous, to treat multiple hernias during a single operative intervention. For example, because femoral and inguinal hernias often occur in the same patient, the laparoscopic correction of one type may be combined with additional procedures to repair or prevent the other type. In fact, in some patients, a single laparoscopic procedure can be employed to correct bilateral inguinal and femoral hernias and a ventral or umbilical hernia. Under such circumstances, the procedure code recorded in the patient's record may not adequately document the full scope of the surgery. As a result, the data presented in this report likely underestimate the proportion of abdominal hernias that were surgically repaired. The fact that femoral and umbilical hernias do not have procedure codes for laparoscopic repair would also tend to underrepresent the apparent frequency of such procedures when done in combination with the repair of other types of hernia.

Even though the young adults who enter the military are screened to preclude their entrance with pre-existing abdominal

FIGURE 9. Proportions of diagnosed cases of the most common, specific abdominal hernias in each year that were associated with subsequent surgical repair, males, active component, U.S. Armed Forces, 2005–2014

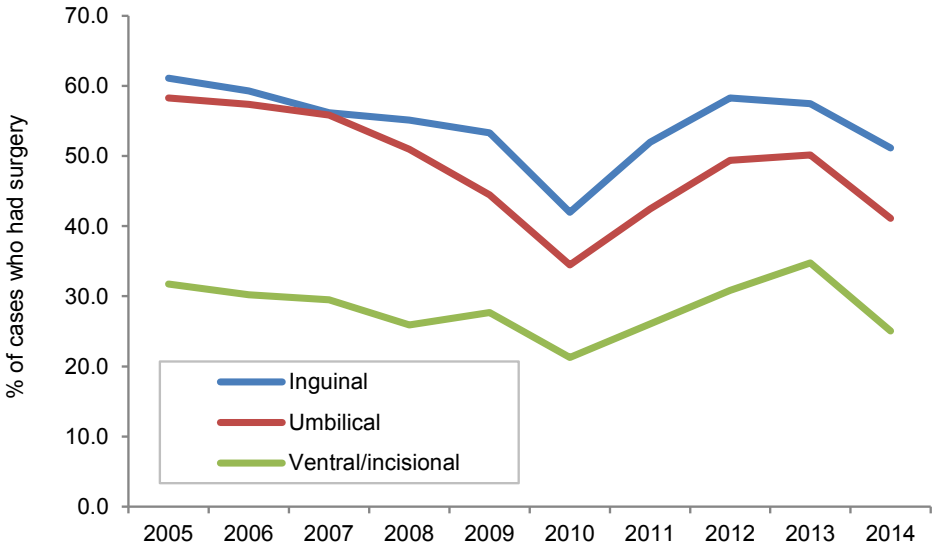
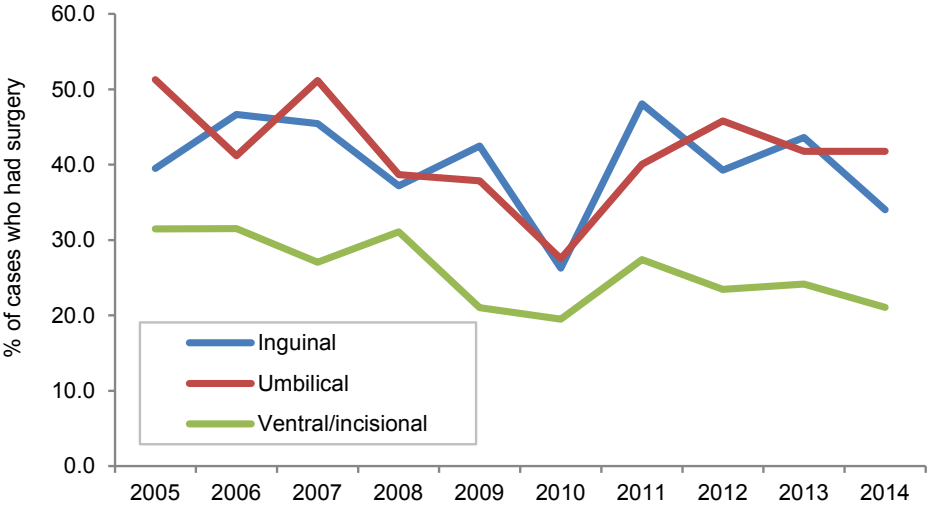


