TABLE 18. Demographic Profile of Exposure Cases by Generic Category of Substance: Pharmaceuticals (Cont'd)

Substance Implicated in the Exposure	No. of Exposures	Age (yr)			Reason			Treated in Health-Care Facility	Outcome*				
		<6	6-17	>17	Acc	Int	Adv Rxn		None	Minor	Moderate	Major	Death
Anthelmintic: piperazine	589	438	53	97	575	11	1	56	255	36	6	0	0
Anthelmintic: other	590	279	50	248	556	12	18	203	173	157	16	1	0
Anthelmintic: unknown	44	31	2	10	41	2	0	6	15	5	0	0	0
Antiparasitic: antimalarials	144	48	21	75	94	36	13	94	55	38	7	5	0
Antiparasitic: metronidazole	1,051	260	132	644	542	326	173	424	285	255	25	3	0
Antiparasitic: other	497	311	44	138	419	42	33	91	128	58	6	0	0
Antitubercular: isoniazid	810	304	127	375	446	219	138	440	78	92	71	37	0
Antitubercular: rifampin	57	20	9	28	36	15	5	32	17	14	3	1	0
Antitubercular: other	14	4	3	7	11	1	2	9	2	4	0	0	0
Antitubercular: unknown	1	0	0	1	1	0	0	0	0	1	0	0	0
Antiviral: topical	55	28	3	24	55	0	0	8	18	8	0	0	0
Antiviral: systemic	526	151	55	316	276	224	21	293	154	93	14	2	0
Antiviral: unknown	41	14	5	21	22	15	4	27	18	5	1	1	0
Other antimicrobial	93	58	3	31	75	11	7	23	33	11	3	0	0
Unknown antimicrobial	8	3	2	3	6	2	0	2	2	2	0	0	0
*Category Total	56,230	36,113	6,405	13,409	44,572	7,584	3,961	12,227	16,628	7,415	637	84	1
Antineoplastics	620	208	31	372	545	45	27	270	209	151	24	1	1
Asthma Therapies													
Aminophylline/theophylline	6,527	1,997	1,664	2,820	4,005	2,136	299	4,183	1,777	2,039	622	93	36
Terbutaline	7,018	5,330	954	716	6,257	561	204	2,648	2,721	1,858	144	7	0
Other beta agonists	531	244	112	175	321	187	17	284	159	167	24	1	0
Other	324	205	54	62	277	36	11	68	113	47	2	1	1
Unknown	18	2	10	6	8	8	2	9	3	6	0	0	0
*Category Total	14,418	7,778	2,794	3,779	10,866	2,928	533	7,192	4,773	4,117	792	102	37
Cardiovascular Drugs													
Alpha blockers	28	8	2	18	19	5	4	15	8	6	1	0	0
Antiarrhythmics	973	276	57	635	809	127	31	421	392	158	26	17	4
Antihypertensives	5,396	2,852	457	2,076	4,133	1,124	116	3,163	2,229	1,166	355	104	4
Beta blockers	4,985	1,918	487	2,550	3,331	1,521	111	3,131	2,072	936	257	72	18
Calcium antagonists	4,638	1,700	313	2,606	3,388	1,125	104	2,693	1,928	818	278	99	36
Cardiac glycosides	1,999	1,025	94	867	1,614	297	68	1,191	845	330	151	36	16
Hydralazine	360	192	38	129	270	82	8	200	161	78	13	3	0
Long-acting nitrates	691	400	28	262	610	74	4	269	371	93	12	3	1
Nitroglycerin	2,121	1,516	117	477	1,830	272	12	743	1,113	230	20	3	0
Nitroprusside	41	3	2	34	19	1	19	37	4	6	12	1	0
Vasodilator: other	945	607	45	281	826	97	18	307	453	113	11	2	0
Vasodilator: unknown	1	1	0	0	1	0	0	1	0	1	0	0	0
Vasopressors	4	3	0	1	3	1	0	2	0	1	0	0	0
Other	166	68	43	56	153	11	2	50	56	50	6	0	0
Unknown	30	14	2	14	25	5	0	15	14	3	0	0	0
*Category Total	22,378	10,583	1,685	10,006	17,031	4,742	497	12,238	9,648	3,989	1,142	340	79
Cough and Cold Preparations	97,077	73,680	10,104	13,039	84,680	10,508	1,792	26,216	37,381	22,631	1,173	86	8
Diagnostic agents	378	192	27	155	331	15	32	140	90	71	17	1	1
Diuretics	4,375	2,432	425	1,498	3,366	894	103	1,876	1,739	839	98	22	0
Electrolytes and Minerals													
Calcium	1,748	1,452	100	187	1,672	64	10	154	517	124	11	2	0
Fluoride	4,437	3,915	284	238	4,380	47	14	338	1,950	653	10	0	0
Iron	4,448	3,120	470	842	3,569	816	51	2,382	1,710	999	184	23	5
Magnesium	249	98	34	111	213	22	11	99	68	59	4	0	0
Potassium	864	511	81	263	723	117	19	303	341	98	17	3	4
Sodium	1,799	1,299	257	233	1,722	70	4	354	623	339	16	0	0
Zinc	1,032	602	77	337	968	37	23	242	220	243	23	1	0
Other	121	69	9	41	107	4	10	18	23	20	1	0	0
Unknown	8	3	3	2	7	1	0	3	3	2	0	0	0
*Category Total	14,706	11,069	1,315	2,254	13,361	1,178	142	3,893	5,455	2,537	266	29	9
Eye/Ear/Nose/Throat Preparations	13,301	9,038	915	3,273	12,904	258	133	2,315	4,795	2,442	150	5	1
Gastrointestinal Preparations													
Antacids: salicylate-containing	2,692	2,387	145	149	2,589	52	45	248	1,106	163	10	2	0
Antacids: other	13,520	12,447	456	595	13,312	137	77	430	3,728	501	12	4	1
Antidiarrheals: nonnarcotic	543	413	35	93	514	13	13	45	153	33	1	0	0
Antidiarrheals: diphenoxylate/atropine	1,654	1,004	137	508	1,331	253	67	984	724	390	63	8	2
Antidiarrheals: paregoric	255	206	13	36	219	18	17	94	102	57	6	0	0
Antidiarrheals: other narcotic	227	208	13	6	226	1	0	6	47	51	0	0	0
Antispasmodics: anticholinergic	1,758	688	316	735	972	699	72	1,072	570	530	85	10	1
Antispasmodics: other	12	6	3	4	9	2	1	7	2	4	0	0	0
Laxatives	13,346	10,472	1,034	1,805	12,489	701	158	2,176	3,525	3,337	157	4	0
Other	2,434	1,767	164	491	2,038	289	106	596	783	282	38	5	1
Unknown	122	70	6	46	92	18	12	40	54	13	2	0	0
*Category Total	36,563	29,668	2,322	4,468	33,791	2,183	568	5,698	10,794	5,361	374	33	5
Hormones and Hormone Antagonists													
Androgens	185	62	20	99	93	77	10	78	43	27	4	0	0
Corticosteroids	4,265	2,931	341	972	3,754	284	210	555	1,136	338	32	0	0
Estrogens	1,603	1,216	98	284	1,425	146	32	225	532	106	10	5	0
Insulin	586	69	32	482	390	171	20	331	165	133	39	8	1

TABLE 18. Demographic Profile of Exposure Cases by Generic Category of Substance: Pharmaceuticals (Cont'd)

Substance Implicated in the Exposure	No. of Exposures	Age (yr)			Reason			Treated in Health-Care Facility	Outcome*				
		<6	6-17	>17	Acc	Int	Adv Rxn		None	Minor	Moderate	Major	Death
Oral contraceptives	9,998	8,975	532	449	9,546	396	50	792	2,854	378	8	0	0
Oral hypoglycemics	1,601	910	120	569	1,265	310	18	1,235	744	374	118	14	1
Progestins	774	486	113	175	664	83	27	153	270	47	5	1	0
Thyroid preparations	3,751	2,811	240	692	3,356	342	41	1,023	1,566	307	36	7	0
Other hormones	503	310	58	137	395	90	22	251	177	173	18	1	0
Other hormone antagonists	151	67	11	71	112	29	7	51	48	21	2	0	0
Unknown hormone or antagonist	5	2	0	3	2	0	3	1	1	0	1	0	0
*Category Total	23,422	17,839	1,565	3,933	21,002	1,928	440	4,695	7,536	1,904	273	36	2
Miscellaneous Drugs													
Allopurinol	263	179	19	63	222	32	7	76	129	24	1	1	0
L-dopa and related drugs	253	111	5	133	210	33	6	102	113	51	6	2	0
Disulfiram	712	43	35	618	234	398	69	524	88	255	47	6	2
Ergot alkaloids	782	395	67	313	522	200	59	436	292	214	32	5	0
Homeopathic	1,239	969	62	194	1,074	111	41	280	510	131	9	1	0
Methysergide	2	2	0	0	2	0	0	0	1	0	0	0	0
Neuromuscular blocking	9	2	0	7	5	4	0	3	0	2	0	0	1
Other	6,052	3,678	549	1,773	5,144	659	225	1,478	1,928	1,241	132	24	2
*Category Total	9,312	5,379	737	3,101	7,413	1,437	407	2,901	3,061	1,918	227	39	5
Muscle Relaxants													
Cyclobenzaprine	2,754	576	369	1,786	906	1,766	48	2,223	645	924	290	59	3
Methocarbamol	932	122	119	675	230	600	41	699	201	350	57	12	0
Other	2,720	386	288	2,010	833	1,771	80	2,064	496	1,006	243	78	2
Unknown	56	3	6	45	6	46	3	48	3	22	5	0	0
*Category Total	6,462	1,087	782	4,516	2,025	4,183	172	5,034	1,345	2,302	595	149	5
Narcotic Antagonists	41	2	3	36	15	19	6	31	4	15	2	3	0
Radiopharmaceuticals	11	4	2	5	9	0	2	4	4	2	0	0	0
Sedative/Hypnotics/Antipsychotics													
Barbiturates: long acting	3,867	957	379	2,474	1,843	1,871	70	2,669	806	1,151	413	151	13
Barbiturates: short acting	1,865	185	197	1,437	469	1,306	52	1,506	301	674	164	66	3
Barbiturates: unknown	27	4	2	21	6	20	0	24	6	9	4	1	1
Benzodiazepines	29,258	4,499	2,051	22,296	8,132	20,320	395	23,309	5,053	10,910	2,233	566	23
Chloral hydrate	499	138	47	310	204	256	38	383	68	197	48	19	3
Ethchlorvynol	257	14	15	224	41	204	3	237	16	82	42	27	1
Glutethimide	157	3	11	143	16	136	2	149	9	59	36	13	2
Meprobamate	515	55	53	400	136	354	10	421	85	171	66	32	3
Methaqualone	85	4	5	75	17	65	2	79	6	24	14	2	0
Sleep aids (OTC)	5,830	368	754	4,624	1,018	4,729	31	5,020	1,147	2,135	413	49	3
Phenothiazines	10,243	1,505	1,131	7,477	3,445	6,111	507	8,194	2,309	3,661	1,013	274	19
Other	1,605	242	134	1,214	536	975	73	1,187	366	557	90	36	1
Unknown	220	15	32	165	20	194	0	199	30	58	9	0	0
*Category Total	54,428	7,989	4,811	40,860	15,883	36,541	1,183	43,407	10,202	19,688	4,545	1,236	72
Serums, Toxids, Vaccines	751	201	90	452	525	12	209	291	106	260	26	1	0
Stimulants and Street Drugs													
Amphetamines	4,340	1,468	1,124	1,700	2,447	1,729	112	2,840	1,166	1,298	337	46	6
Amyl/butyl nitrites	164	15	17	128	51	110	0	115	20	58	17	2	0
Caffeine	5,461	1,224	2,104	2,091	2,205	3,071	114	3,089	952	2,338	262	5	1
Cocaine	2,431	103	187	2,090	282	2,098	19	2,261	248	927	319	82	32
Diet aid: phenylpropanolamine	1,915	956	373	578	1,209	650	43	969	718	503	*103	4	0
Diet aid: phenylpropanolamine and caffeine	266	132	62	70	164	99	3	156	98	69	8	0	0
Diet aid: other, OTC	106	54	12	40	74	25	7	43	28	25	4	0	0
Diet aid: other, R_x	38	20	4	14	23	11	3	25	13	10	1	1	0
Diet aid: unknown	154	68	29	56	86	61	4	114	45	43	8	1	0
Heroin	527	17	20	484	67	443	8	486	53	132	107	36	9
LSD	1,025	25	420	556	158	848	2	828	61	441	138	9	0
Marijuana	716	89	195	417	194	500	12	503	62	236	51	8	1
Mescaline/peyote	263	81	71	106	154	103	1	144	34	93	15	0	0
Phencyclidine	267	14	58	191	56	200	2	242	13	98	54	13	2
Phenylpropanolamine look-alike drugs	269	53	80	129	69	198	0	233	60	117	20	1	0
Other stimulants	33	5	5	21	8	24	1	27	4	17	2	2	0
Other hallucinogens	3	0	1	2	0	3	0	3	1	0	0	0	0
Unknown hallucinogens	12	0	4	8	2	9	1	11	0	3	3	0	0
Other street drugs	79	25	29	23	43	31	1	47	11	23	1	0	0
Unknown stimulant/street drugs	89	7	30	52	14	72	1	79	13	30	15	0	0
*Category Total	18,158	4,356	4,825	8,756	7,306	10,285	334	12,215	3,600	6,461	1,465	210	51
Topicals													
Acne preparations	1,162	718	176	259	1,088	22	53	132	336	262	17	1	0
Boric acid/borates	358	241	26	87	344	12	2	42	121	61	2	0	0
Calamine	5,498	4,507	272	700	5,439	44	15	443	1,688	421	12	1	0
Camphor	7,202	5,811	335	1,020	7,057	124	18	1,849	3,413	1,187	44	9	1
Camphor and methyl salicylate	1,288	1,007	76	200	1,238	21	30	271	506	298	7	0	0

