The UHMS/CDC Carbon Monoxide Poisoning Surveillance Program Three-year data

Neil B. Hampson M.D.[1]; Susan L. Dunn CHRN[1]; Fuyuen Y. Yip, PhD[2]; Jacquelyn H. Clower MPH[3]; Lindell K. Weaver M.D.[4]

[1] Section of Hyperbaric Medicine, Virginia Mason Medical Center, Seattle, Washington

[2] Centers for Disease Control and Prevention, National Center for Environmental Health, Air Pollution and Respiratory Health Branch, Atlanta, Georgia

[3] Contractor to Centers for Disease Control and Prevention. National Center for Environmental Health, Air Pollution and Respiratory Health Branch Atlanta, Georgia

[4] Medical Director and Division Chief, Hyperbaric Medicine LDS Hospital, Salt Lake City, Utah, and Intermountain Medical Center, Murray, Utah; Professor of Medicine, University of Utah School of Medicine

CORRESPONDING AUTHOR: Dr. Neil Hampson – *neil.hampson@vmmc.org*

INTRODUCTION

As described earlier in this issue of the *Undersea and Hyperbaric Medicine Journal*, the Undersea and Hyperbaric Medical Society (UHMS) collaborated with the Centers for Disease Control and Prevention (CDC) from 2008-2011 to trial online surveillance for carbon monoxide poisoning in the United States [1].

Over those three years, 64 UHMS member facilities reported unidentifiable demographic, epidemiologic and clinical data on 1,907 patients treated with hyperbaric oxygen for CO poisoning. The following data summary for those 1,907 patients represents an enormous effort by UHMS members who collected, collated and submitted the information, and each of them is extended sincere thanks from those who planned, supported and conducted this project.

The following data summary on nearly 2,000 patients treated with hyperbaric oxygen for acute CO poisoning is undoubtedly the most comprehensive description of this population published to date.

REFERENCES

1. Hampson NB, Bell J, Clower JH, Dunn SL, Weaver LK. Partnering with a medical specialty society to perform online disease surveillance. Undersea Hyperb Med 2012; 39(2):649-657.

2. Centers for Disease Control and Prevention. Carbon monoxide-related deaths: United States 1999-2004. MMWR 2007; 56(50):1309-1312.

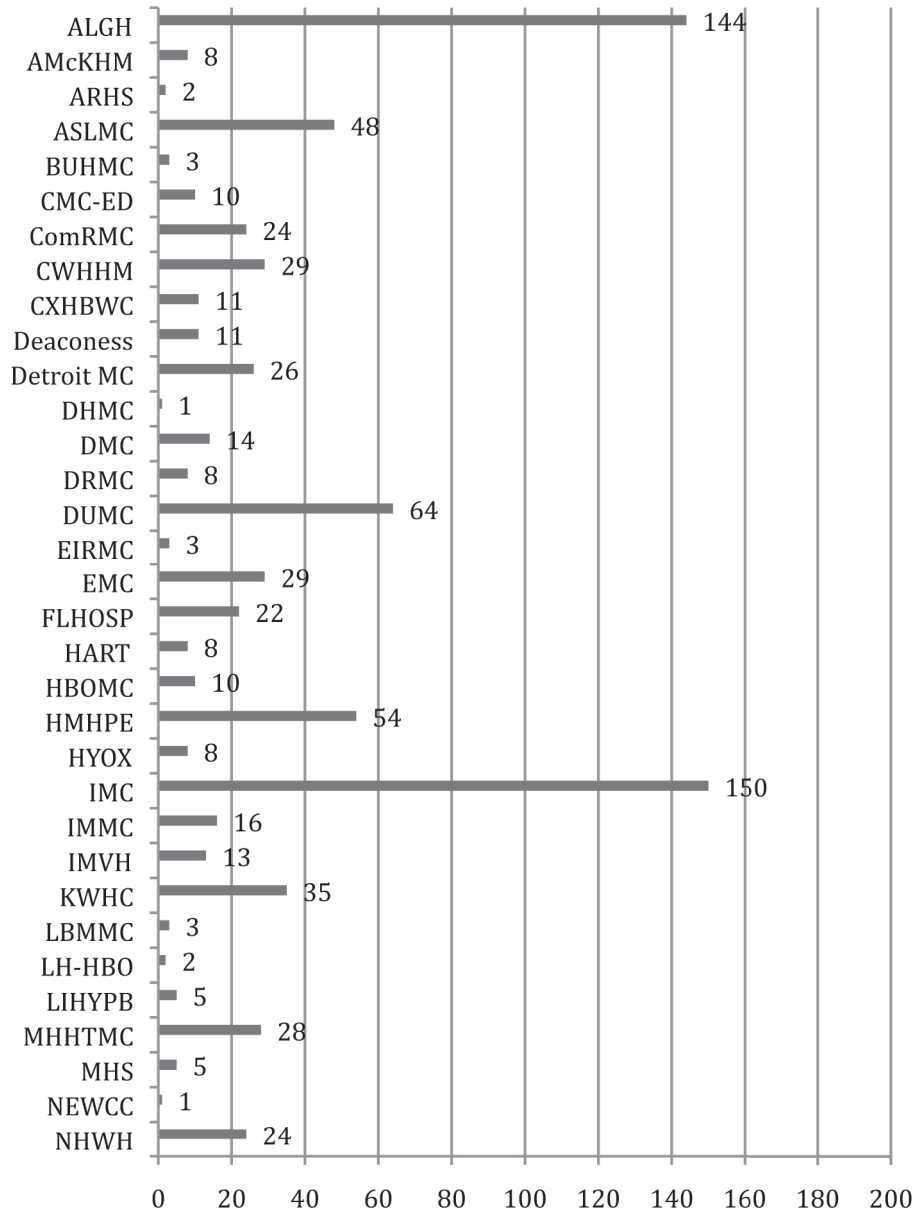**FIGURE 1(a).** *Patients reported over three years per facility, by facility code*