FIGURE 10. Proportions of diagnosed cases of the most common, specific abdominal hernias in each year that were associated with subsequent surgical repair, females, active component, U.S. Armed Forces, 2005–2014



hernias, a sizable proportion of service members subsequently develop hernias while in uniform. Apart from their potential for serious complications, many hernias cause symptoms such as pain that may worsen with the passage of time. In service members, painful hernias may interfere with the demands of their military duties and the requirements for meeting standards of physical fitness. Unfortunately, surgical repair of hernias may be associated with subsequent pain and even recurrence of hernia.[9] What can be done to decrease the impact of abdominal hernias on service members and the general population? In general, hernias occur at anatomical sites where there are defects, presumably congenital, in the integrity of the structures that comprise the abdominal wall. In addition, however, incisional hernias, and some recurrent hernias, occur where previous surgery or injury has weakened the abdominal wall. The predisposition to such hernias could be considered acquired rather than congenital. Although there is no preventive strategy for congenital predisposition to hernia, the treatment of hernias can entail some preventive impact. As noted earlier, the presence of a femoral hernia warrants close monitoring and a low threshold for surgical repair, given the frequency of strangulation with femoral hernias. Moreover, the goal of surgery of most abdominal hernias includes the prevention of strangulation as well as the relief of symptoms. Modern laparoscopic surgery has made possible the combination of a less invasive approach to repairing a single hernia with the pre-emptive treatment of sites of potential future hernias. Malangoni and Rosen discuss some recent data about the surgical technique used to close a midline laparotomy and suggest that a higher suture-to-wound-length ratio would reduce the incidence of subsequent incisional hernia.[1] Lastly, the same authors state that ventral hernia formation has been linked to the patient-related factors of obesity, older age, male gender, sleep apnea, emphysema, and prostatism. Of these, obesity and emphysema are theoretically susceptible to modifications in individual lifestyle.

REFERENCES

1. Malangoni MA, Rosen MJ. Hernias. In: Townsend CM, Beauchamp RD, Evers M, Mattox KL, eds. *Sabiston Textbook of Surgery*. 20th ed. Philadelphia, PA: Elsevier; 2017;1092–1119.
2. Flum DR. The asymptomatic hernia: "if it's not broken, don't fix it." *JAMA*. 2006;295(3):328–329.
3. Zendejas B, Ramirez T, Jones T, et al. Incidence of inguinal hernia repairs in Olmsted County, MN: a population-based study. *Ann Surg*. 2013;257(3):520–526.
4. Armed Forces Health Surveillance Branch. Absolute and relative morbidity burdens attributable to various illnesses and injuries, active component, U.S. Armed Forces, 2015. *MSMR*. 2016;23(4):2–7.
5. Armed Forces Health Surveillance Branch. Hospitalizations among members of the active component, U.S. Armed Forces, 2015. *MSMR*. 2016;23(4):8–16.
6. Armed Forces Health Surveillance Branch. Ambulatory visits among members of the active component, U.S. Armed Forces, 2015. *MSMR*. 2016;23(4):17–25.
7. DoD Instruction 6130.03. Medical Standards for Appointment, Enlistment, or Induction in the Military Services. 28 April 2010. Incorporating Change 1, 13 September 2011.
8. Armed Forces Health Surveillance Center. Surveillance snapshot: Age and gender distribution of service members, active component, U.S. Armed Forces, compared to the U.S. population, 2011. *MSMR*. 2013;20(11):16.
9. Fitzgibbons RJ, Giobbie-Hurder A, Gibbs JO, et al. Watchful waiting vs repair of inguinal hernia in minimally symptomatic men: a randomized clinical trial. *JAMA*. 2006;295(3):285–292.