(Continued on following page)

TABLE 18. Demographic Profile of Exposure Cases by Generic Category of Substance: Pharmaceuticals (Cont'd)

Substance Implicated in the Exposure	No. of Exposures	Age (yr)			Reason			Treated in Health-Care Facility	Outcome*				
		<6	6-17	>17	Acc	Int	Adv Rxn		None	Minor	Moderate	Major	Death
Diaper products	16,253	15,743	166	309	16,235	17	17	248	4,285	772	5	1	0
Hexachlorophene antiseptics	160	90	23	46	155	4	1	48	42	46	1	0	0
Hydrogen peroxide	8,177	5,140	624	2,372	7,990	166	17	509	2,100	1,598	35	4	1
Iodine or iodide antiseptics	1,913	862	221	814	1,655	208	28	557	637	406	34	1	0
Mercury antiseptics	949	797	39	113	910	32	6	116	368	71	2	1	0
Methyl salicylate	7,251	5,794	450	971	7,161	58	32	916	2,704	1,496	35	4	3
Silver nitrate	120	15	36	66	112	4	4	26	17	48	2	1	0
Topical steroids	5,461	4,572	171	693	5,391	24	47	145	1,385	318	9	0	0
Topical steroid with antibiotic	1,571	1,349	57	158	1,538	9	23	70	469	143	2	0	0
Wart preparations	2,097	1,564	181	341	2,045	34	19	287	718	496	14	0	1
Podophyllin	78	25	19	34	70	6	2	25	27	16	7	0	0
Other liniment	1,311	946	100	260	1,277	23	12	157	455	255	5	0	0
Other topical antiseptic	2,082	1,560	104	403	2,003	52	24	339	733	340	12	1	0
Category Total	62,931	50,741	3,076	8,846	61,708	860	350	6,180	20,004	8,234	245	24	6
Miscellaneous Veterinary	2,937	1,486	182	1,255	2,906	25	5	335	937	425	23	1	0
Vitamins													
Multiple Vitamin Tablets: Adult Formulations													
No iron, no fluoride	2,004	1,530	184	280	1,784	144	71	253	748	195	2	1	0
With iron, no fluoride	5,055	3,970	564	515	4,512	509	32	1,396	2,244	553	45	5	0
With iron, with fluoride	47	42	4	1	46	1	0	13	27	4	0	0	0
No iron, with fluoride	193	188	5	0	192	0	1	7	94	6	0	0	0
Multiple Vitamin Tablets: Pediatric Formulations													
No iron, no fluoride	9,030	8,123	852	48	8,898	129	11	402	3,479	471	2	2	0
With iron, no fluoride	10,323	9,309	914	70	10,180	142	8	1,889	4,678	1,221	55	4	0
With iron, no fluoride	587	574	12	1	587	0	0	52	224	45	0	0	0
No iron, with fluoride	2,054	1,979	60	16	2,047	8	2	98	598	77	0	0	0
Multiple Vitamin Liquids: Adult Formulations													
No iron, no fluoride	47	34	5	8	42	5	0	13	11	2	0	0	0
With iron, no fluoride	45	25	2	18	35	6	4	15	11	11	2	0	0
With iron, with fluoride	2	1	0	1	2	0	0	0	1	0	0	0	0
No iron, with fluoride	1	1	0	0	1	0	0	0	0	0	0	0	0
Multiple Vitamin Liquids: Pediatric Formulations													
No iron, no fluoride	226	211	12	3	226	1	0	18	79	8	1	0	0
With iron, no fluoride	307	290	11	5	300	6	1	52	135	36	1	0	0
With iron, with fluoride	83	82	0	1	81	0	2	9	32	6	0	0	0
No iron, with fluoride	633	629	4	1	626	4	2	27	229	46	0	0	0
Multiple Vitamin, Unspecified Adult Formulations													
No iron, no fluoride	41	25	4	12	36	3	3	5	14	4	0	0	0
With iron, no fluoride	1,005	782	122	101	879	117	7	302	438	123	11	1	0
With iron, with fluoride	8	7	0	1	7	1	0	2	3	1	0	0	0
No iron, with fluoride	3	2	0	1	3	0	0	0	1	1	0	0	0
Multiple Vitamin, Unspecified Pediatric Formulations													
No iron, no fluoride	235	209	26	0	233	3	0	14	96	12	0	0	0
With iron, no fluoride	248	226	18	1	245	3	0	48	106	41	2	0	0
With iron, with fluoride	10	8	2	0	10	0	0	0	4	0	0	0	0
No iron, with fluoride	54	54	1	0	55	0	0	3	27	3	0	0	0
Other vitamins													
Vitamin A	857	628	68	161	771	62	24	140	248	89	8	0	0
Niacin (B_3)	1,449	362	115	953	858	87	499	220	118	814	22	0	1
Pyridoxine (B_6)	245	152	18	74	185	50	9	61	88	27	6	4	0
Other B complex vitamins	861	601	69	187	727	87	46	141	270	89	1	0	0
Vitamin C	1,848	1,476	212	156	1,709	111	26	148	622	139	7	0	0
Vitamin D	202	170	7	24	186	11	4	53	91	10	0	0	0
Vitamin E	792	660	45	86	727	42	19	75	243	45	1	0	0
Other	754	628	51	74	687	54	12	142	288	81	5	0	0
Unknown	1,090	875	96	111	992	73	22	176	310	108	5	1	0
Category Total	40,338	33,853	3,485	2,910	37,869	1,659	805	5,774	15,557	4,268	176	18	1
Miscellaneous Unknown Drugs	14,544	5,582	2,133	6,508	10,879	2,798	414	7,340	3,439	3,735	570	94	0
Total No. Pharmaceutical Substances	742,030	425,146	82,940	229,103	537,304	182,952	17,969	285,677	237,145	148,632	23,928	5,339	809
% of Pharmaceutical Substances		57.3	11.2	30.9	72.4	24.7	2.4	38.5	32.0	20.0	3.2	0.7	0.1
% of All Substances	41.3	23.7	4.6	12.8	29.9	10.2	1.0	15.9	13.2	8.3	1.3	0.3	0.0

Patients with totally unknown age, reason or medical outcome were omitted from the respective tabulations.

ABBREVIATIONS: Acc, accidental, Adv Rxn, Adverse Reaction; Int, intentional; OTC, over-the-counter, R_x, prescription; MAO, monoamine oxidase.

* Medical outcome data were also collected in categories labelled "unknown, nontoxic," "unknown, potentially toxic," and "unrelated effect." Thus, the numbers listed here do not represent the total poison exposure experience.

TABLE 19. Demographic Profile of *Accidental* Exposure Cases by Substance Category

	No. of Exposures	Age (yr)			Treated in Health-Care Facility	Outcome*				
		<6	6-11	>17		None	Minor	Moderate	Major	Death
Adhesives/Glues	19,640	10,476	2,487	6,498	3,390	4,747	4,869	349	5	1
Alcohols	26,988	19,220	1,637	5,948	5,615	10,405	5,025	377	38	5
Arts/Crafts/Office Supplies	30,019	23,985	3,761	2,097	1,336	7,920	1,984	58	3	0
Auto/Aircraft/Boat Products	9,139	3,488	755	4,796	3,119	2,603	3,402	288	13	2
Batteries	7,005	3,907	1,146	1,888	2,588	2,312	2,151	178	8	0
Bites/Envenomations	62,004	13,625	12,851	34,971	15,630	4,820	33,908	2,976	134	1
Building Products	7,266	4,087	455	2,668	1,565	1,730	1,720	329	10	0
Chemicals	52,423	19,856	4,871	27,004	19,428	10,256	18,354	2,674	128	8
Cleaning Substances	175,666	112,903	10,103	51,499	32,146	46,823	54,877	4,222	112	5
Cosmetics/Personal Care	142,701	120,982	6,893	14,139	10,578	47,127	24,022	639	31	1
Deodorizers (non-personal)	15,469	14,013	546	850	1,167	5,827	1,931	53	3	0
Dyes	2,594	2,131	172	273	218	861	190	11	1	0
Essential Oils	2,485	1,820	304	347	413	669	980	16	2	0
Fertilizers	8,200	5,890	738	1,510	472	2,747	670	34	0	0
Fire Extinguishers	2,141	280	455	1,386	695	401	953	47	1	0
Food Products/Poisoning	41,923	12,498	5,515	23,348	4,430	5,848	10,911	685	12	1
Foreign Bodies/Toys	58,642	45,137	7,802	5,344	5,699	15,800	5,048	135	9	0
Fumes/Gases/Vapors	22,077	2,594	2,754	16,385	10,415	2,347	10,998	1,558	91	21
Fungicides (non-medicinal)	1,214	526	89	579	350	307	305	29	1	0
Heavy Metals	8,203	3,200	977	3,923	2,594	1,682	1,633	235	8	1
Herbicides	5,717	1,642	609	3,394	1,744	1,254	1,687	143	4	0
Hydrocarbons	60,697	30,684	5,749	23,688	14,784	18,249	21,720	1,418	81	6
Insecticides/Pesticides	51,148	27,130	4,501	18,938	11,819	15,112	11,948	893	76	3
Lacrimators	5,023	1,680	1,667	1,609	947	341	3,240	74	0	0
Matches/Fireworks/Explosive	3,254	2,971	144	125	198	1,091	202	22	1	0
Moth Repellants	6,066	5,206	260	563	1,100	2,891	471	13	2	0
Mushrooms	9,127	7,745	607	737	1,995	6,115	921	134	5	1
Paints/Stripping Agents	23,011	13,219	1,656	7,925	3,827	5,280	5,147	417	15	0
Photographic Products	789	352	100	324	207	189	222	21	1	0
Plants	100,434	84,294	6,809	8,793	6,773	36,461	12,506	707	16	2
Polishes/Waxes	6,186	5,196	246	707	659	2,518	1,182	41	1	0
Radioisotopes	147	12	17	116	57	19	21	3	1	0
Rodenticides	13,256	12,265	280	615	4,548	5,934	521	30	7	0
Sporting Equipment	871	549	191	122	223	365	119	8	0	0
Swimming Pool/Aquarium	4,968	2,734	575	1,620	771	1,427	1,349	92	1	0
Tobacco Products	10,112	9,533	187	346	2,059	4,246	2,241	75	3	0
Unknown Nondrug Substance	7,837	3,973	1,119	2,675	1,668	2,028	1,899	122	8	0
Analgesics	109,725	90,071	7,312	11,786	22,423	44,965	7,736	633	73	3
Anesthetics	4,992	3,955	299	707	1,007	2,233	740	53	11	2
Anticholinergic	1,595	920	110	539	691	597	362	65	12	0
Anticoagulants	481	334	15	125	202	203	34	11	2	0
Anticonvulsants	5,506	2,826	710	1,925	2,572	1,987	1,271	344	61	2
Antidepressants	8,413	3,453	939	3,932	4,842	2,990	1,811	407	119	5
Antihistamines	17,603	12,928	1,830	2,746	4,118	7,602	2,899	176	14	1
Antimicrobials	44,572	35,279	3,041	5,988	4,071	14,504	3,425	162	11	1
Antineoplastics	545	201	20	314	209	198	123	14	1	0
Asthma Therapies	10,867	7,608	1,500	1,703	4,094	4,353	2,513	298	30	6
Cardiovascular Drugs	17,030	10,510	841	5,592	7,309	8,686	2,110	380	93	10
Cough/Cold Preparations	84,680	72,809	6,113	5,440	16,658	35,213	17,568	442	19	0
Diagnostic Agents	331	191	21	117	103	88	55	10	1	0
Diuretics	3,366	2,421	190	740	1,002	1,537	455	27	7	0
Electrolytes/Minerals	13,361	11,017	826	1,453	2,795	5,171	2,057	168	16	6
Eye/Ear/Nose/Throat Prep	12,904	9,002	820	2,990	2,123	4,749	2,294	121	4	0
Gastrointestinal Prep	33,791	29,511	1,629	2,511	3,749	10,361	4,353	210	13	1
Hormones & Antagonists	21,002	17,783	952	2,182	2,846	7,072	1,210	100	4	0
Miscellaneous Drugs	7,413	5,336	423	1,580	1,478	2,808	1,241	90	9	0
Muscle Relaxants	2,025	1,067	175	767	966	793	466	62	8	0
Narcotic Antagonists	15	2	1	12	9	2	3	1	0	0
Radiopharmaceuticals	9	4	2	3	4	4	1	0	0	0