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver

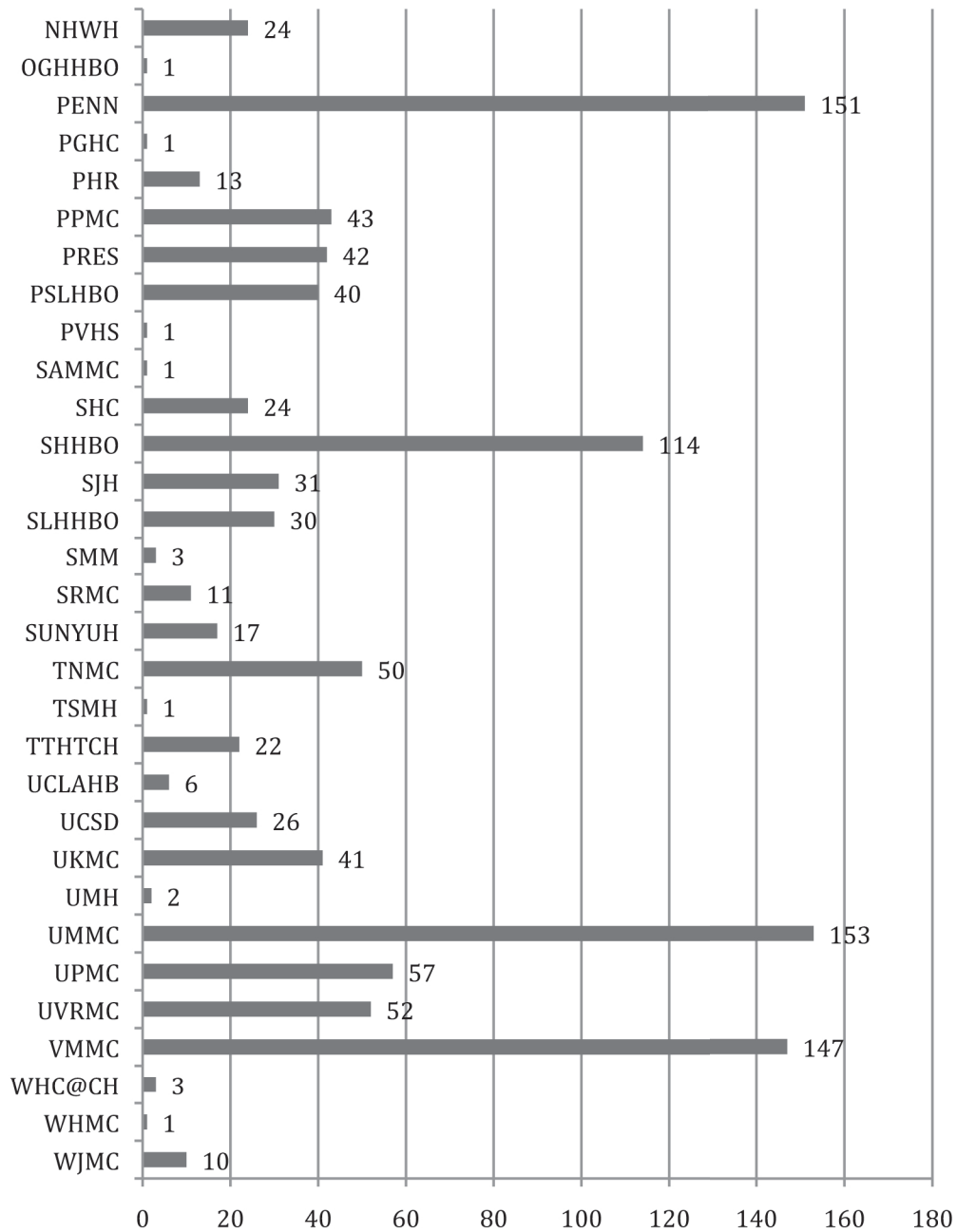**FIGURE 1(b).** *Patients reported by remainder of facilities*

FIGURE 2. *U.S. states in which poisoning occurred for 1,907 reported patients.*
Variation in numbers reported likely relate to differences in regional risks for CO poisoning, availability
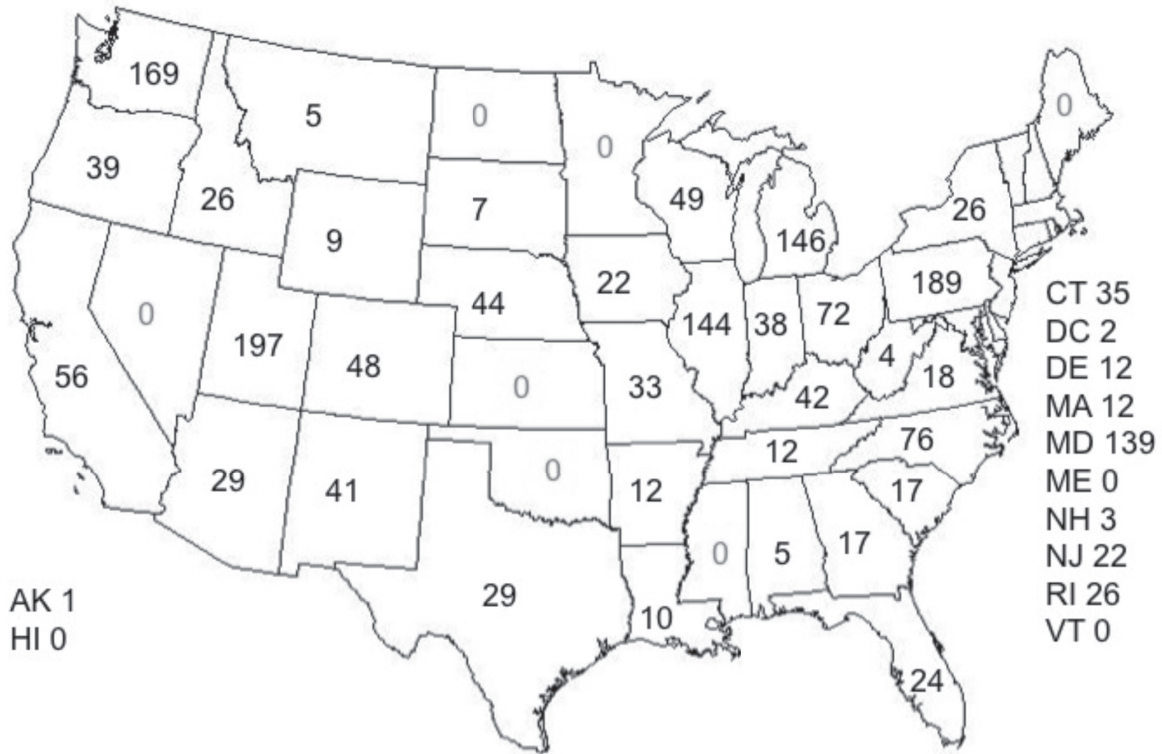***of hyperbaric chambers and level of participation in the UHMS/CDC surveillance system***

FIGURE 3. *Comparison of total CO deaths per state from 1999-2004 (as reported by the CDC,*
reference 2). Linear regression analysis demonstrates a significant correlation (p=0.0056),
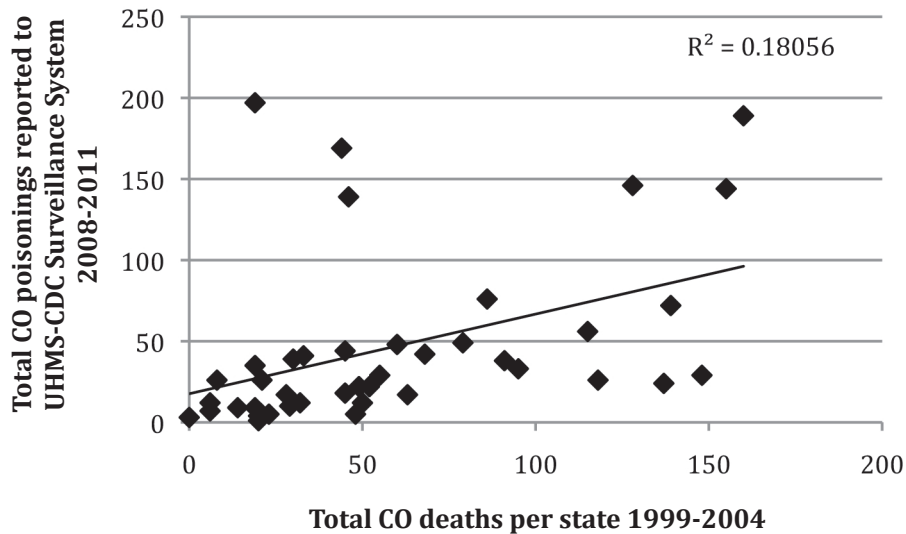***suggesting that much of the variation seen in Figure 2 is geographic***