Incidence of Hiatal Hernia in Service Members, Active Component, U.S. Armed Forces, 2005–2014

Francis L. O'Donnell, MD, MPH (COL, USA, Ret.); Stephen B. Taubman, PhD

From 2005 through 2014, a total of 27,276 active component service members had incident diagnoses of hiatal hernia documented in their medical records. The overall incidence rate was 19.7 cases per 10,000 person-years (p-yrs); annual incidence rates ranged from 16.5 to 22.2 cases per 10,000 p-yrs. Rates overall increased monotonically with increasing age and were higher among Air Force and Army members, officers, and healthcare workers than their respective counterparts. During the surveillance period, the 27,276 service members who had incident diagnoses of hiatal hernia accounted for 44,092 hiatal hernia-related encounters overall (1.6 encounters per case). Among all incident cases, 235 (0.86%) had surgical repairs documented during the period. The frequency of surgical treatment of hiatal hernias among military members mirrored the low frequency in U.S. civilian practice. During 2010–2014, most surgical procedures (79%) were accomplished via laparoscopic approaches. The incidence rates of hiatal hernia diagnoses reported here likely greatly underestimate the true incidence in U.S. military populations. Reasons for the underestimates and comparisons with other populations are discussed.

Under normal circumstances, the esophagus passes from the thoracic cavity (above the diaphragm) to the stomach (below the diaphragm) through an opening in the diaphragm ("esophageal hiatus"). If the esophageal hiatus becomes enlarged, abdominal structures (e.g., stomach) can protrude from the abdominal into the thoracic cavity; such situations are referred to as hiatal hernias.[1,2]

Type I hiatal hernia is characterized by migration of the junction of the esophagus and stomach to a position above the diaphragm. Published reports estimate that approximately 95% of diagnosed hiatal hernias are Type I. Most persons with Type I hiatal hernias have no troubling symptoms and may not be aware that they have hiatal hernias. More serious types of hiatal hernias are characterized by the migration upward, alongside the esophagus, of the fundus of the stomach (Types II and III) or, more seriously, of other abdominal structures such as portions of the omentum, colon, or small intestine (Type IV).

The most common symptoms associated with hiatal hernias are attributable to reflux of acidic stomach contents into the esophagus. Over time, the stomach acid can produce inflammation of the esophagus that can cause burning or tightness in the chest, heartburn, and regurgitation of food. When symptoms caused by acid reflux persist despite initial treatment measures, the condition is described as gastroesophageal reflux disease (GERD). Hiatal hernia is a common risk factor for GERD, but not all cases of GERD are due to hiatal hernias. Types II–IV of hiatal hernia pose the risk of obstruction or strangulation of the herniated organ and pre-emptive surgery is often undertaken to prevent such potentially fatal complications. Unfortunately, the occurrence of such complications requires surgical treatment, sometimes under emergent conditions. Hiatal hernias increase in prevalence with older age; prevalence as high as 60% has been estimated among persons aged 50 years and older.[3] Obesity is a risk factor for the development of hiatal hernia.

A diagnosis of hiatal hernia is not a disqualifying condition for entrance into military service, although GERD with complications is disqualifying. Surgery of the type commonly used for GERD with hiatal hernia (fundoplication) within the preceding 6 months is considered a basis for delaying entry.[4]

This study estimated the incidence of hiatal hernia among active component service members during 2005–2014 and the frequency of surgical procedures for the condition. Although surgery is necessary for only a small fraction of cases of hiatal hernia, such surgery is associated with significant disability and absence from duty.

METHODS

The surveillance period was 1 January 2005 through 31 December 2014. The surveillance population included all active component service members of the Army, Navy, Air Force, and Marine Corps who served at any time during the surveillance period. Records of both inpatient and outpatient health care documented in the databases of the Defense Medical Surveillance System (DMSS) were searched to ascertain cases of hiatal hernia. A case was defined by the presence of an ICD-9 code for hiatal hernia in any diagnostic position of the record of an inpatient or outpatient encounter **(Table 1)**. For each individual who met the criterion for a case,

TABLE 1. ICD-9 diagnostic codes for hiatal hernia and ICD-9 and CPT procedure codes for open and laparoscopic repairs