(Continued on following page)

TABLE 19. Demographic Profile of *Accidental* Exposure Cases by Substance Category (Cont'd)

	No. of Expsoures	Age (yr)			Treated in Health-Care Facility	Outcome*				
		<6	6-11	>17		None	Minor	Moderate	Major	Death
Sedatives/Hypnotics/ Antipsychotics	15,883	7,590	1,323	6,788	7,911	4,881	4,135	646	102	1
Serums, Toxoids, Vaccines	525	125	49	345	168	104	154	12	0	0
Stimulants/Street Drugs	7,306	4,233	1,340	1,654	3,131	2,610	1,789	248	20	2
Topicals	61,708	50,608	2,740	8,018	5,476	19,744	7,790	200	16	4
Miscellaneous Veterinary	2,906	1,485	176	1,228	313	934	415	19	1	0
Vitamins	37,869	33,704	2,672	1,362	4,509	15,037	3,389	119	8	0
Unknown Drugs	10,879	5,438	1,233	3,961	4,243	3,065	2,737	303	22	0
TOTAL	1,541,744	1,050,214	126,330	354,258	284,249	483,443	322,463	24,427	1,509	102

Patients with totally unknown age or medical outcome were omitted from the respective tabulations.
* Medical outcome data were also collected in categories labelled "unknown, nontoxic," "unknown, potentially toxic," and "unrelated effect". Thus the numbers listed here do not represent the total poison exposure experience.

TABLE 20. Frequency of Plant Exposures by Plant Type

Botanical Name	Common Name	Frequency
Philodendron spp	Philodendron	6,565
Dieffenbachia spp	Dumbcane	4,124
Euphorbia pulcherrima	Poinsettia	3,214
Capsicum annuum	Pepper	2,737
Crassula spp	Jade plant	2,424
Ilex spp	Holly	2,330
Brassaia & Schefflera spp	Schefflera	2,085
Spathiphyllum spp	Peace lily	1,712
Toxicodendron radicans	Poison ivy	1,662
Epipremnum aureum	Pothos, Devil's ivy	1,625
Phytolacca americana	Pokeweed, Inkberry	1,597
Saintpaulia spp	African violet	1,360
Pyracantha spp	Firethorn	1,233
Rhododendron spp	Rhododendron, Azalea	1,048
Ficus benjamina	Weeping fig tree	1,023
Solanum dulcamara	Climbing Nightshade	959
Chrysanthemum spp	Chrysanthemum	952
Chlorophytum comosum	Spider plant	920
Aloe spp	Aloe	862
Ficus elastica	Rubber plant	825

TABLE 21. Substances Most Frequently Involved in Human Exposure

Substance	No.	%*
Cleaning substances	180,096	10.5
Analgesics	172,278	10.1
Cosmetics	146,274	8.5
Plants	102,254	6.0
Cough and cold preparations	97,277	5.7
Pesticides (includes rodenticides)	66,677	3.9
Hydrocarbons	63,131	3.7
Topicals	63,030	3.7
Bites/envenomations	62,509	3.6
Foreign bodies	59,205	3.5
Antimicrobials	56,347	3.3
Chemicals	55,084	3.2
Sedatives/hypnotics/antipsychotics	54,578	3.2
Alcohols	49,097	2.9
Food poisoning	48,383	2.8
Vitamins	40,407	2.4

NOTE. Despite a high frequency of involvement, these substances are not necessarily the most toxic, but rather often represent only ready availability.
* Percentages are based on the total number of human exposures rather than the total number of substances.

TABLE 22 Categories With Largest Numbers of Deaths

Category	No	% of All Exposures in Category
Antidepressants	159	0.524
Analgesics	134	0.078
Alcohols	79	0.161
Cardiovascular drugs	79	0.353
Sedative/hypnotics	72	0.013
Stimulants and street drugs	51	0.625
Gases and fumes	39	0.171
Asthma therapies	37	0.257
Chemicals	34	0.062
Cleaning substances	26	0.014
Hydrocarbons	25	0.397
Pesticides (including rodenticides)	12	0.018

TABLE 23. Decontamination Trends

Year	Human Exposures Reported	% of Exposures Involving Children <6 Years	Ipecac Administered (% of Exposures)	Activated Charcoal Administered (% of Exposures)
1983	251,012	64.0	13.4	4.0
1984	730,224	64.1	12.9	4.0
1985	900,513	63.4	15.0	4.6
1986	1,098,894	63.0	13.3	5.2
1987	1,166,940	62.3	10.1	5.2
1988	1,368,748	61.8	8.4	6.5
1989	1,581,540	61.1	7.0	6.4
1990	1,713,462	60.8	6.1	6.7

TABLE 24. 8-Year Comparisons of Fatality Data

	Total Fatalities		Suicides		Pediatric Deaths (<6 years)	
Year	No	%	No.	% of deaths	No	% of deaths
1983	95	0.038	60	63.2	10	10.5
1984	293	0.040	165	56.3	21	7.2
1985	328	0.036	178	54.3	20	6.1
1986	406	0.037	223	54.9	15	3.7
1987	397	0.034	226	56.9	22	5.5
1988	545	0.040	297	54.5	28	5.1
1989	590	0.037	323	54.7	24	4.1
1990	612	0.036	350	57.2	25	4.1

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APPENDIX

Drug and chemical levels provided in these abstracts were obtained on blood, serum, or plasma unless otherwise indicated.

Case 1. A 35-year-old man was applying a carpet cement containing 84% 1,1,1 trichloroethane in the hull of a boat in an enclosed body shop. He was last seen conscious approximately an hour prior to being discovered unconscious and pulseless by shop personnel. Cardiopulmonary resuscitation was initiated immediately and paramedics arrived within minutes. On arrival at the emergency department (ED), the patient was dusky-colored with no spontaneous movements, no spontaneous respirations, and no palpable pulse. Cardiopulmonary resuscitation was continued and the patient was intubated. His initial rhythm was sinus bradycardia with a rate of 40 to 50 beats/min. Fluid challenge and atropine produced a transient response, but then his rhythm degenerated to ventricular fibrillation. After being defibrillated numerous times and after receiving lidocaine and bretylium, the patient developed an agonal rhythm. He died 70 minutes after presenting to the ED. Postmortem examination showed hemorrhagic congestion of the lungs.

Case 24. A 40-year-old man presented with a chief complaint of headache and blurred vision after alleged closed head trauma. Head computed tomography (CT) scan was normal. Twelve hours after presentation, the patient became unresponsive with an arterial pH of 6.9 and bicarbonate of 10 mEq/L. A blood methanol level, sent more than 36 hours after presentation because of persistent acidosis, was 23 mg/dL. Intravenous (IV) ethanol was initiated and the patient underwent hemodialysis. After 2 hours of hemodialysis, the methanol level decreased to 11 mg/dL. The ethanol infusion was continued for an additional 24 hours, during which the methanol level rebounded to 14 mg/dL. Because of increased intracranial pressure, the patient was hyperventilated and given mannitol. Three days after presentation, the patient postured to painful stimuli and had nonreactive pupils. Magnetic resonance imaging scan showed basal ganglia infarcts. Four days after presentation, the patient received antibiotics for aspiration pneumonia. After 28 days of supportive care with no signs of neurological recovery, the patient died.

Case 28. A 28-year-old man and his intoxicated friends mistook a 19 L drum of methanol for ethanol. The methanol was an ingredient used in their methamphetamine laboratory. The patient was found unresponsive after drinking an unknown amount of the methanol. On arrival at the ED, he was comatose. Laboratory studies showed sodium, 141 mEq/L; potassium, 5.1 mEq/L; chloride, 98 mEq/L; bicarbonate, [illegible] Eq/L; blood urea nitrogen (BUN), 13 mg/dL; glucose, 253 mg/dL, pH, 6.9. Toxicologic analysis showed a blood methanol level of 293 mg/dL and an ethanol level of 130 mg/dL. Amphetamines were also present. Treatment included intubation, gastric lavage, ethanol infusion, and folate. On the second hospital day, the patient had fixed and dilated pupils. He underwent hemodialysis and was receiving ethanol via the nasogastric (NG) tube. He became anuric. His methanol level decreased to 29 mg/dL, his ethanol level to 45 mg/dL. Other laboratory studies showed sodium, 141 mEq/L; potassium, 3.6 mEq/L; chloride, 107 mEq/L; bicarbonate, 19 mEq/L; BUN, 17 mg/dL; creatinine, 2.8 mg/dL; lactate dehydrogenase (LDH), 1,665 IU/L; aspartate aminotransferase (AST), 841 IU/L; alanine aminotransferase (ALT), 355 IU/L. On the third hospital day, an electroencephalogram (EEG) was consistent with no brain wave activity. His serum creatinine had increased to 7.0 mg/dL. On the fourth hospital day, serial EEGs showed no activity and there was no response to ice water caloric testing. Laboratory studies included sodium, 131 mEq/L; potassium, 7.0 mEq/L; chloride, 96 mEq/L; bicarbonate, 21 mEq/L; creatinine, 7.6 mg/dL; methanol, 0 mg/dL. He died on the fifth hospital day. A 26-year-old friend who had also consumed the methanol died as well.