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver

FIGURE 4. *Number of CO poisoning cases reported by month*
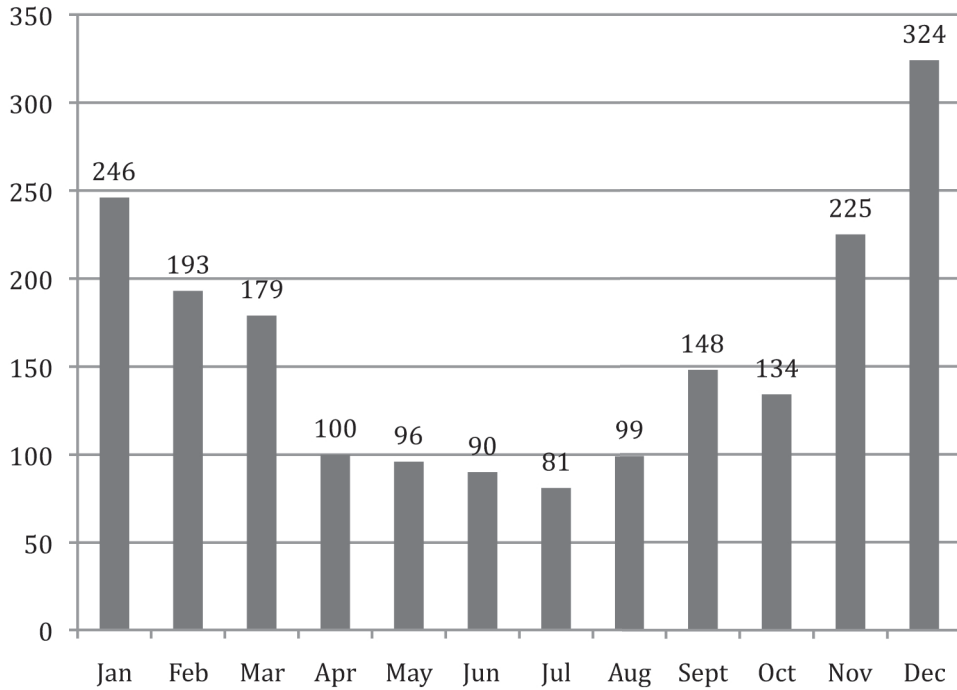
FIGURE 5. *Patients reported per decade of age in years*

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver
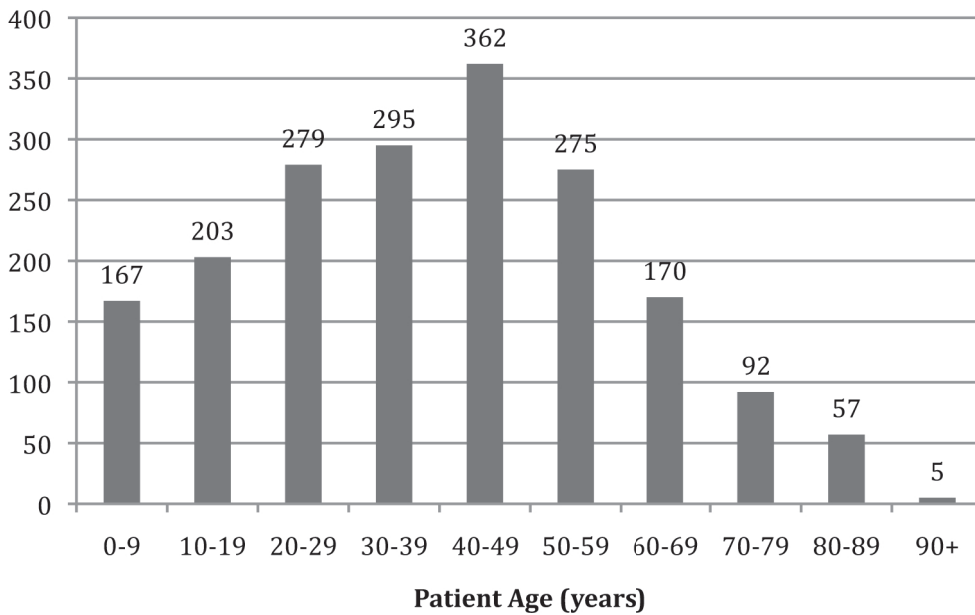
FIGURE 6. *Gender of patients reported*

FIGURE 7. *Race/ethicity of patients reported*

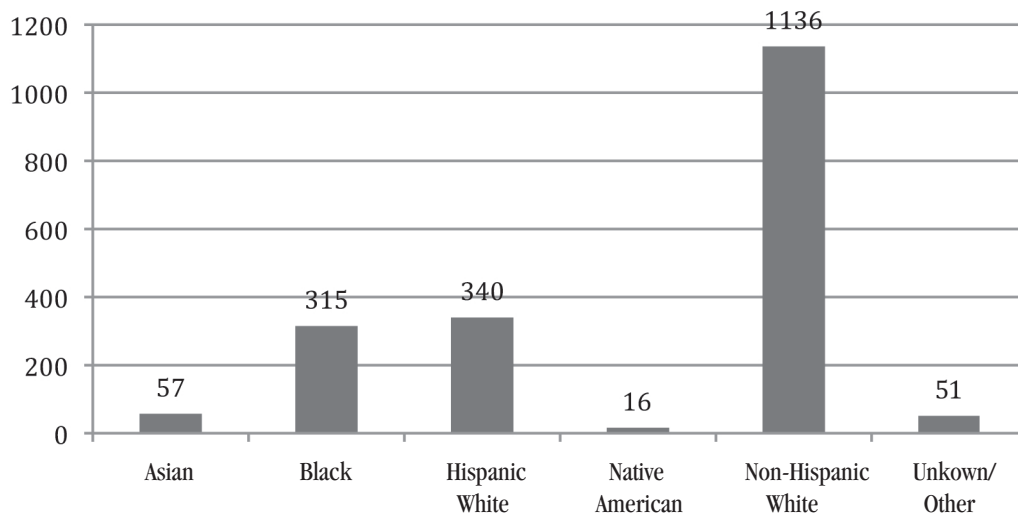*N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver*
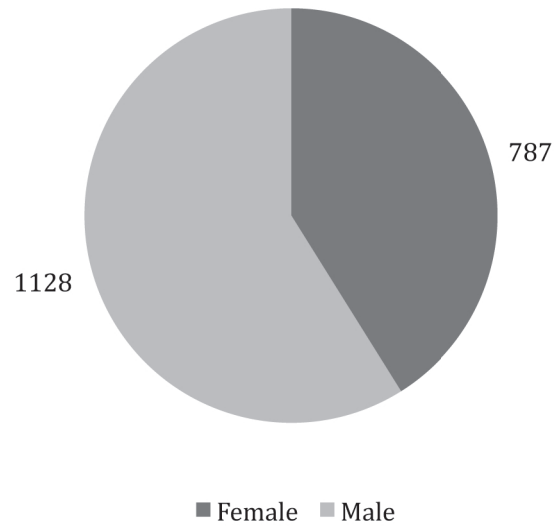
TABLE 1. *Number of patients reported with various primary languages and whether they spoke English if it was not their primary tongue*

	Primary language	Speak English
Arabic	6	3
Brazilian	1	1
Chinese	3	2
Creole	2	2
English	1,608	1,608
Farsi	1	0
French	3	2
Greek	1	0
Hebrew	1	1
Hmong	2	0
Italian	1	0
Japanese	2	2
Korean	1	1
Native American	5	4
Peruvian	2	2
Russian	1	1
Serbian	1	1
Spanish	195	94
Unknown	60	0
Urdu	2	2
Vietnamese	18	14