Description	ICD-9 diagnostic codes
Hiatal hernia with gangrene	551.3
Hiatal hernia specified as irreducible, strangulated, or with obstruction	552.3
Hiatal hernia without mention of obstruction or gangrene	553.3
Hernia repair (inpatient setting)	ICD-9 procedure codes
Open	53.7, 53.72, 53.75, 53.8, 53.80, 53.82, 53.84
Laparoscopy	53.71, 53.83
Hernia repair (outpatient setting)	CPT procedure codes
Open	39502, 39520, 39530, 39531, 39540, 39541, 43332–43337
Laparoscopy	None

the date of the first-ever encounter with a hiatal hernia diagnosis during the surveillance period was considered the incidence date. Individuals who had a case-defining encounter before the surveillance period were excluded from the analysis. An individual was considered an incident case just once during the surveillance period, but all subsequent encounters with a diagnosis of hiatal hernia were captured. For all defined incident cases, their healthcare records were searched for documentation of surgical repair of a hiatal hernia coincident with, or subsequent to, their incident diagnosis. An instance of surgical repair was defined as an inpatient encounter with a procedure (PR) code for the repair in any position or an outpatient encounter with a Current Procedural Terminology (CPT) code for hiatal hernia repair in any position **(Table 1)**. For cases of hiatal hernia identified during each year of the surveillance period, their complete medical records were searched for evidence of subsequent surgical repair at any time during the period. Each case's follow-up continued until the end of the surveillance period or until the service member left active duty, retired, or died. The numbers of such procedures were associated with the year in which the incident diagnoses were made. The proportions of each year's cases that eventually had documented surgical repair were calculated. Because procedural codes for hiatal hernia repairs changed during the surveillance period, codes that specified surgical approaches as laparoscopic were not used until late 2008 and were restricted to inpatient procedures. Accordingly, the frequencies of laparoscopic versus open surgical approaches are summarized for the years 2010–2014 only.

Incidence rates for hiatal hernia were compared across several demographic characteristics (sex, race/ethnicity, age group, branch of military service, rank, and military occupational field) and for each year of the surveillance period. The analysis examined the distribution of cases according to the total number of their healthcare encounters for hiatal hernia and for any possible correlation between numbers of such encounters and the likelihood of surgical repair. The study also examined the relative frequencies of laparoscopic versus open surgical repair and of inpatient versus outpatient surgical repair.

RESULTS

During the 10-year surveillance period, the records of 27,276 active component service members documented first-time diagnoses of hiatal hernias ("incident cases"). Among the incident diagnoses, 13 specified the code for hiatal hernia with gangrene (ICD-9: 551.3); 47 had the code for a hernia obstructed, strangulated, or irreducible (ICD-9: 552.3); and all others (n=27,216) had the code 553.3, which simply indicates hiatal hernia with no mention of obstruction or gangrene **(data not shown)**. The overall incidence rate was 19.7 cases per 10,000 person-years (p-yrs); annual incidence rates ranged from 16.5 to 22.2 cases per 10,000 p-yrs in 2010 and 2005, respectively **(Table 2, Figure 1)**. Overall rates were slightly higher (by 3.5%) among females than males. The most striking association between a demographic characteristic and incidence rate was for age. Rates increased monotonically from the youngest to the oldest age groups examined in this analysis **(Figure 2)**. Compared to the rates in their respective counterparts, incidence rates were higher among service members who were white, non-Hispanic; in the Air Force or Army; officers; and in healthcare occupations **(Table 2)**.

During the surveillance period, the 27,276 incident cases accounted for 44,092 hiatal hernia-associated healthcare encounters. The mean and median numbers of such encounters per case were 1.62 and 2, respectively **(data not shown)**. Most cases (n=19,213; 70.4%) had only one episode of care documented with a hiatal hernia diagnosis; and nearly all cases (97.3%) had five or fewer hiatal hernia-related encounters **(Table 3)**.

Of the 27,276 service members with incident diagnoses of hiatal hernia, 235 (0.86%) had surgical repairs during the surveillance period that were documented in medical records. The proportions of males and female cases who had such procedures were 0.87% (n=201) and 0.83% (n=34), respectively **(Table 4)**. Although the duration of potential follow-up progressively shortened for each year from 2005 forward, the numbers and proportions for each year's cases fluctuated greatly. Only the decline in the 2014 cases' numbers and proportions who had surgery suggests the effect of a shortened follow-up period. Service members with five or fewer hiatal hernia-associated encounters accounted for 97.3% of all cases but 60.0% of all surgical procedures; those with six to 10 encounters accounted for 2.4% of cases but 30.6% of surgical procedures; and those with more than 10 encounters accounted for 0.3% of cases but 9.4% of all procedures. Of cases with five or fewer encounters, six to 10