Case 35. A 48-year-old man ingested diesel antifreeze that he mistook for moonshine. He was asymptomatic for 10 hours. Because of visual disturbances, abdominal pain, and vomiting, he went to the ED 34 hours after the ingestion. When severe metabolic acidosis was noted, the patient was transferred to a tertiary care facility. On arrival, he was comatose with a systolic blood pressure of 50 mm Hg, pulse of 90 beats/min, and temperature of 34.5°C. Laboratory results included measured serum osmolality, 458 mOsm/kg H_2O; arterial pH, 6.73; no calcium oxalate crystals in his urine. Toxicologic analysis showed a blood methanol level of 285 mg/dL approximately 36 hours after the ingestion. Initial therapy included fluid resuscitation, dopamine, large quantities of sodium bicarbonate, and IV ethanol. While the patient underwent hemodialysis for 16 hours, his neurological status deteriorated. His pupils became unreactive and he had no corneal or caloric responses. Postdialysis methanol level was 26 mg/dL. The next day his head CT scan showed massive cerebral edema. The patient died 5 days after the ingestion when life support measures were withdrawn.

Case 37. A 45-year-old man ingested approximately 2 L of windshield washer fluid containing 40% methanol, 60% water, and a trace of an unspecified antifoaming agent. In the ED 21 hours after the ingestion, the patient was comatose with decorticate posturing and fixed, dilated pupils. He had a palpable systolic blood pressure of 70 mm Hg. Laboratory results included a pH of 6.73 and potassium of 7.3 mEq/L. After intubation, the patient received activated charcoal, magnesium citrate, IV ethanol, and sodium bicarbonate. The patient was then transferred for hemodialysis. On arrival, there was no change in his neurological status and he was hypothermic. His initial blood methanol level was 143 mg/dL. He received IV ethanol, leucovorin, folic acid, and sodium bicarbonate. In addition, his blood pressure was maintained with norepinephrine and dopamine. Laboratory results showed potassium, 7.3 mEq/L; pH, 7.03; ethanol, 89 mg/dL. Repeat methanol level 6 hours after presentation was 270 mg/dL. The patient underwent hemodialysis for 6 hours with a drop in the methanol level to 158 mg/dL. There was no change in his neurological status and the patient died 46 hours after the ingestion.

Case 38. An 80-year-old woman developed weakness, dizziness, and vomiting and then became unresponsive over the course of a few hours. When paramedics arrived she had a palpable blood pressure of 60 mm Hg, pulse of 72 beats/min, and respirations of 6 breaths/min. She was intubated and transported. Arterial blood gases in the ED showed pH, 6.78; Pco_2, 13 mm Hg; Po_2, 385 mm Hg; bicarbonate, 2 mEq/L. Fluids and sodium bicarbonate were administered. Head CT scan and lumbar puncture were unremarkable. A possible diagnosis of methanol or ethylene glycol poisoning

was considered and blood levels were ordered. In the intensive care unit (ICU), she developed intractable metabolic acidosis, a tension pneumothorax probably secondary to Swan-Ganz catheter (Baxter Healthcare, Irvine, CA) insertion, and hypotension. After the blood methanol level returned at 114 mg/dL, the patient received an ethanol loading dose and underwent hemodialysis. Postdialysis methanol level was 9 mg/dL. Blood drawn in the ED was retrieved and a serum osmolality by freezing point depression was 369 mOsm/kg H_2O, calculated osmolality was 308 mOsm/kg H_2O, and the osmolal gap was elevated at 61 mOsm/kg H_2O, correlating with a predicted methanol level of approximately 160 mg/dL. The patient developed multiorgan failure and died. In retrospect, the family recalled that a container of windshield washer solvent had been left on the kitchen counter and a cup containing a blue liquid was found next to the patient's bed. It was thought that the patient had mistaken the solution for a blue soft drink that was kept in a similar container.

Case 40. A 59-year-old man was bitten by a kissing bug (*Triatoma protracta*) while asleep in bed. He told his wife he felt ill and he suffered an anaphylactic reaction. The wife found the bug attached to the patient, killed it, and noted that it contained blood. The patient had been bitten by a kissing bug three times in the past, twice within the previous 3 weeks. When the paramedics arrived 10 minutes later, the patient was given a total of 4 mg of epinephrine. He then went into ventricular fibrillation. He was defibrillated and transported to the ED. On arrival, the patient had a sinus rhythm, but needed dopamine and fluids for hypotension. He was also intubated. Two hours after the exposure, the patient had a seizure and was comatose. His pupils were fixed and dilated. He was given hydrocortisone. By 7.5 hours after the exposure, he had developed disseminated intravascular coagulation, hemorrhagic gastritis; and had received blood transfusions. Ten hours after the exposure, dopamine and norepinephrine were administered to maintain his systolic blood pressure at 98 mm Hg. Laboratory studies showed sodium, 137 mEq/L; potassium, 3.9 mEq/L; chloride, 116 mEq/L; bicarbonate, 8.4 mEq/L; prothrombin time (PT), 70 seconds; partial thromboplastin time (PTT), >240 seconds; fibrinogen, 40 mg/dL; fibrin split products, 1280 μg/mL. Arterial blood gases showed pH, 7.02; P_{CO_2}, 33 mm Hg; P_{O_2}, 85 mm Hg; bicarbonate, 8 mEq/L. Over the next 2 to 3 hours, the patient's seizures became more frequent and he developed status epilepticus. In addition, he developed acute renal failure. He died 17 hours after the exposure.

Case 41. An adult woman with a pseudocyst was hospitalized for hyperalimentation. In addition, because of hemorrhagic cystitis, her bladder was being irrigated with a 1% alum solution. A health-care worker put the alum solution into a glass container. It was then confused with the hyperalimentation solution and was infused IV over 12 hours. The error was then discovered and the alum solution discontinued. The patient remained stable until 24 to 48 hours later, when she developed acute renal failure and died.

Case 42. A 46-year-old man drank an unknown quantity of battery acid containing sulfuric acid. In the ED 2 to 3 hours after the ingestion, he was in respiratory distress and was complaining of abdominal pain. Physical examination showed a white plaque on his tongue. Arterial blood gases on admission showed pH, 6.56; P_{CO_2}, 34 mm Hg; P_{O_2}, 206 mm Hg. During emergency endoscopy 4 hours postingestion, the patient had a cardiac arrest and died. Postmortem examination showed disintegration of the stomach and absence of the anterior gastric wall. A large 10 cm diameter erosion of the middle third of the esophagus was also found. A black material was found throughout the peritoneal cavity and mediastinum. The airway and oral cavity were unremarkable.

Case 44. A 45-year-old man ingested nearly 500 mL of boric acid dissolved in water. Several hours later he developed nausea and vomiting. In the ED about 56 hours after the ingestion, he complained of weakness and lightheadedness. Vital signs included a blood pressure of 60/40 mm Hg, pulse of 120 to 150 beats/min, respirations of 20 breaths/min, and temperature of 36.6°C. An erythematous rash was present on the face, abdomen, arms, and legs. Initial laboratory results included sodium, 132 mEq/L; potassium, 4 mEq/L; chloride, 93 mEq/L; bicarbonate, 13 mEq/L; BUN, 55 mg/dL; creatinine, 6.0 mg/dL; glucose, 134 mg/dL; calcium, 7.8 mg/dL; AST, 14 IU/L; bilirubin, 0.4 mg/dL; creatine phosphokinase (CPK), 197 IU/L; hemoglobin, 14.1 g/dL; PT, 15 seconds; PTT, 37 seconds; arterial pH, 7.2. An electrocardiogram (ECG) showed sinus tachycardia with occasional premature ventricular contractions. His blood pressure did not improve after 1 L of normal saline, and dopamine was started. During the first 12 hours after admission, he remained lethargic but responded appropriately to commands and questions. He developed oliguria with increasing BUN and creatinine values, hypocalcemia (calcium of 6.4 mg/dL), and an elevated CPK of 1,193 IU/L. About 18 hours after admission the patient suddenly developed an arrhythmia, had several episodes of projectile vomiting, and then became pulseless. Resuscitation attempts were unsuccessful. Toxicologic analysis of specimens collected approximately 72 hours after the ingestion showed blood boric acid level, 440 μg/mL; blood boron level, 70 μg/mL; spot urine boric acid level, 1600 μg/mL; spot urine boron level, 280 μg/mL. Postmortem blood boron level was 294 μg/mL.

Case 45. A 13-month-old boy ingested an unknown white substance that had been purchased in Thailand and was used to clean jewelry. He presented to the ED in respiratory arrest. In the ED he was bradycardic and had no oral burns. Laboratory studies included sodium, 137 mEq/L; potassium, 4 mEq/L; bicarbonate, 21 mEq/L; chloride, 102 mEq/L; glucose, 86 mg/dL; BUN, 12 mg/dL; creatinine, 0.4 mg/dL; pH, 6.9. The patient was intubated and the cyanide antidote kit was administered. Cardiac pacing was unsuccessful and the patient died. Toxicologic analysis of blood drawn on arrival at the ED showed a serum cyanide level of 1.4 μg/mL.

Case 46. An 11-year-old girl visiting her uncle in an isolated cabin without electricity or running water drank two glasses of a liquid from a water jug containing an unknown concentration of potassium cyanide. Within moments she collapsed and had a generalized tonic-clonic seizure. She was driven by car 7 miles to a police station, then transported by ambulance to the ED. On arrival, 40 minutes after the ingestion, she was in full cardiopulmonary arrest. Her rhythm was electromechanical dissociation. Her pupils were fixed and dilated, and she was areflexic. Her first arterial blood gas showed pH, 6.8; P_{CO_2}, 90 mm Hg; P_{O_2}, 30 mm Hg. She was intubated and placed on mechanical ventilation. She received epinephrine, sodium bicarbonate, dopamine, and phenytoin. It took 30 minutes for the hospital to locate a cyanide antidote kit. After the sodium thiosulfate was administered, the patient's bradycardia resolved. The dose was repeated in 30 minutes. Her rhythm degenerated from a sinus tachycardia of 110 beats/min to ventricular fibrillation. She was defibrillated and received lidocaine, mannitol, calcium chloride, and atropine. Two hours after arrival, repeat arterial blood gases showed pH, 7.39; P_{CO_2}, 15 mm Hg; P_{O_2}, 400 mm Hg. Serial methemoglobin levels were 8.8% , 11% , and 20%. The patient was transferred to a tertiary health-care facility. On arrival 2 hours later, her vital signs were blood pressure, 65/43 mm Hg, pulse 120 beats/min, and temperature 35.5°C. Chest roentgenogram showed pulmonary edema. Her methemoglobin level was 30.8%. Because of hypotension, she received dopamine, dobutamine, and epinephrine. Urine toxicologic analysis was negative. On neurological examination, there was no evidence of cortical or brainstem function. She developed diabetes insipidus. The EEG was flat except for ECG artifact. She died about 24 hours after the ingestion.

Case 48. A 28-year-old man who worked in a jewelry store was seen drinking an unknown liquid. Within 5 to 10 minutes, he was apneic and frothing. When the paramedics arrived the patient was bradycardic. He was intubated, given atropine, and transported to the hospital. En route, his rhythm deteriorated to ventricular tachycardia, which was cardioverted, but then degenerated into asystole. Epinephrine and additional atropine were administered. In the hos-

pital, the cyanide antidote kit was given without response. Thirty minutes later, the methemoglobin level was 4%. Despite the administration of numerous ampules of sodium bicarbonate, sodium nitrite and sodium thiosulfate, his arterial pH remained below 7 and he died. Postmortem cyanide level was 12 μg/mL.