FIGURE 8. *Educational level of patients reported*
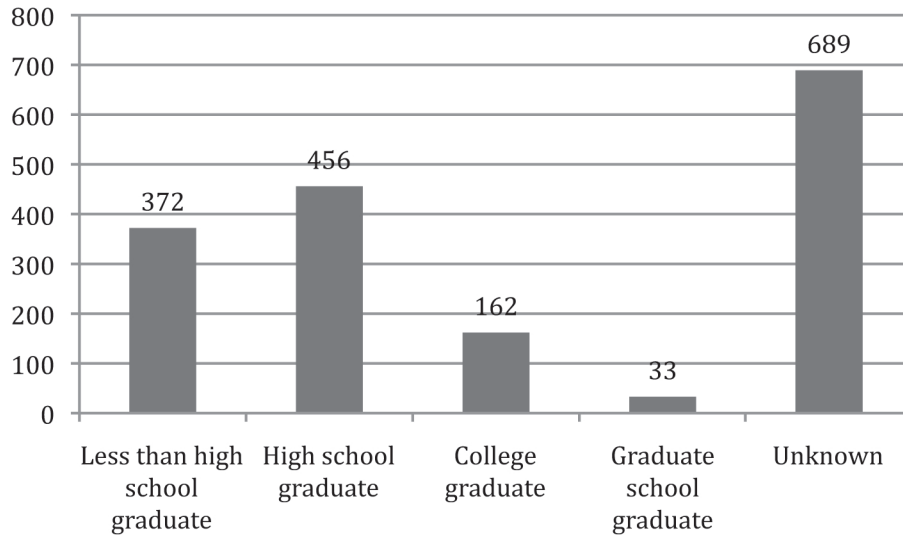
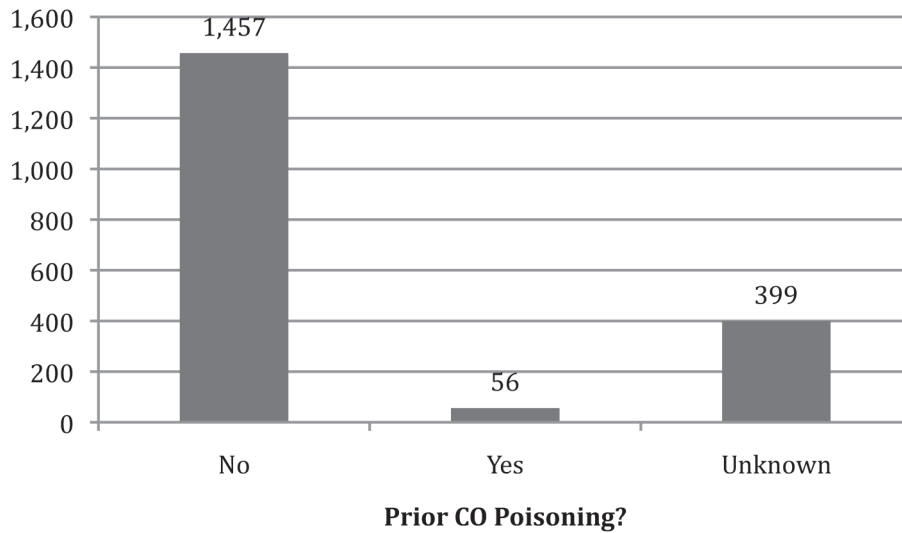**FIGURE 9.** *Number of patients reported with prior CO poisoning*

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver

FIGURE 10(a). *Pregnancy status of 783 female patients reported*
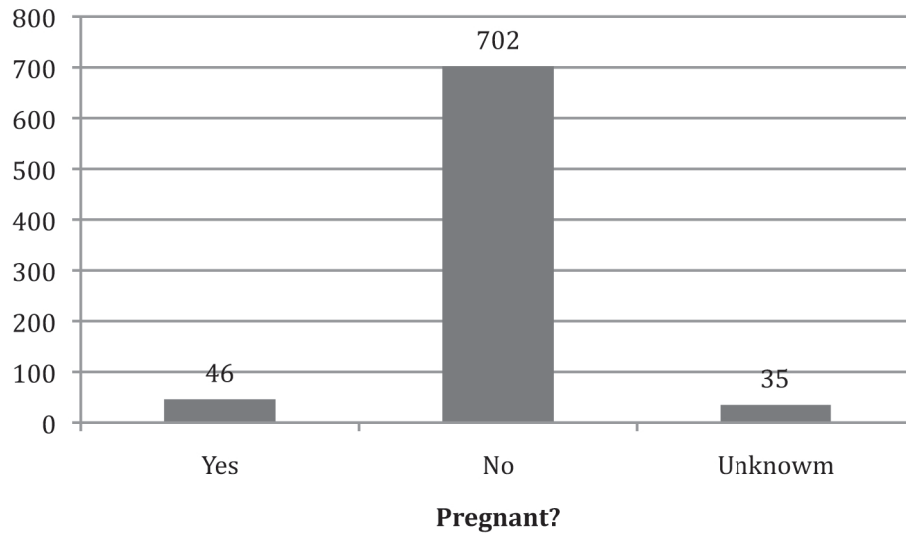
Pregnant?

FIGURE 10(b). *Weeks of gestation for the 46 pregnant patients reported*

Weeks Gestation
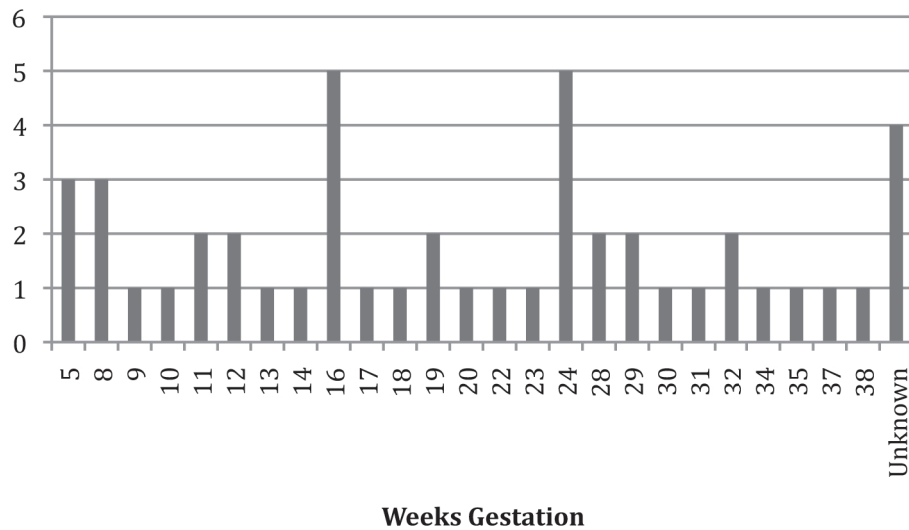
FIGURE 11. *Number of patients reported for various sources of CO*