TABLE 2. Counts and rates of incident diagnoses of hiatal hernia, by demographic characteristics, active component, U.S. Armed Forces, 2005–2014

	No.	Rate[a]
Total	27,276	19.7
Sex		
Male	23,192	19.6
Female	4,084	20.3
Race/ethnicity		
White, non-Hispanic	19,260	22.6
Black, non-Hispanic	3,627	16.0
Hispanic	2,343	14.6
Asian/Pacific Islander	592	11.2
American Indian/ Alaska Native	193	12.0
Other/unknown	1,261	17.5
Age		
<20	318	3.5
20–24	3,718	8.2
25–29	4,913	15.1
30–34	4,447	21.5
35–39	5,129	31.6
40–44	4,931	50.7
45+	3,820	77.2
Service		
Army	11,991	22.7
Navy	5,550	16.9
Air Force	7,604	22.9
Marine Corps	2,131	11.1
Rank		
Enlisted	20,702	18.0
Officer	6,574	28.5
Occupation		
Combat-specific	3,269	16.2
Armor/motor transport	712	17.0
Pilot/air crew	1,150	22.0
Repair/engineering	7,555	18.9
Communications/ intelligence	6,553	21.3
Health care	3,405	28.9
Other/unknown	4,632	17.9

[a]Rate per 10,000 person-years

TABLE 3. Distribution of hiatal hernia cases by numbers of encounters for hiatal hernia, and distribution of surgical procedures according to numbers of encounters

No. of encounters for hiatal hernia	No. of incident cases	% of all incident cases	No. of encounters for hiatal hernia	% of all encounters for hiatal hernia	No. who had surgical procedures[a]	% of all surgical procedures	% of cases who underwent surgery
1–5	26,542	97.3	38,200	86.6	141	60.0	0.5
6–10	647	2.4	4,648	10.5	72	30.0	11.1
11+	87	0.3	1,244	2.8	22	9.4	25.3
Total	27,276		44,092		[a]235		0.86

[a]Seven service members (all males) underwent two repair procedures, for a total number of 242 procedures.

TABLE 4. Numbers of incident diagnoses of hiatal hernia, by year, and the numbers and proportions of cases who underwent surgical repair procedures at any time after the incident diagnosis

Total	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Incident diagnoses	3,054	2,849	2,866	2,590	2,672	2,337	2,728	3,038	2,645	2,497	27,276
Subsequent repair (any year)	27	27	25	15	14	21	30	26	35	15	235
Proportion (%) with repairs	0.88	0.95	0.87	0.58	0.52	0.90	1.10	0.86	1.32	0.60	0.86
Male	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Incident diagnoses	2,596	2,453	2,486	2,213	2,274	1,991	2,317	2,530	2,212	2,120	23,192
Subsequent repair (any year)	22	21	23	13	12	20	29	17	31	13	201
Proportion (%) with repairs	0.85	0.86	0.93	0.59	0.53	1.00	1.25	0.67	1.40	0.61	0.87
Female	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Incident diagnoses	458	396	380	377	398	346	411	508	433	377	4,084
Subsequent repair (any year)	5	6	2	2	2	1	1	9	4	2	34
Proportion (%) with repairs	1.09	1.52	0.53	0.53	0.50	0.29	0.24	1.77	0.92	0.53	0.83

encounters, and more than 10 encounters, 0.5%, 11.1%, and 25.3% underwent surgery, respectively **(Table 3)**.

The frequencies of laparoscopic versus open surgical approaches are summarized for the years 2010–2014 only. Of the 144 surgical repairs for hiatal hernia during those years, the recorded procedure codes indicated that 114 (79%) were performed via laparoscopy and 30 (21%) via open approach. All surgical procedures were done in the inpatient setting **(data not shown)**.