Case 55. A 35-year-old man ingested 640 mL of isopropanol in a sulcide attempt. When the paramedics arrived, he was asystolic. He was intubated and resuscitated in the field. An hour postingestion he was unresponsive with a systolic blood pressure of 70 mm Hg, pulse of 70 beats/min, and temperature of 35.5 °C. After receiving 4 ampules of sodium bicarbonate, his arterial blood gases showed pH, 7.17; Pco_2, 23 mm Hg; bicarbonate, 9 mEq/L. His blood isopropanol level was 110 mg/dL. Initial treatment included gastric lavage and administration of activated charcoal. The patient remained hypotensive and unresponsive after 6 L of IV fluids, dopamine, norepinephrine, epinephrine, and calcium chloride. Despite 10 ampules of sodium bicarbonate, central venous pH was 6.8 and bicarbonate was 6 mEq/L 4 hours postingestion. The patient developed bradycardia unresponsive to atropine and died 4.5 hours after the ingestion. Further investigation at the home showed a pill bottle filled with powdered potassium cyanide. Premortem blood from admission showed a cyanide level of 3.4 μg/mL.

Case 57. A 31-year-old man with a history of schizophrenia, mental retardation, and alcohol abuse was brought to the ED because he was "acting odd." He was evaluated by psychiatry and was described as being agitated. He was not sedated but was placed in leather restraints. He was then described as being stable and it was believed that he was sleeping. However, in the morning he could not be awakened and he had fixed and dilated pupils. An initial pH was 6.6. He was also bradycardic to 20 beats/min. Other laboratory studies showed potassium of 8.0 mEq/L, creatinine of 2.9 mg/dL, and an anion gap of 41 mEq/L. After receiving 10 ampules of sodium bicarbonate, his pH was 7.2. Within 24 hours of being brought to the ED, the patient developed refractory hypotension and arrhythmias and died. Urine toxicologic analysis was positive for amphetamine. Methanol and ethylene glycol levels were pending at the time of his death. Postmortem examination showed minimal cerebral edema and fan-shaped crystals consistent with oxalate crystals in the proximal tubules of the kidneys. Postmortem blood toxicologic analysis showed a lidocaine level of 6.7 μg/mL and ethylene glycol level of 540 mg/dL.

Case 58. A 53-year-old man ingested a blue liquid assuming it was wine. He was found unconscious the following morning. In the ED, he was comatose with a pH of 6.75, bicarbonate of 1.5 mEq/L, anion gap of 25 mEq/L, and osmolal gap of 200 mOsm/kg H_2O. His urine output was poor and no oxalate crystals were present. Toxicological analysis showed a blood ethylene glycol level of 850 mg/dL and a methanol level of 5.7 mg/dL. In the ED, the patient was lavaged and given activated charcoal. In the ICU 3.5 hours after admission, treatment included hemodialysis, ethanol infusion, and sodium bicarbonate. He remained comatose, intubated, and on mechanical ventilation. His vital signs were blood pressure, 192/76 mm Hg; pulse, 108 beats/min; respirations, 20 breaths/min; temperature, 36°C. Pertinent physical findings were unreactive pupils, bilateral rales, irregular cardiac rhythm, and bilateral lower extremity edema with a purplish discoloration. Laboratory data included sodium, 140 mEq/L; potassium, 5.2 mEq/L; chloride, 102 mEq/L; bicarbonate, 10 mEq/L; BUN, 12 mg/dL; creatinine, 1.5 mg/dL; glucose, 306 mg/dL; serum osmolality, 468 mOsm/kg H_2O; PT, 16.1 seconds; PTT, 49.7 seconds. Arterial blood gases showed pH, 6.75; Po_2, 186 mm Hg; bicarbonate, 10.5 mEq/L. Urinalysis showed proteinuria and glycosuria. The chest roentgenogram showed diffuse bilateral patchy lung infiltrates, mild pulmonary vascular congestion, and slight cardiomegaly. Approximately 7.5 hours after admission, the methanol level was 14.9 mg/dL and the acetone level was 43 mg/dL. Twelve hours after admission, the patient's systolic blood pressure was 50 mm Hg. Fourteen hours after admission, the patient had two seizures that were controlled with anticonvulsant therapy. On the second hospital day, the ethylene glycol level was 168.7 mg/dL, the methanol level was 2.1 mg/dL. The chest roentgenogram showed an increase in the interstitial infiltrates and pulmonary vascular distribution. Later that day the ethylene glycol level had decreased to 75.6 mg/dL and methanol was no longer detected. The patient remained comatose with decorticate posturing. Urine output decreased to 5 mL/hour. Creatinine was 3.4 mg/dL, ethanol level, 5 mg/dL; CPK, 9,592 IU/L. On the third hospital day, the patient underwent hemodialysis and his ethylene glycol level was 90.8 mg/dL. The patient had myoclonic seizures and an EEG showed status epilepticus. Pentobarbital was administered to control the seizures. By the fourth hospital day, the seizures had stopped and the pentobarbital infusion was discontinued. The patient was also hemodialyzed. On the fifth hospital day, the patient needed an insulin infusion to control hyperglycemia and he was hemodialyzed. On the seventh hospital day, the ethylene glycol level was 2 mg/dL and an EEG was consistent with diffuse cerebral dysfunction. Life support measures were discontinued and he died on the tenth hospital day.

Case 59. A 27-year-old man ingested a goldplating solution containing 15 g of gold cyanide in a suicide attempt at an unknown time aboard a ship. On arrival at the hospital, the patient was apneic, without a palpable blood pressure, and tachycardic at 140 beats/min. The patient was intubated and given dopamine. The cyanide antidote kit was given with a resultant methemoglobin level of 11%. Arterial blood gases showed pH, 7.24; Pco_2, 27 mm Hg; Po_2, 287 mm Hg. Systolic blood pressure during administration of norepinephrine was 40 mm Hg. A neurological examination showed a comatose patient with fixed and dilated pupils. Six hours after arrival, an EEG showed no brain activity. Life support was terminated 24 hours after arrival. A whole blood cyanide level drawn about 2 hours after admission was 2.1 μg/mL.

Case 60. A 59-year-old man who had sustained a myocardial infarction 3 months earlier accidentally spilled on himself some of the contents of a 209 L drum containing a 70% solution of hydrofluoric acid. He was in the process of diluting the material for future use at his site of employment. In the ED, he was awake and alert with a systolic blood pressure of 110 mm Hg. However, he quickly became dyspneic and then comatose. Life support measures were initiated and he was stabilized. The patient received calcium gluconate gel topically and IV calcium gluconate. The patient was subsequently transferred to the burn unit because of burns that covered 11% of his total body surface area, including second- and third-degree burns on his head and neck. His course was further complicated by the presence of severe hypocalcemia (calcium of 2.7 mg/dL), profound hypotension and refractory ventilatory failure. Approximately 6 hours after admission, he developed ventricular fibrillation and cardiopulmonary resuscitation was unsuccessful.

Case 61. A 2-year-old boy ingested an unknown amount of a 35% solution of hydrogen peroxide that was stored in the refrigerator. The family lived on a farm and kept peroxide on hand to treat raw milk for drinking. Several minutes after the ingestion, he had a seizure and then became apneic. He was transported by private vehicle to the ED; he arrived in cardiorespiratory arrest. He was resuscitated, intubated, and transferred to a pediatric hospital. Endoscopy showed mucosal burns, without perforation, especially in the esophagus and sphincter areas. Severe gastric distention required decompression via NG suction. He died on the sixth hospital day from subsequent complications including respiratory and metabolic acidosis, air emboli, and anoxic encephalopathy with marked cerebral edema. Postmortem examination showed multiple pinpoint hemorrhagic areas on the gastric mucosal surfaces.

Case 63. A 35-year-old woman with a history of chronic depression and numerous suicide attempts was found by the sheriff unconscious in her car on the roadside. In the car were an empty trazodone bottle, a jar with a white crystalline powder labeled sodium azide reagent grade, and a container with white powder around its edge, containing a dark liquid with a strong hydrocarbon smell. When paramedics arrived, she had a systolic blood pressure of 140

mm Hg, pulse of 60 beats/min, and a respiratory rate of 6 breaths/min. Her pupils were midrange and unreactive. She was given naloxone and 50% dextrose with no response. The hazardous materials team was summoned. They donned gloves and goggles and self-contained breathing equipment. The patient was transferred by helicopter to a nearby university hospital. En route she needed atropine for a pulse of 40 beats/min. Her rhythm then deteriorated to ventricular fibrillation. The odor of the patient permeated the entire ED and many staff complained of burning, watery eyes and headache, necessitating decontamination and medical evaluation. The patient died an hour after being found in her car. Her body and the involved chemical containers were wrapped in double bags. Rinse water from the patient could not be disposed of in regular sinks, because of the risk of formation of shock sensitive metal azides. The suspected source of the sodium azide was the laboratory where the patient had been working. Postmortem examination showed generalized visceral congestion and 150 mL of a thick grey-brown fluid in the stomach. Drug screen was negative. Azide analysis was not performed.

Case 64. A 30-year-old woman developed nausea and severe headaches after consuming two drinks of tequila. She collapsed on her bed. Paramedics were summoned and found the patient seizing with fixed and dilated pupils. She then developed apnea and asystole. Cardiopulmonary resuscitation was initiated and she was intubated. Physical examination in the ED showed a comatose woman with a blood pressure of 180/80 mm Hg and a pulse of 100 beats/min. Her systolic blood pressure dropped to 80 mm Hg, then to 50 mm Hg. Arterial blood gases showed pH 6.28; Pco_2, 40 mm Hg; Po_2, 297 mm Hg. The patient remained acidotic, comatose and ventilator dependent. Approximately 5 days after admission, she developed profound hypotension. Her rhythm deteriorated from bradycardia to asystole and she died. Postmortem toxicologic analysis showed the presence of **strychnine** in the blood (0.17 μg/mL), brain (0.42 μg/g), liver (0.97 μg/g), kidney (0.53 μg/g), and gastric contents (10.9 mg). The patient's husband has been charged with murder.

Case 70. An 87-year-old woman ingested an unknown amount of a disinfectant cleaner containing 6.5% **ethylene glycol butyl ether**. In the ED she was comatose and had the odor of the disinfectant on her breath. She was intubated and placed on mechanical ventilation. She received IV naloxone, 50% dextrose, thiamine, and pyridoxine without any change in her mental status. She underwent gastric lavage, and then received activated charcoal and a cathartic. Initial arterial blood gases showed a metabolic acidosis. Her ethylene glycol level was 110 mg/dL. Three hours after admission, the patient received a loading dose of ethanol and a continuous infusion was started. Hemodialysis was discontinued after only 12 minutes because she developed ventricular tachycardia. Her hospital course was complicated by prolonged metabolic acidosis, hypotension, ventricular arrhythmias, hepatic and renal failure, and disseminated intravascular coagulation. Despite reduction of the ethylene glycol level to 10 mg/dL, the patient had a cardiac arrest and died 3 days after admission.

Case 83. A 78-year-old mentally retarded man ingested approximately 180 mL of a **pine oil cleaner**. Over the next 7 hours he vomited several times then became increasingly unresponsive. When paramedics arrived, he had a heart rate of 30 beats/min. Cardiopulmonary resuscitation was initiated. On arrival at the ED, he was in ventricular fibrillation. He was defibrillated twice and received epinephrine. He then developed an irregular rhythm with bradycardia, occasional P waves, and varying wide QRS complexes. The patient had a history of an old left bundle branch block. His pulse varied from 25 to 60 beats/min, and he was hypotensive. Atropine had no effect. Dopamine was administered to maintain his systolic blood pressure at 90 to 100 mm Hg. He was admitted to the ICU and placed on mechanical ventilation. On the second hospital day, he suddenly became asystolic and resuscitation was unsuccessful.