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver
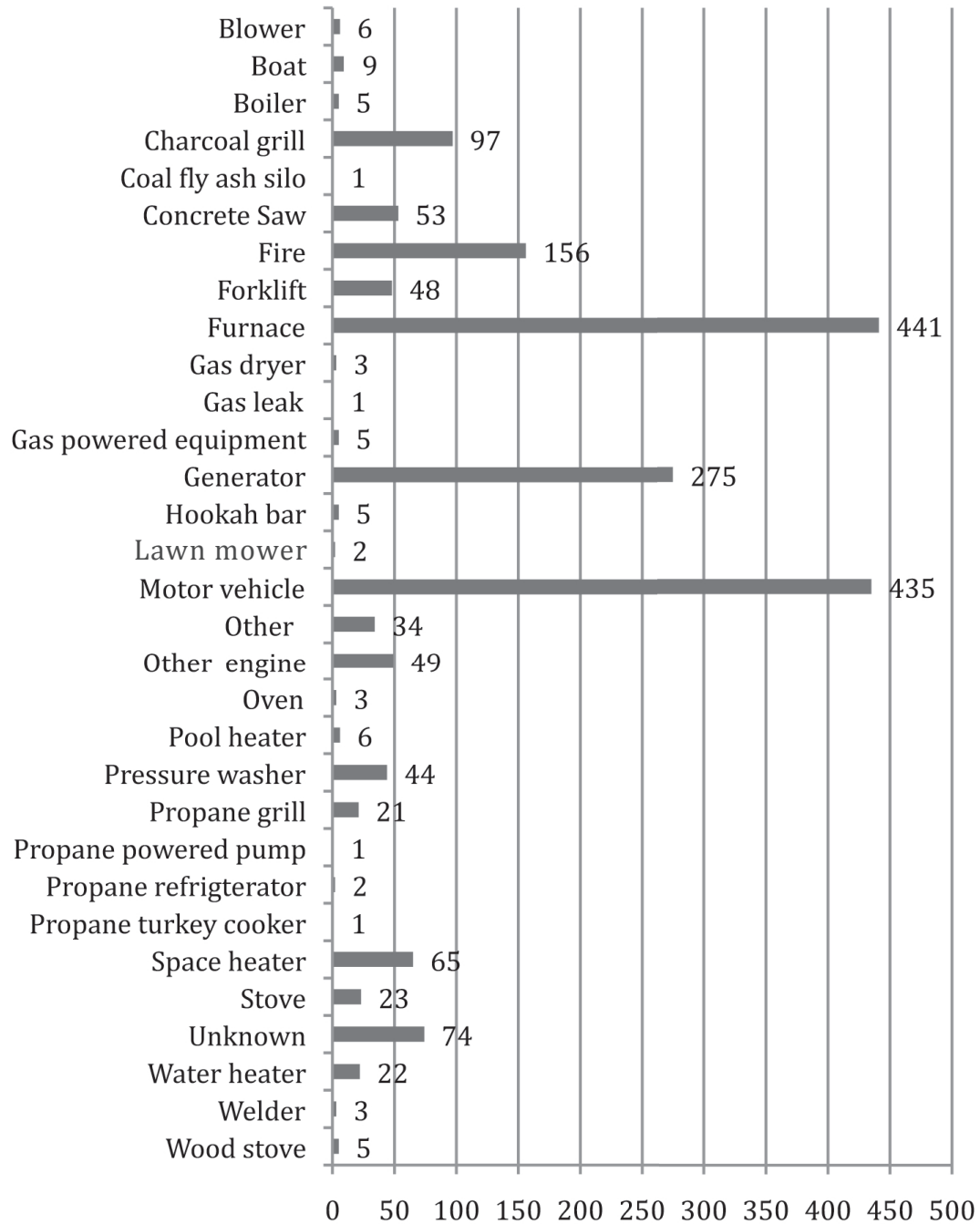
FIGURE 12. *Locations where poisonings occurred*

Location	Count
Bar	3
Boat	10
Camper/trailer	13
Church	5
Dormitory	1
Farm silo	4
Garage	17
Hotel/motel	15
Manhole	1
Motor home	1
Motor vehicle	159
Nursing facility	2
Outdoors	22
Public building	8
Recreational facility (e.g. skating rink)	13
Residence (circumstances unknown)	323
Residence (owned)	687
Residence (rented)	280
Residence (visiting)	98
Restaurant	1
Shed	5
Tent	1
Unknown	27
Workplace (e.g. warehouse)	203

FIGURE 13. *Activity at the time of CO exposure*
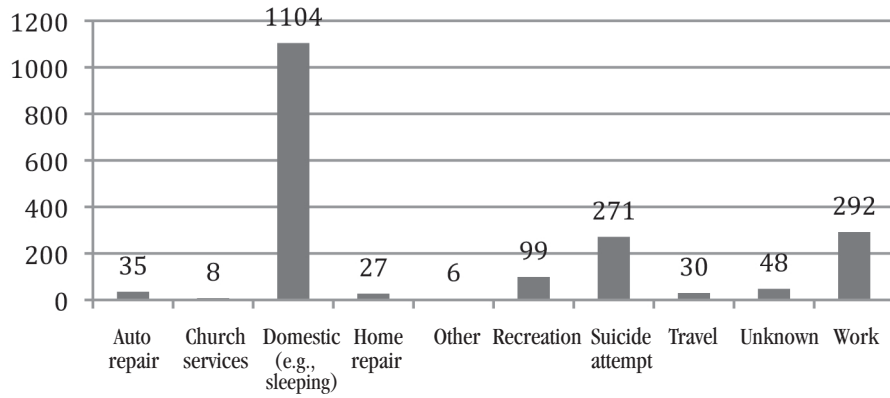
FIGURE 14. *Nature of CO exposure*

Nature of CO Exposure
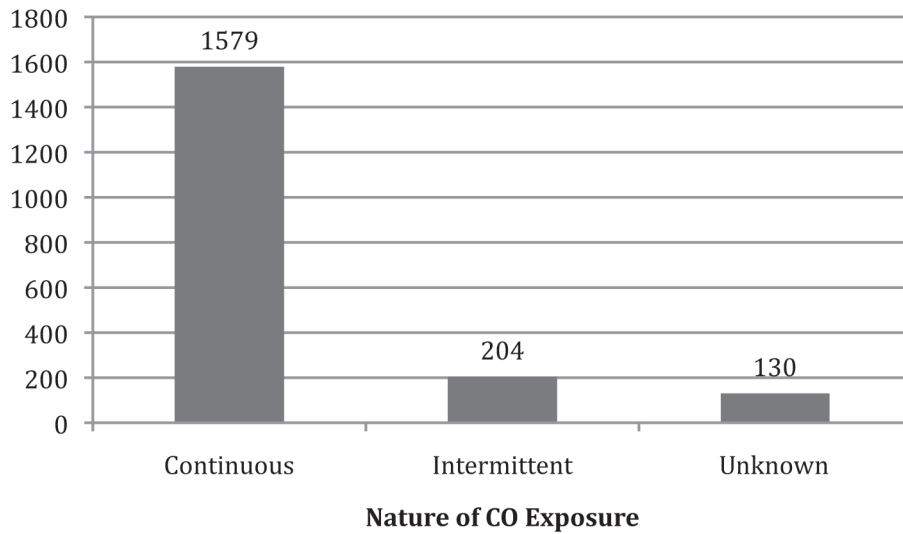
FIGURE 15. *Intent of poisoning*