EDITORIAL COMMENT

Hiatal hernias are considered relatively common conditions among adults, especially those aged 50 years or older. However,

FIGURE 1. Annual incidence rates of hiatal hernia diagnoses for all cases and for each sex, active component, U.S. Armed Forces, 2005–2014

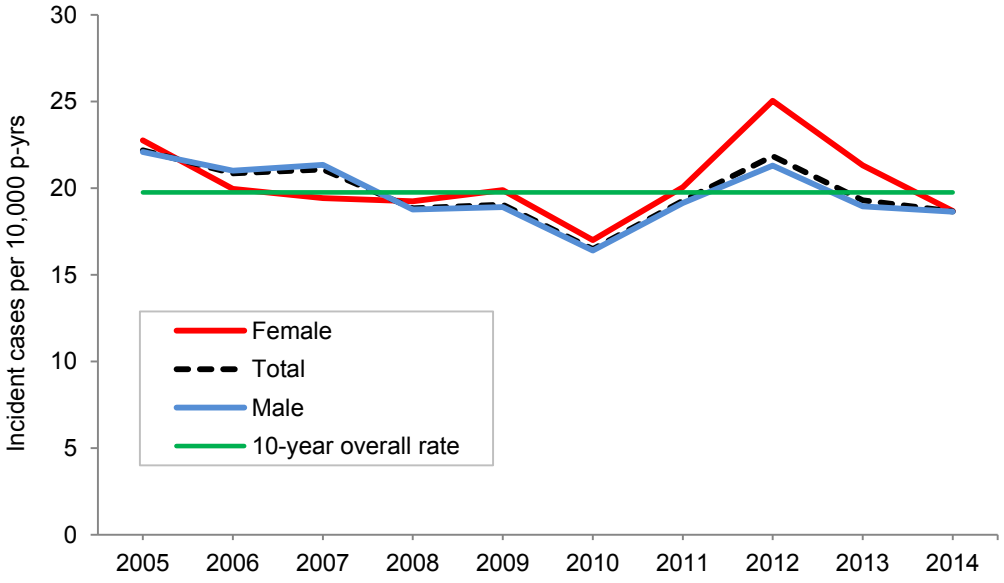
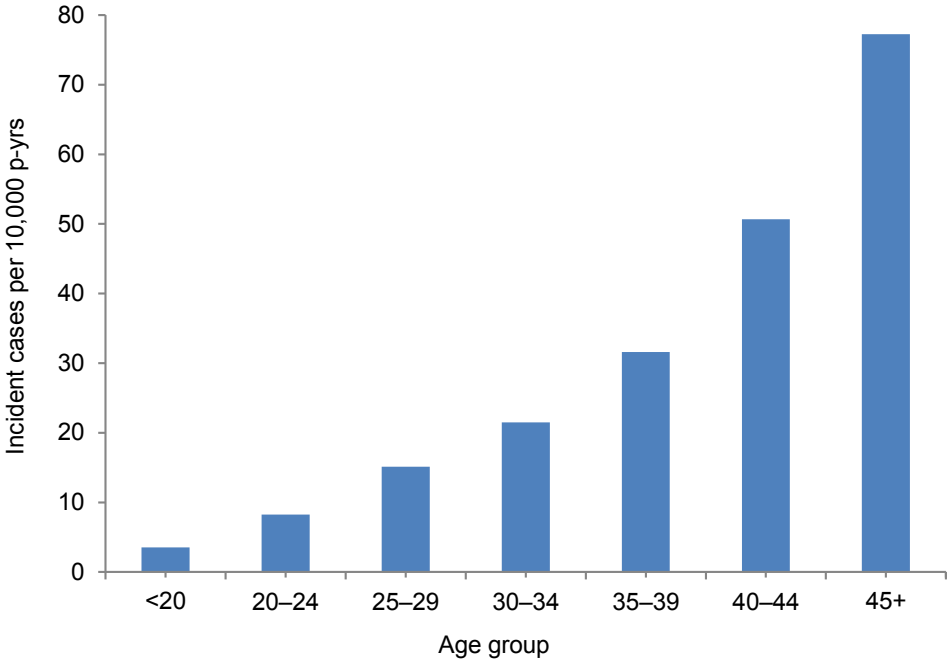


FIGURE 2. Incidence rates of hiatal hernia diagnoses, by age group, active component, U.S. Armed Forces, 2005–2014



estimation of the true prevalence of the condition is difficult because most hiatal hernias do not produce symptoms. Moreover, when symptoms do occur, they are typically those of gastroesophageal reflux (GER), a condition that is usually first treated with medications and lifestyle modifications. When such treatments are effective, further diagnostic evaluations are not undertaken. As a result, diagnoses of hiatal hernias are usually confirmed if symptoms of GER are difficult to manage and further diagnostic assessments are pursued, or incidentally during medical evaluations (e.g., imaging procedures such as x-ray, endoscopy) for other conditions.[5,6]