Case 84. A 90-year-old man with Alzheimer's disease ingested approximately 60 mL of a **cleaner** containing **pine oil**. The 60 mL container was found empty, and the odor of the substance was detected on his breath. Fifteen minutes after the ingestion, the patient was asymptomatic and in no distress. In the ED he was given activated charcoal and a cathartic. Within 1.5 hours he became comatose and developed respiratory failure requiring mechanical ventilation. A chest roentgenogram showed right lower lobe infiltrates consistent with aspiration pneumonitis. Dopamine, dobutamine and a plasma protein expander were infused to maintain his blood pressure at 90-100/60-70 mm Hg. By the fourth hospital day, the patient was hemodynamically stable off all vasopressors and fluid expanders. By the sixth hospital day, the patient remained comatose and his chest roentgenograms were unchanged. He was receiving ticarcillin for a hospital-acquired *Staphylococcus aureus* infection. By the tenth hospital day, the patient's mental status returned to his preexposure baseline levels, and there was slight improvement of his chest roentgenogram. Unsuccessful attempts were made to wean the patient from the ventilator over the next 2 days. During his 15 day hospitalization, his arterial blood gases ranged as follows: pH, 7.31 to 7.46; Pco_2, 34 to 41 mm Hg; Po_2, 76 to 88 mm Hg; bicarbonate, 17 to 18 mEq/L. Postmortem examination showed consolidated lungs with only a small portion still aerated. The parietal and visceral pleura contained focal areas of grayish-white plaques. The lumen of the tracheobronchial tree contained mucopurulent exudate with roughening and congestion of the mucous membrane.

Case 87. An 83-year-old woman drank an unknown amount of 8% **hydrofluoric acid** in a suicide attempt. Because of hematemesis and dysphagia, she went to the ED 30 minutes after the ingestion. On physical examination, she was lethargic with a palpable blood pressure of 60 mm Hg, pulse of 128 beats/min, and respirations of 28 breaths/min. She had bright red blood per NG tube. Serum calcium was 6.1 mg/dL. Initial treatment included IV fluid resuscitation, dopamine, calcium chloride, and blood transfusions. Six hours after the ingestion, she developed a prolonged QT interval and intermittent ventricular tachycardia. Her serum calcium at that time was 9.7 mg/dL. Seventeen hours after the ingestion, she sustained a cardiac arrest and died.

Case 88. A 35-year-old man was inside a closed storage vessel, which had previously contained chicken livers, disinfecting it with a 12.5% **sodium hypochlorite** solution. It is unknown whether any other substances were being used. Approximately 5.5 hours after he was expected to have finished the cleaning job, an ambulance was called. Cardiopulmonary resuscitation was initiated at the scene, and he was transported to the ED. The patient died 13 minutes after arriving at the ED. Postmortem examination showed massive bilateral pulmonary edema and congestion and ecchymosis of a shoulder.

Case 120. A 3-year-old boy was pulled out of the flames of a four alarm fire by a neighbor. Cardiopulmonary resuscitation was initiated by joggers. When paramedics arrived, the child was not breathing and was asystolic. Cardiopulmonary resuscitation was continued, and he was intubated and given IV epinephrine. In the ED, he was comatose and flaccid with a blood pressure of 99/29 mm Hg, pulse of 95 beats/min, and temperature of 33°C. After receiving 100% O_2 for 30 to 60 minutes, his **carboxyhemoglobin level** was 26%. Arterial blood gases showed pH, 7.04; Pco_2, 18 mm Hg; Po_2, 462 mm Hg; bicarbonate, 4.8 mEq/L. Thirty minutes later, second studies showed carboxyhemoglobin, 7%; pH, 7.32; Pco_2, 7 mm Hg; Po_2, 539 mm Hg; bicarbonate, 3.3 mEq/L. The patient then received hyperbaric O_2 for 2 hours. Initially there was improvement in his muscle tone, but then he developed posturing. The patient was anuric. Thiosulfate was administered, and the patient was transferred to a pediatric hospital. On arrival, he was comatose with decorticate posturing. After 2 days in the ICU, the patient was not triggering the ventilator. His vital signs were blood pressure, 90/60 mm Hg; pulse, 140 beats/min; temperature, 36°C. Electrolytes were sodium, 128 mEq/L; potassium, 2.9 mEq/L; chloride, 104 mEq/L; bicarbonate, 13 mEq/L. Arterial blood gases were pH, 7.35; Pco_2, 21 mm Hg; bicarbonate, 11 mEq/L. The chest roentgenogram showed minimal

bronchial thickening. After two EGs showed no brain wave activity, life support was discontinued on the fifth hospital day. Postmortem examination showed a markedly narrowed airway with extreme swelling of the epiglottis, and markedly erythematous larynx and trachea. Pulmonary findings included erythematous bronchi, edematous upper lobes, and consolidated pulmonary parenchyma. The brain was very soft and extremely swollen. The cause of death was confirmed to be hypoxic encephalopathy due to inhalation of products of combustion. Toxicologic analysis on blood drawn on the first hospital day showed a cyanide level of 0.32 μg/mL and a methemoglobin level of 0.7%.

Case 130. A 25-year-old professional landscaper ingested unknown amounts of a **lawn fungicide** containing 20.1% **cadmium chloride** and a **water hardener kit** containing less than 0.1% **calmagite solution**. On presentation to the ED 30 minutes after the ingestion, the patient was agitated and diaphoretic with a systolic blood pressure of 50 mm Hg and a pulse of 140 beats/min. His lungs were clear and he had no jugular venous distention. Initial laboratory results included hemoglobin, 22 g/dL; hematocrit, 68%; white blood cell (WBC) count , 7,600/μL; platelets, 302,000/μL; sodium, 143 mEq/L; potassium, 3.6 mEq/L; chloride, 104 mEq/L; bicarbonate, 30 mEq/L; glucose, 127 mg/dL; AST, 22 IU/L; ALT, 14 IU/L; alkaline phosphatase, 72 IU/L; LDH, 224 IU/L. Arterial blood gases showed pH, 7.15; Pco_2, 24 mm Hg; Po_2, 194 mm Hg; bicarbonate, 8.3 mEq/L. Because of his agitation, he was given diazepam and pancuronium before he was intubated. IV fluids, dopamine, and norepinephrine were required to sustain a systolic blood pressure of 90 mm Hg. In the ED he received ethylenediaminetetraacetic acid (EDTA), 75 mg/kg IV. Because of persistent anuria and progressive elevations of his BUN and creatinine levels, EDTA was discontinued. After 13 ampules of sodium bicarbonate, his arterial pH remained less than 7.2. The patient also received broad spectrum antibiotics, cimetidine, and dexamethasone. He remained hypotensive, became unresponsive, then died 26 hours after the ingestion.

Case 131. A 20-year-old man arrived at the ED by ambulance 8 hours after intentionally ingesting **arsenic trioxide**. He stated that after the ingestion, he had vomited 25 times and the emesis had contained blood. He was initially awake and oriented, but had ventricular tachycardia requiring cardioversion. Initial laboratory results included hemoglobin, 19.2 g/dL; hematocrit, 55.6%; WBC count, 39,300/μL; platelets, 402,000/μL; sodium, 142 mEq/L; potassium, 3.7 mEq/L; chloride, 92 mEq/L; bicarbonate, 15.5 mEq/L; BUN, 19 mg/dL; creatinine, 2.6 mg/dL; glucose, 298 mg/dL. Arterial blood gases on 13 L O_2 were pH, 7.2; Pco_2, 29 mm Hg; Po_2, 339 mm Hg; bicarbonate, 11.4 mEq/L. An abdominal roentgenogram showed radiopaque material. Treatment included dopamine, lidocaine, sodium bicarbonate, dimercaprol, bretylium, and lorazepam. In the ICU, a Swan-Ganz catheter (Baxter Healthcare) was inserted and his pulmonary capillary wedge pressure was 14 cm H_2O. He was also intubated and an NG tube was inserted. He was lavaged and then activated charcoal and a cathartic were given. He became more hypotensive and norepinephrine was started. A Foley catheter was placed, but he remained anuric despite receiving 8 liters of fluid and furosemide. His last arterial blood gases were pH, 7.25; Pco_2, 39 mm Hg; Po_2, 64; bicarbonate, 17 mEq/L. Despite receiving dopamine, norepinephrine, and dobutamine, he remained hypotensive and died approximately 16 hours after the ingestion.

Case 132. A 35-year-old woman with multiple prior suicide attempts mixed **arsenic** powder with water and then injected the solution IV at an unknown time. Later that day, she was found vomiting and incontinent by a family member. In the ED, she was vomiting coffee ground emesis and complained of throat, epigastric, and abdominal pain. On physical examination, she was lethargic with a blood pressure of 97/51 mm Hg, pulse of 111 beats/min, and respirations of 20 breaths/min. Rectal examination showed guaiac-negative stool. Treatment included dimercaprol and urine alkalinization. A few hours later, she became progressively hypotensive and was given fluids, dopamine, and blood transfusions. Two days after the ingestion, she became oliguric and was hemodialyzed. Her hospital course was complicated by the development of refractory hypotension, fluid overload, liver failure, renal failure, and disseminated intravascular coagulation. She died on the third hospital day.

Case 134. A 75-year-old man stumbled out of a garage and informed his girlfriend that he had ingested an unknown amount of an unknown poison which had been stored in a mason jar. By the time paramedics arrived 9 minutes later, the patient had coughed up sputum and then vomited white mucous. He denied any pain or shortness of breath. On physical examination he had a palpable systolic blood pressure of 110 mm Hg, pulse of 76 beats/min, and respiratory rate of 28 breaths/min. The cardiac monitor showed normal sinus rhythm. The patient received oxygen and normal saline was infused. Minutes later, during transport, the patient's mental status rapidly deteriorated. Repeat vital signs 13 minutes after the previous set showed a palpable systolic blood pressure of 80 mm Hg, pulse of 50 beats/min, and respiratory rate of 12 breaths/min. A few minutes later the patient developed electromechanical dissociation at a rate of 40 beats/min, without an obtainable blood pressure. Cardiopulmonary resuscitation was initiated and the patient was intubated. After receiving atropine, epinephrine, and dopamine in the ED, he had a palpable systolic blood pressure of 90 mm Hg with a pulse rate in the 80s. On physical examination, the patient had dilated pupils that were minimally reactive. Other physical findings were warm and dry skin, clear lungs, and absent bowel sounds. On 100% O_2 his arterial blood gases showed pH, 7.16; Pco_2, 36 mm Hg; Po_2, 62 mm Hg. Gastric lavage produced a green liquid with a strong hydrocarbon odor. During continued lavage, the return became hemorrhagic. Despite receiving sodium bicarbonate, isoproterenol, and an external pacemaker, his rhythm and blood pressure could not be maintained. The patient died approximately 1 hour after his arrival. The coroner analyzed the gastric contents from the beginning of the lavage and determined the cause of death to be secondary to the ingestion of **arsenic**.

Case 135. An 84-year-old man with a history of dementia and alcohol abuse went to the ED claiming to have ingested **arsenic trioxide** the day before. He had vomited and had diarrhea but was now asymptomatic. Creatinine was 1.8 mg/dL and BUN was 18 mg/dL. An abdominal roentgenogram showed radiopaque material. He remained asymptomatic until the following morning when he became hypotensive and delirious. His urine output dropped and he developed hematuria. A subsequent abdominal roentgenogram showed radiopaque material still present. An NG tube was inserted and whole bowel irrigation initiated, but the patient vomited the solution. He later developed rales and was intubated. His blood pressure was 90/60 mm Hg, BUN 58 mg/dL, and creatinine 2.5 mg/dL. Treatment included colonic irrigation, urinary alkalinization, and chelation with intramuscular dimercaprol. The patient developed aspiration pneumonia. Arterial blood gases were pH, 7.37; Pco_2, 28 mm Hg; Po_2, 86 mm Hg; bicarbonate, 16 mEq/L. On the fourth hospital day, the patient was agitated and anuric with a blood pressure of 106/60 mm Hg. He underwent hemodialysis for acute tubular necrosis. On the fifth hospital day, he became comatose and his systolic blood pressure fell to almost 60 mm Hg. Treatment included hemodialysis and dimercaprol. Whole bowel irrigation was discontinued. Activated charcoal was suctioned from the endotracheal tube. Laboratory results included sodium, 141 mEq/L; potassium, 2.4 mEq/L; chloride, 99 mEq/L; bicarbonate, 18 mEq/L; BUN, 35 mg/dL; creatinine, 4.3 mg/dL. He died on the sixth hospital day. It was later learned that he had acquired the arsenic 20 years earlier from a chemical plant employer and had been saving it to kill chickens.