Intent of CO Exposure

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver
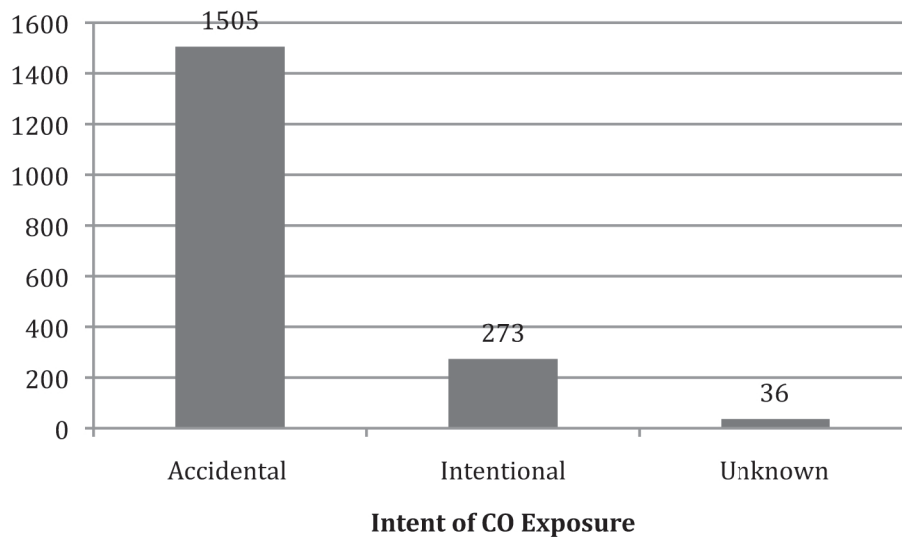
FIGURE 16(a). *Number of cases where CO alarm was reported to be present*
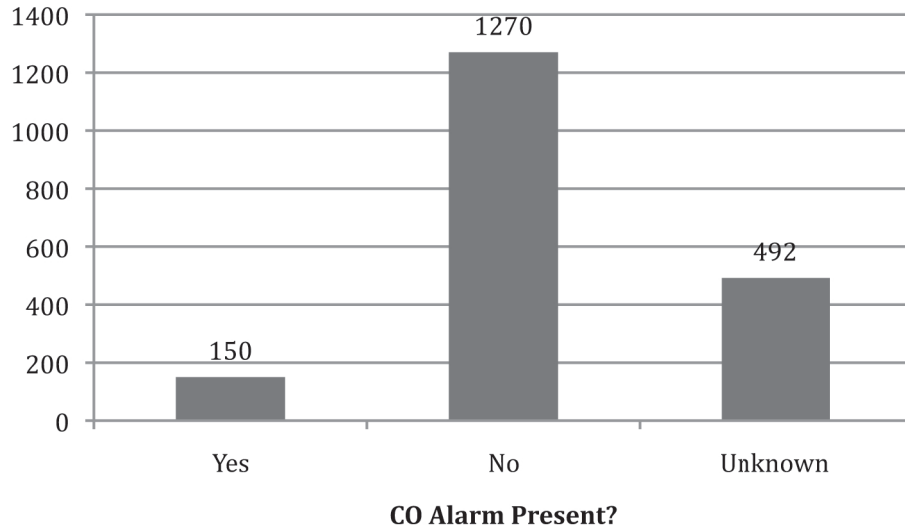
CO Alarm Present?

FIGURE 16(b). *In cases where CO alarm was present, number of times it did or did not activate*

Did CO Alarm Activate?
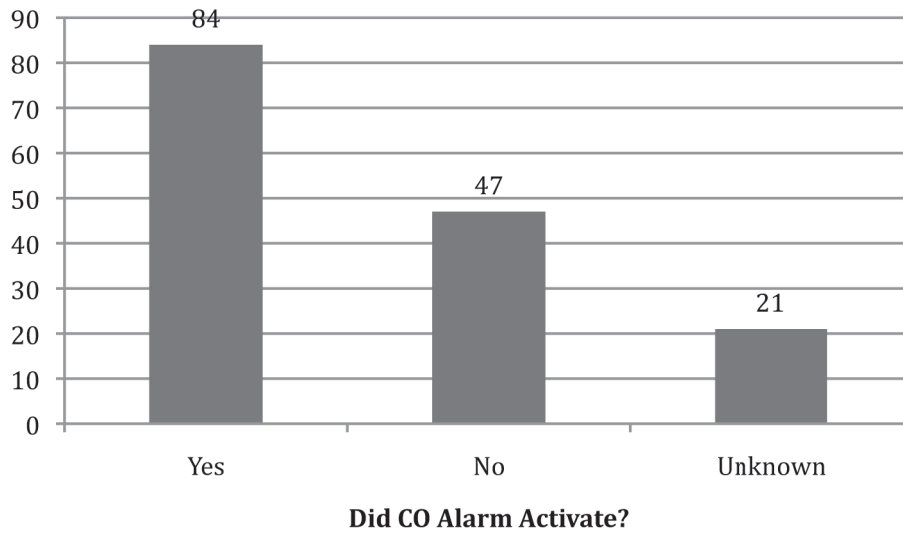
FIGURE 17. *Number of patients reporting simultaneous exposure to CO by others*

Were others present and simultaneously poisoned?
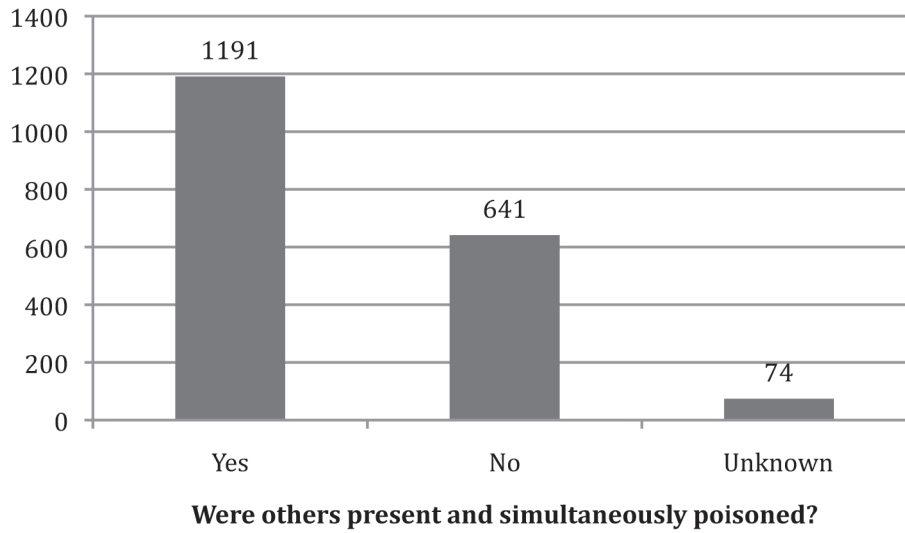
FIGURE 18. *Estimated duration of exposure for CO-poisoned individuals*

Duration of CO Exposure (hours)