Because many cases of hiatal hernia are asymptomatic or, when symptomatic, are not specifically diagnosed, the finding of an average annual incidence of about 2,700 new diagnoses of hiatal hernias among active component service members significantly underestimates the true incidence of the condition in the military population. Also, because a relatively small proportion of the active military force is aged 50 years or older, an age range for which the prevalence of hiatal hernia disease is much higher than among the age groups that predominate in the military, it is not surprising that the overall incidence rate (unadjusted) documented in this study is less than estimates derived from civilian populations. In non-military adult populations, prevalences of hiatal hernia of 15%–55% have been estimated using radiographic techniques.[7]

The findings of this analysis were consistent with the surgical literature that reports that the incidence and prevalence of diagnoses increase with advancing age and are approximately the same among males and females. The relatively higher incidence rates among officers and those in healthcare occupations may reflect the confounding effect of higher average age in these groups and easier access to health care. The crude incidence rate was higher among white, non-Hispanic service members than among other race/ethnicity groups. It is possible that this finding is affected by other differences between race/ethnicity groups with respect to age, service, rank, and occupation. As a result, the comparisons between these crude incidence rates may be misleading. However, some older studies in Africa have indicated that hiatal hernias are much less common than has been reported in Europe and the U.S.[8] This analysis did not attempt to examine the other diagnoses (e.g., GERD) that were associated with the 27,276 cases of hiatal hernia that were identified in service members' health records.

This study confirmed the general consensus that the overwhelming majority of diagnosed cases of hiatal hernia do not require surgery. Surgery is generally believed to be unnecessary for Type I hiatal hernias unless they are complicated by GERD that is

relatively severe and not successfully treated with nonsurgical measures.[2] This analysis did not allow differentiation of Types II–IV hiatal hernias (said to represent 5% of all cases) from Type I cases, so it was not possible to discern what proportion of the surgical cases were associated with the higher-risk types of hiatal hernia. The observation that the likelihood of surgery increased with the numbers of encounters for hiatal hernia is compatible with the usual practice of avoiding surgical treatment unless more conservative treatment approaches have failed to relieve severe symptoms or one of the complications of Types II–IV hiatal hernia has occurred. Another limitation in the estimation of surgical repairs is the possibility that some surgical patients, especially those whose surgery was for one of the serious complications of hiatal hernia, may have undergone surgical procedures whose description and procedural codes are not specific to the repair of hiatal hernias and thus were not searched for in cases' medical records. Fewer than 1% of all hiatal hernia cases identified in this study ever had surgery during the surveillance period. Another limitation of this estimate of the long-term likelihood of surgery is the varying lengths of follow-up due to service members' death, departure from active service, or the end of the study period. There were undoubtedly additional cases of hiatal hernia who eventually underwent corrective surgery but such individuals were not identified in this study because their surgery took place following their military service or after 2014.

The frequency of surgery for hiatal hernia in this study may also have been lower than estimates in civilian populations due to active component service members' relative youth, lower prevalence of obesity, and overall fitness and health status. The inability to capture diagnoses and surgical procedures among service members in the years after they left military service would result in underestimates of incidence because age-related risk factors for both asymptomatic and symptomatic disease would become more prevalent.