Case 136. A 35-year-old man ingested an unknown powder with suicidal intent. The patient's wife brought a bag of powder to the ED, saying it contained diclorodiphenyltrichloroethane (DDT). Her husband had reportedly mixed the powder and cigarettes together and then ingested the mixture. He was asymptomatic on arrival but began vomiting following insertion of an NG tube. He was lavaged

and given activated charcoal and a cathartic. Within 3 hours the patient had some seizure activity and became combative. He was treated with IV diazepam and phenytoin. Approximately 9 hours after the ingestion the patient became hypotensive with blood pressures ranging from 80/38 mm Hg to 86/50 mm Hg. His pulse was 120 beats/min and his respiratory rate was 28 to 32 breaths/min. He had vomited approximately seven times. Laboratory results included sodium, 148 mEq/L; potassium, 3.4 mEq/L; chloride, 112 mEq/L; serum creatinine, 1.0 mg/dL; glucose, 106 mg/dL; BUN, 11 mg/dL. Urinalysis was 3+ for glucose with WBC and red blood cells present. Approximately 18 hours after ingestion the patient was transferred to a tertiary care facility because of hypotension and reduced urine output. His blood pressure remained low despite dopamine, dobutamine, metaraminol, and atropine. Shortly after arrival at the referral hospital, the patient had a cardiac arrest and resuscitation attempts were unsuccessful. Two hours after his death the substance was identified as arsenic. Postmortem findings were consistent with arsenic intoxication, including myocarditis and gastritis. The blood arsenic concentration was 46.0 μg/dL.

Case 137. A 46-year-old man with a history of chronic ethanol abuse and multiple suicide attempts ingested approximately 50 g of mercuric chloride during a drinking episode. In the ED, he was in acute respiratory distress and had significant oral swelling. After an emergency cricothyrotomy, the patient was sedated, paralyzed, and transferred by helicopter to the ICU of a large medical center. Dimercaprol was administered, but he developed anuric renal failure, upper and lower gastrointestinal (GI) bleeding, increasing respiratory failure, and disseminated intravascular bleeding. On the first hospital day, the patient underwent a tracheotomy, right thoracotomy, and exploratory laparotomy. Esophagostomy and jejunostomy were required due to extensive necrosis of the stomach. Postoperatively, the patient experienced increasing hypotension and respiratory failure, leading to severe metabolic acidosis. Cardiac arrest occurred 16 hours after the ingestion. Postmortem examination showed erosive gastroesophagitis, stomatitis and pharyngitis, tracheobronchitis, facial edema, and edematous colonic mucosa.

Case 139. A 45-year-old man was at work when the platform he was standing on collapsed. He then fell into a vat containing nickel sulfate, nickel chloride, and nickel oxide at a temperature of 54.4 °C. He was pulled from the vat within 30 to 60 seconds. Physical examination showed second degree burns of his lower extremities, for a total surface area of 3%. Laboratory results included bilirubin, 5.4 mg/dL; AST, 57 IU/L; ALT, 85 IU/L; alkaline phosphatase, 78 IU/L. Within 24 hours of admission, he developed renal and hepatic failure and sustained a myocardial infarction. The patient's respiratory status deteriorated and he required mechanical ventilation. He died 72 hours after the exposure.

Case 140. A 37-year-old previously healthy man became ill while attending a party. He consumed five beers and then drank from a newly opened bottle of vodka. Minutes later, he developed crampy lower abdominal pain and vomiting and then became unconscious. He awakened in the ED and continued to have abdominal pain, nausea with brownish emesis, and diarrhea. Two other people at the party had tasted the vodka and reported that it "tasted bad." Physical examination showed an alert and agitated man in moderate distress. His vital signs were blood pressure, 94/40 mm Hg; pulse, 124 beats/min; respirations, 36 breaths/min; temperature, 37.8°C. Abdominal examination was remarkable for a midline surgical scar, active bowel sounds and moderate tenderness to palpation with mild guarding in the right lower quadrant. Rectal examination showed guaiac-positive stool. Laboratory results included potassium, 2.8 mEq/L; anion gap, 17 mEq/L; BUN, 14 mg/dL; creatinine, 1.2 mg/dL; hemoglobin, 14.3 g/dL; WBC count, 24,100/μL with neutrophilia and a left shift; platelets, 269,000/μL; alkaline phosphatase, 25 IU/L; AST, 105 IU/L; ALT, 45 IU/L; amylase, 42 IU/L; lactate, 2.9 mEq/L; negative serum ketones. Urinalysis showed protein, 43 WBC/high-power field and 98 erythrocytes/high-power field. Arterial blood gases were pH, 7.48; Pco_2, 24 mm Hg; Po_2, 86 mm Hg; bicarbonate, 18 mEq/L. Toxicologic analysis results of serum and urine were negative except for an ethanol level of 160 mg/dL. Roentgenograms of the chest and abdomen were unremarkable. Despite receiving vasopressors and fluids, the patient remained hypotensive in the ICU. Over the next few hours, he developed stupor, hypoxemia and metabolic acidosis. A chest roentgenogram showed interstitial lung infiltrates. The patient underwent exploratory laparotomy for possible ischemic bowel, viscus perforation, or occult abscess, but only mild adhesions and edema of the retroperitoneum were found. The remainder of his hospital course was remarkable for persistent metabolic acidosis, adult respiratory distress syndrome, hypotension, fever, disseminated intravascular coagulation, and multisystem organ failure necessitating hemodialysis. The patient died on the eighth hospital day. Postmortem toxicological analysis of multiple tissues showed high levels of arsenic. The remaining liquid in the vodka bottle contained 18% potassium arsenite by weight.

Case 141. A 60-year-old woman presented to the ED complaining of "burning all inside" after ingesting approximately 60 mL of dichlorophenoxyacetic acid (2,4-D) herbicide in a petroleum distillate vehicle. In the ED she was alert and oriented with stable vital signs. Initial therapy included gastric lavage and administration of activated charcoal. Within the first 22 hours she became comatose responding only to deep pain. Vital signs remained stable. Forty-eight hours after presentation, she developed occasional twitching and remained comatose with minimal response to pain. Continuous electroencephalographic monitoring showed extremely slow activity indicative of frontal lobe damage. Her BUN and creatinine levels were reported as mildly elevated. Eleven days after presentation, it was learned that the patient had developed renal failure and then diabetes insipidus. Her EEG showed a flat line and she was pronounced dead.

Case 142. A 29-year-old man presented to the ED complaining of nausea, vomiting, diarrhea, epigastric pain, and generalized weakness of approximately 36 hours duration. The emesis was coffee ground and the diarrhea was black and tarry. The patient denied prior GI bleeding and also denied recent abuse of ethanol or salicylates. The patient was in no acute distress with a blood pressure of 70/50 mm Hg, pulse of 80 beats/min, respiratory rate of 18 breaths/min, and temperature of 36.7o C. Physical examination was remarkable for an excessively dry tongue, slightly icteric sclera, crepitation on both sides of the neck consistent with subcutaneous emphysema, distant heart sounds, mild epigastric tenderness, and brown guaiac-positive stool in the rectum. Gastric aspirate was also guaiac positive. Laboratory results included hemoglobin, 16.6 g/dL; hematocrit, 50.9%; WBC count, 26,500/μL with a differential of 82% segmented neutrophils, 7% band neutrophils, 7% lymphocytes, 4% monocytes, and 1% nucleated red blood cells; platelets, 283,000/μL; sodium, 143 mEq/L; potassium, 3.3 mEq/L; chloride, 97 mEq/L; bicarbonate, 12.4 mEq/L; glucose, 109 mg/dL; BUN, 65 mg/dL; creatinine, 9.6 mg/dL; anion gap, 34 mEq/L. Coagulation studies showed PT, 22.7 seconds; PTT, 41.1 seconds; fibrinogen, 43 mg/dL. Arterial blood gases on room air showed pH, 7.40; Pco_2, 25 mm Hg; Po_2, 47 mm Hg. Chest roentgenogram showed a pneumomediastinum, bilateral infiltrates, and an enlarged cardiac silhouette. Upper GI contrast study showed mucosal swelling in the duodenum consistent with diffuse injury. The patient had been spraying a dilute solution of paraquat in his back yard, but repeatedly denied any ingestion. His hospital course was marked by the extremely rapid development of respiratory failure. He had a cardiac arrest 7.5 hours after presentation and died 35 minutes later. Postmortem examination confirmed acute paraquat ingestion as the cause of death. The postmortem serum paraquat level was 6.4 μg/mL.

Case 144. A 34-year-old man with a history of chronic alcohol abuse presented to the ED after ingesting up to 240 mL of paraquat. He complained of vomiting and muscle cramps. After activated charcoal was given, the patient was transferred. At the second facility, the patient was hypotensive and still complaining of cramps.

The patient received fluids, sodium polystyrene sulfonate, and potassium. Throughout the night his blood pressure remained stable. Early the next morning, he was slightly tachypneic, but his lungs were clear. His urine output was excellent. He then became hypotensive and was unresponsive to fluids and vasopressors. By midafternoon, he had a respiratory arrest. After 2 hours of continuous cardiopulmonary resuscitation, he died. Toxicologic analysis showed the presence of paraquat and a blood ethanol level of 219 mg/dL.

Case 153. A 2-year-old boy was allegedly found with a can of insecticide after he had sprayed it into his eyes. After washing his face with water, his mother called the poison center. By that time, he had vomited once and was crying. There was no history of coughing or choking. Because the mother was so upset, paramedics were asked to respond and the boy was transported to the ED. On presentation, he was comatose with labored breathing. Chest roentgenogram showed greater than 50% consolidation of the lungs. Arterial blood gases showed a pH of 7.18 and Pco_2 of 59 mm Hg. He developed seizures and was treated with diazepam and succinylcholine. On transfer to a tertiary care facility the child was comatose, tachycardic to 190 beats/min, and ventilator dependent. His lungs were described as wet. Treatment included dopamine to maintain his blood pressure and activated charcoal. Atropine was given for a possible insecticide exposure without improvement. Sixteen hours after the exposure, the parents stated their son had actually ingested charcoal lighter fluid. He developed bloody pulmonary secretions and was treated for aspiration pneumonitis. Twelve hours after the exposure, he developed ventricular fibrillation and arrested. Cardiopulmonary resuscitation was initiated and 12 minutes later his rhythm converted to sinus. After the resuscitation, he was unresponsive to pain with no spontaneous movement and occasional spontaneous respirations. His pupils were nonreactive. Within 36 hours, he developed multisystem failure. His transaminases ranged from 1,700 to 2,000 IU/L. The bloody pulmonary secretions persisted and prophylactic antibiotics were administered. He was hyperkalemic, requiring multiple doses of calcium and sodium bicarbonate. Bradycardia and asystole ensued. Postmortem examination confirmed the cause of death as ingestion and aspiration of a volatile hydrocarbon.

Case 155. A 14-year-old boy sprayed a fabric protector containing 1,1,1-trichloroethane on a shirt and was inhaling it with friends in the parking lot at a dance. He abruptly stood up, ran into the building, and collapsed. When paramedics arrived, the patient was in cardiac arrest, which progressed to cardiopulmonary arrest prior to arrival at the ED. Lidocaine, epinephrine, and dopamine were administered. About 4 hours after he collapsed, the resuscitation attempts were discontinued and he died. Postmortem examination showed generalized visceral congestion, pulmonary edema, and swelling of the brain. The cause of death was confirmed to be ventricular arrhythmias secondary to inhalation of 1,1,1-trichloroethane. Postmortem toxicological analysis showed a blood level of 8 μg/mL of 1,1,1-trichloroethane.