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver
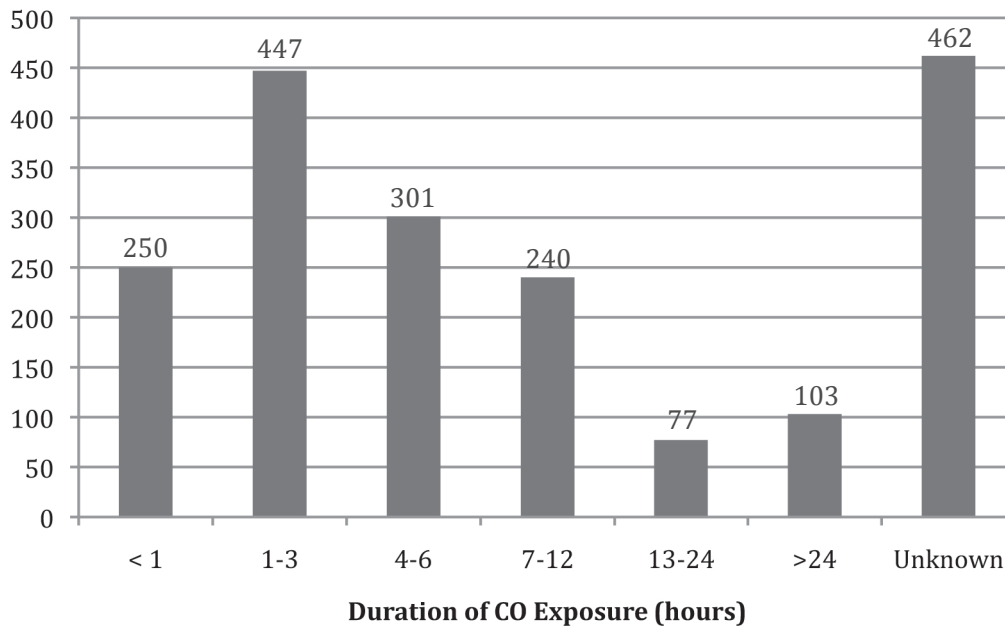
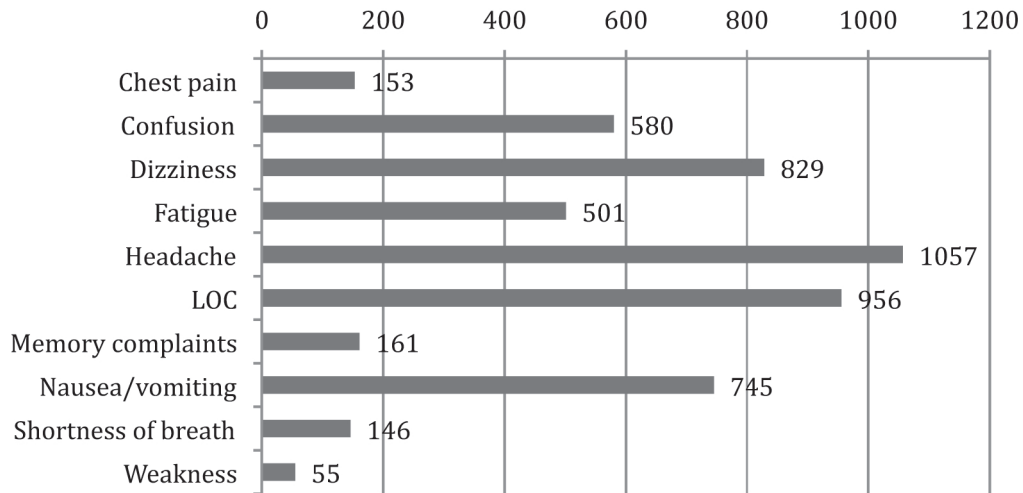**FIGURE 19.** *Number of individuals with each of the 10 most common symptoms*

Figure 19. Every patient reported had at least one of these symptoms. LOC = loss of consciousness

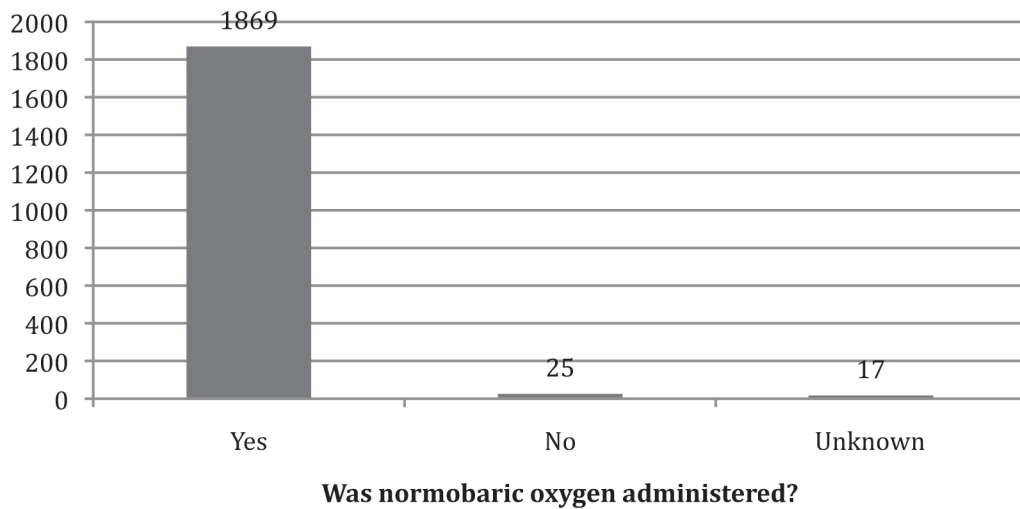**FIGURE 20(a).** *Number of patients administerednormobaric oxygen prior to hyperbaric oxygen*

Was normobaric oxygen administered?

FIGURE 20(b). *Number of individuals receiving normobaric oxygen by different delivery methods prior to hyperbaric oxygen treatment*
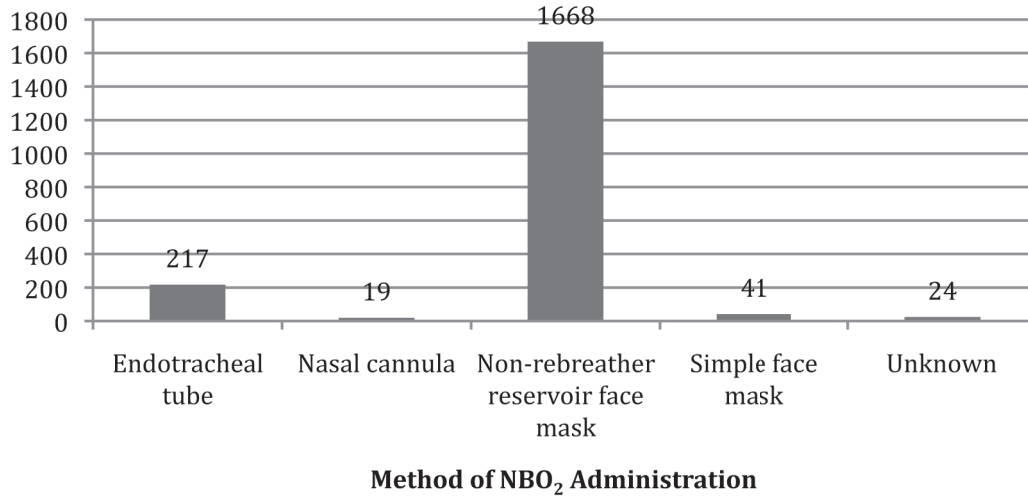

Method of NBO$_2$ Administration

FIGURE 21(a). *Frequency of carboxyhemoglobin measurement*

Was carboxyhemoglobin level measured?