REFERENCES

1. Yates RB, Oelschlager BK, Pellegrini CA. Gastroesophageal reflux disease and hiatal hernia. In: Townsend CM, Beauchamp RD, Evers M, Mattox KL, eds. *Sabiston Textbook of Surgery*. 20th ed. Philadelphia, PA: Elsevier; 2017;1043–1064.
2. Kohn GP, Price RR, Demeester SR, et al. Guidelines for the management of hiatal hernia. *Surg Endosc*. 2013;27(12):4409–4428.
3. Goyal RK. Diseases of the esophagus. In: Fauci AS, Braunwald E, Isselbacher KJ, et al., eds. *Harrison's Principles of Internal Medicine*. 14th ed. New York, NY: McGraw-Hill; 1998;1589–1596.
4. DoD Instruction 6130.03. Medical Standards for Appointment, Enlistment, or Induction in the Military Services. 28 April 2010. Incorporating Change 1, 13 September 2011.
5. Hyun JJ, Bak YT. Clinical significance of hiatal hernia. *Gut Liver*. 2011;5(3):267–277.
6. Stilson WJ, Sanders I, Gardiner GA, Gorman HC, Lodge DF. Hiatal hernia and gastroesophageal reflux. A clinicoradiological analysis of more than 1,000 cases. *Radiology.* 1969;93(6):1323–1327.
7. Dyer NH, Pridie RB. Incidence of hiatus hernia in asymptomatic subjects. *Gut*. 1968;9(6):696–699.
8. Bassey OO, Eyo EE, Akinhanmi GA. Incidence of hiatus hernia and gastro-oesophageal reflux in 1030 prospective barium meal examinations in adult Nigerians. *Thorax*. 1977;32(3):356–359

MSMR's Invitation to Readers

Medical Surveillance Monthly Report (MSMR) invites readers to submit topics for consideration as the basis for future *MSMR* reports. The *MSMR* editorial staff will review suggested topics for feasibility and compatibility with the journal's health surveillance goals. As is the case with most of the analyses and reports produced by Armed Forces Health Surveillance Branch staff, studies that would take advantage of the healthcare and personnel data contained in the Defense Medical Surveillance System (DMSS) would be the most plausible types. For each promising topic, Armed Forces Health Surveillance Branch staff members will design and carry out the data analysis, interpret the results, and write a manuscript to report on the study. This invitation represents a willingness to consider good ideas from anyone who shares the *MSMR*'s objective to publish evidence-based reports on subjects relevant to the health, safety, and well-being of military service members and other beneficiaries of the Military Health System (MHS).

In addition, *MSMR* encourages the submission for publication of reports on evidence-based estimates of the incidence, distribution, impact, or trends of illness and injuries among members of the U.S. Armed Forces and other beneficiaries of the MHS. Information about manuscript submissions is available at www.health.mil/Military-Health-Topics/Health-Readiness/Armed-Forces-Health-Surveillance-Branch/Reports-and-Publications/Medical-Surveillance-Monthly-Report/Instructions-for-Authors.

Please email your article ideas and suggestions to the *MSMR* editorial staff at: dha.ncr.health-surv.mbx.afhs-msmr@mail.mil.

Medical Surveillance Monthly Report (MSMR)
Armed Forces Health Surveillance Branch
11800 Tech Road, Suite 220 (MCAF-CS)
Silver Spring, MD 20904

MEDICAL SURVEILLANCE MONTHLY REPORT (MSMR), in continuous publication since 1995, is produced by the Armed Forces Health Surveillance Branch (AFHSB). The *MSMR* provides evidence-based estimates of the incidence, distribution, impact and trends of illness and injuries among United States military members and associated populations. Most reports in the *MSMR* are based on summaries of medical administrative data that are routinely provided to the AFHSB and integrated into the Defense Medical Surveillance System for health surveillance purposes.

Archive: Past issues of the *MSMR* are available at www.health.mil/Military-Health-Topics/Health-Readiness/Armed-Forces-Health-Surveillance-Branch/Reports-and-Publications/Medical-Surveillance-Monthly-Report/View-Past-Reports.

Subscriptions (electronic and hard copy): Submit subscription requests online at www.health.mil/Military-Health-Topics/Health-Readiness/Armed-Forces-Health-Surveillance-Branch/Reports-and-Publications/Medical-Surveillance-Monthly-Report/Subscribe-to-the-MSMR.

Editorial inquiries: Call (301) 319-3240 or send email to: dha.ncr.health-surv.mbx.afhs-msmr@mail.mil.

Instructions for authors: Information about article submissions is provided at www.health.mil/Military-Health-Topics/Health-Readiness/Armed-Forces-Health-Surveillance-Branch/Reports-and-Publications/Medical-Surveillance-Monthly-Report/Instructions-for-Authors.

Follow us:
www.facebook.com/AFHSCPAGE
http://twitter.com/AFHSBPAGE

ISSN 2158-0111 (print)
ISSN 2152-8217 (online)