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver
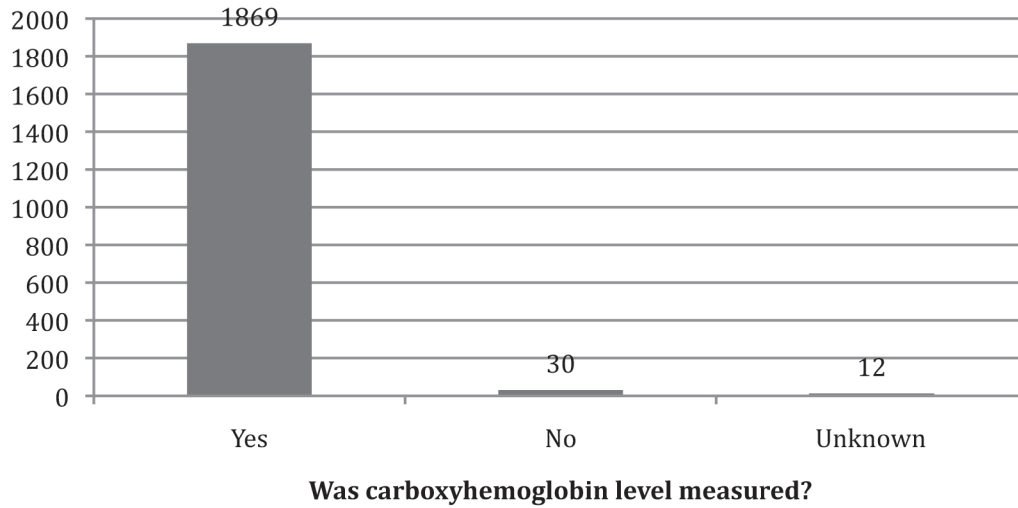
FIGURE 21(b). *Method by which initial carboxyhemoglobin level was measured*
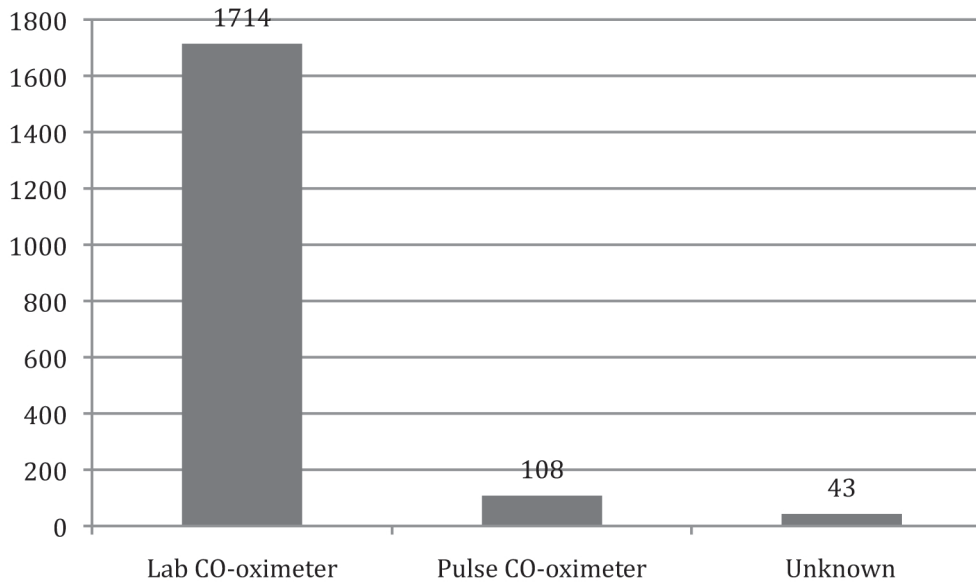
FIGURE 22(a). *Abnormal cardiac testing*

■ Yes	■ 295
☐ No	☐ 1337
■ Unknown	■ 270

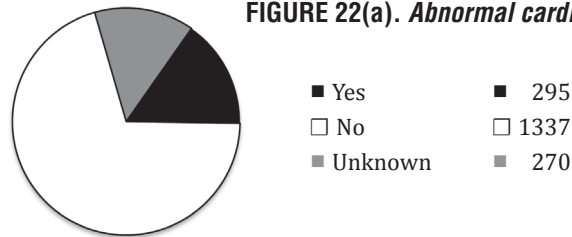**Figure 22(a).** Number of patients with abnormal cardiac testing suggesting ischemia *(above)*.

Figure 22(b). Number of patients reported with different types of abnormal cardiac testing *(below)*.

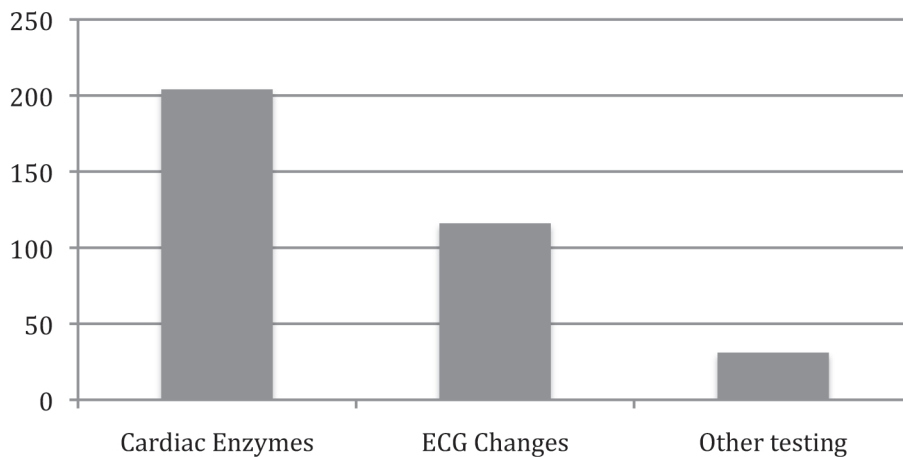**FIGURE 22(b).** *Type of abnormal cardiac testing*

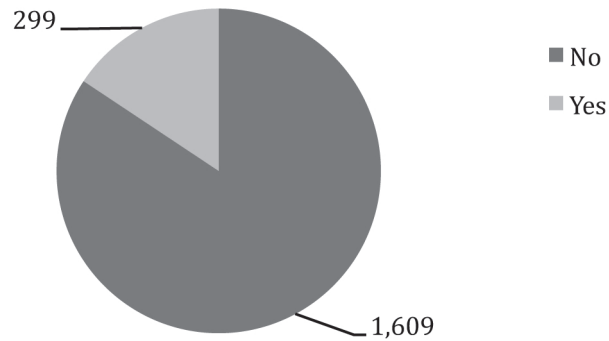**FIGURE 23.** *Number of patients with CO poisoning who were endotracheally intubated*

TABLE 2. *COHb level and arterial blood gases*

	Mean + SD	N	Range
COHb measurement (%)	23.4 ± 10.4	1,394	0.1-77.0
Time from end of CO exposure to COHb (hours)	2.2 ± 6.9	1,394	0-198
Arterial pH	7.36 ± 0.13	596	6.68-7.65
Arterial PCO2 (mmHg)	36.5 ± 10.1	587	10.0-96.0
Arterial PO2 (mmHg)	260 ± 160	575	24-1,410
Time from end of CO exposure to HBO2 (hours)	5.3 ± 3.1	1,794	1.0-24.0

Table 2. Laboratory values for COHb level and arterial blood gases, as well as times from end of CO exposure to obtaining blood for COHb measurement and initiation of HBO$_2$ treatment.

N.B. Hampson; S.L. Dunn; F.Y. Yip; J.H. Clower; L.K. Weaver

FIGURE 24. *Number of individuals treated at various pressures*
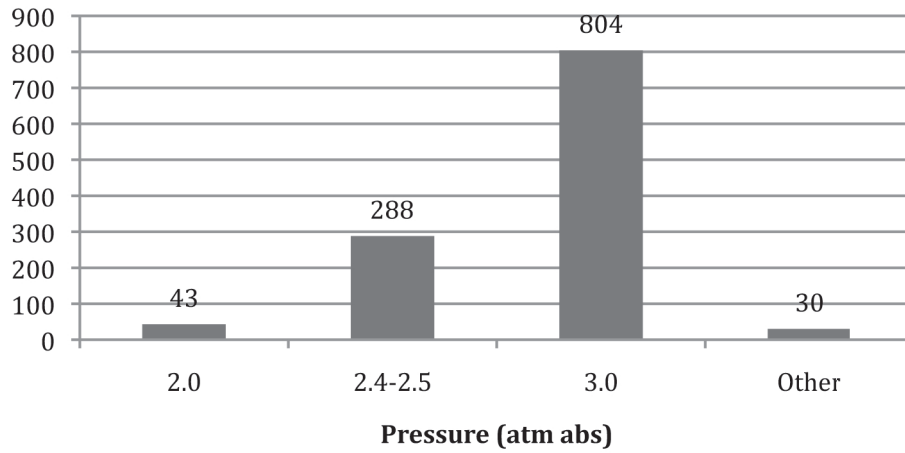

Pressure (atm abs)

FIGURE 25. *Disposition of patients following hyperbaric oxygen treatment for CO poisoning*

Disposition after HBO_2