Case 163. A 13-year-old boy was found unresponsive in complete cardiopulmonary arrest. Cardiopulmonary resuscitation was initiated. He vomited several times and a gasoline odor was present. He died approximately 1 hour later. Postmortem examination showed massive pulmonary edema. Toxicological analysis results of the urine was positive for caffeine, nicotine, and nicotine metabolites and negative for drugs of abuse. Headspace analysis showed unidentified volatile peaks with similar retention times to some found in gasoline.

Case 165. A 13-month-old boy ingested an unknown quantity of kerosene. Approximately an hour later in the ED, he was spitting, drooling, and coughing. After a vomiting episode, he suddenly developed severe respiratory distress. He was intubated and transferred to a tertiary medical facility. Approximately 9 hours after the exposure, he was "fighting" the ventilator and was paralyzed with pancuronium. Chest roentgenogram showed multiple infiltrates. After the endotracheal tube suctioning produced a tan secreti ceftazidime and clindamycin were started. The inspired oxygen c centration was increased to 100%. The patient became febr Forty-eight hours after the exposure, he developed a pneumothor Seventy-two hours after the exposure, severe pulmonary edema veloped, which was treated with diuretics. He died 100 hours af the exposure.

Case 166. A 12-month-old girl ingested an unknown amount lamp oil containing 58% mineral oil, 40% vegetable oil, and 2% p fume oil. In the ED, she was lethargic with bilateral wheezing. Ch roentgenogram showed a right-sided infiltrate. Initial arterial blo gases on 10 L O_2 were pH, 7.35; Pco_2, 45 mm Hg; Po_2, 446 mm H She developed increasing respiratory distress and a repeat ch roentgenogram showed bilateral infiltrates. She was then transferr to a pediatric hospital. Vital signs on arrival were systolic blo pressure, 92 mm Hg; pulse, 156 beats/min; respirations, 80 breat min; temperature, 36.4°C. On physical examination, she was leth gic and had substernal and subcostal retractions. In addition, s had bilateral otitis media and decreased basilar breath sounds. S was admitted to the ICU and antibiotics were administered. Aft continuous positive airway pressure was applied, she initial seemed to improve. However, over the ensuing 24 hours, she d veloped respiratory failure and was intubated and mechanically ve tilated. Chest roentgenogram showed a right pneumothorax and chest tube was inserted. During her hospitalization, she require increasing positive end-expiratory pressures, 100% inspired oxyge dopamine, and dobutamine. On the fourth hospital day, she su denly deteriorated. Chest roentgenogram showed a recurrence the right pneumothorax and a pneumomediastinum. After the plac ment of both a chest tube and mediastinum tube, the patient's bloo pressure increased and her respiratory status temporarily improvec On the fifth hospital day, she could no longer be oxygenated. Sh became bradycardic, hypotensive, and died.

Case 167. A 2-year-old girl mistook kerosene for a red beverag and drank it. At home she had several episodes of coughing an choking. In the ED, she was intubated and placed on mechanica ventilation. She developed bilateral pulmonary infiltrates an needed high concentrations of forced inspiratory oxygen and a hig positive end-expiratory pressure for oxygenation. After a week sh improved slightly, but then began to worsen. At this time, her bes arterial blood gases showed Po_2 of 50 mm Hg and Pco_2 of 50 mm Hg She developed a pneumothorax, which was treated with chest tub insertion. She also developed shock, which was treated with dopamine and fluid boluses. She was then transferred to a facility offering extracorporeal membrane oxygenation. Despite the treatment of a tension pneumothorax, the patient continued to have poor ventilation-perfusion. Twenty days after admission, she had a sudden arterial decannulation and had 10 minutes of complete hypoxia. She then sustained a cardiopulmonary arrest and died.

Case 173. A 72-year-old man, despondent over the recent death of his father, ingested an unknown number of aluminum phosphide tablets in front of his wife. In addition, he had been drinking heavily that evening. He had a history of alcohol abuse, chronic obstructive pulmonary disease, and abdominal aortic aneurysm. When paramedics arrived, he was obtunded. On arrival at the ED 1.5 hours after the ingestion, he was diaphoretic with a systolic blood pressure of 65 mm Hg. Physical examination showed equal and small pupils, clear lungs, and regular heart rhythm. Laboratory studies included sodium, 130 mEq/L; creatinine, 2.6 mg/dL; glucose, 131 mg/dL; calcium, 7.5 mg/dL; phosphorus, 42.2 mg/dL; AST, 1,206 IU/L; LDH, 2,267 IU/L; CPK, 26,216 IU/L; WBC count, 11,000/μL; PT, 16.6 seconds. Toxicologic analysis showed an ethanol level of 230 mg/dL and an acetaminophen level of < 10 μg/mL. Arterial blood gases showed pH, 7.32; Pco_2, 40 mm Hg; Po_2, 64 mm Hg. An ECG showed nonspecific diffuse repolarization abnormalities with premature ventricular contractions. In the ED the patient received fluids and dopamine and his blood pressure was stable. He underwent gastric lavage, and was given activated charcoal and a cathartic.

While being moved from the gurney, he developed ventricular fibrillation and was defibrillated. He was also intubated and placed on mechanical ventilation. In the ICU he had refractory hypotension with a systolic blood pressure of 66 mm Hg. In addition, he became anuric. Repeat arterial blood gases drawn approximately an hour after the first showed pH, 7.15; Pco_2, 19 mm Hg; Po_2, 156 mm Hg. Other laboratory studies obtained in the ICU included hemoglobin, 9.4 g/dL; potassium ranging from 2.9 to 3.6 mEq/L; bicarbonate, 3 mEq/L; glucose, 769 mg/dL; lactate, 25.5 mEq/L. The patient died approximately 30 hours after the ingestion.

Case 179. A 30-year-old man with a history of alcoholism and depression was found unresponsive with an empty bottle of lindane next to him. In the ED, the patient was unresponsive. In the ICU, he was intubated and placed on mechanical ventilation. He was having generalized seizures and constant muscle tremors. Diazepam was given to control the seizures. An hour after admission, he became anuric. Three hours after admission, his vital signs were systolic blood pressure of 60 mm Hg, pulse of 120 beats/min, and rectal temperature of 42°C. Five hours after admission, he remained comatose, anuric, and tachycardic to 122 beats/min. He continued to deteriorate and died 10 hours after admission.

Case 182. A 55-year-old man was exposed to methyl bromide when he went inside a house that was tented for exterminating termites. After leaving the house, he collapsed on the sidewalk and started to seize. Thirty-six hours after the exposure, the patient was comatose with a blood pressure of 60/40 mm Hg and temperature of 39.4°C. Laboratory studies included sodium, 148 mEq/L; bicarbonate, 9 mEq/L; BUN, 44 mg/dL; creatinine, 8 mg/dL; glucose, 355 mg/dL. He developed complete heart block and was placed on an intraaortic balloon pump. Treatment also included epinephrine, dopamine, and hemodialysis. The patient died on the sixth hospital day.

Case 183. An 18-month-old girl was found by her mother playing with buckets containing an insecticide (terbufos). Four hours later while en route to the physician's office, she experienced a cardiopulmonary arrest. Cardiopulmonary resuscitation was initiated and the patient was transported to the hospital. In the ED, the child was found to be without a discernable cardiac rhythm. Atropine and pralidoxime were administered with no effect. She was also decontaminated with soap and water and underwent gastric lavage with return of large amounts of orange fluid. She died approximately 7.3 hours after the exposure.

Case 185. A 65-year-old woman, experienced in collecting mushrooms, picked and ate a mushroom growing in her yard. Twenty-four hours later, the patient began experiencing nausea and vomiting. Presuming it was the flu, she did not seek medical attention for several days. Five days after the ingestion, the patient became obtunded and hypotensive. Laboratory results included AST, 3,000 IU/L; bilirubin, 9.1 mg/dL; PT, 80 seconds; PTT, 100 seconds; an anion gap, 30 mEq/L. The patient was intubated and received dopamine and fresh frozen plasma. Repeat laboratory results 8 hours later were sodium, 141 mEq/L; potassium, 3.6 mEq/L; chloride, 93 mEq/L; bicarbonate, 18 mEq/L; glucose, 275 mg/dL; BUN, 50 mg/dL; creatinine, 2.4 mEq/L; AST, 4,314 IU/L; total bilirubin, 6.2 mg/dL; direct bilirubin, 3.1 mg/dL; alkaline phosphatase, 221 IU/L; LDH, 4,350 IU/L; PT, 20 seconds; PTT, 30 seconds. Arterial blood gases showed pH, 7.61; Pco_2, 21 mm Hg; Po_2, 129 mm Hg. The patient remained unresponsive. A liver biopsy 6 days after ingestion showed no viable cells. Urine output was minimal. The patient continued to receive dopamine and dobutamine, as well as lidocaine for ventricular ectopy. Seven days after the ingestion, she died. Although the mushroom was identified as an *amanita*, further classification to species was not possible.

Case 186. While hiking in the mountains, a 32-year-old woman ingested a root from a stream bank that she mistook for watercress. Thirty minutes after the ingestion, she developed status epilepticus. An hour later, at an initial health-care facility, she continued to seize, with no response to diazepam and phenytoin. She was then paralyzed with succinylcholine and pancuronium. GI decontamination consisted of gastric lavage and the administration of activated charcoal and a cathartic. Two hours after the initial presentation, the patient was transferred to another health-care facility. On arrival, she was comatose with a temperature of 36.1°C. She was intubated and placed on mechanical ventilation. She received diazepam, phenytoin, and phenobarbital to control seizure activity. Eight hours after the ingestion, the patient was exhibiting flexor and tonic contraction and extensor posturing. Complications included a spiking temperature and possible aspiration pneumonia. An EEG performed 2 days after the ingestion demonstrated no electrical activity. The patient died 4 days after the exposure. Postmortem examination showed marked congestion of the kidneys and spleen. The lungs had focal intraalveolar acute inflammation. The heart had focal fiber disarray and a focal mild acute inflammatory cell infiltrate composed of eosinophils and polymorphonuclear leukocytes. The brain had focal areas of rarefaction of the occipital lobes. Thrombosis was noted in the right coronary artery and basilar artery with multifocal bilateral infarcts of the occipital lobes. Plants submitted to the toxicology laboratory were identified as *Cicuta douglasii, Conium maculatu*, and *Rorippa spp.*

Case 187. A 71-year-old previously healthy woman was hospitalized with hepatitis. She had been drinking an undiluted ginseng extract from China for 2 weeks prior to admission. The patient developed progressive hepatic failure and died. A sample of the tea was sent for analysis. No solvent was found.

Case 211. A 17-year-old girl ingested 15 tablets of acetaminophen 500 mg and less than one bottle of an over-the-counter cold preparation containing acetaminophen, doxylamine, dextromethorphan, and pseudoephedrine. Sixty-seven hours after the ingestion, she presented to the ED with a complaint of 2 days of vomiting. Laboratory results included sodium, 127 mEq/L; potassium, 4.0 mEq/L; chloride, 98 mEq/L, bicarbonate, 16 mEq/L; BUN, 23 mg/dL; creatinine, 5.1 mg/dL; AST, 9,900 IU/L; LDH, 15,000 IU/L; arterial pH, 7.29; Pco_2, 32 mm Hg; Po_2, 104 mm Hg. Toxicologic analysis showed an acetaminophen level of 13.6 μg/mL and a salicylate level of 2 mg/dL. On admission to the ICU, she was described as lethargic, but arousable (after meperidine was administered). N-acetylcysteine was recommended but never administered because of problems with her NG tube. The evening of her presentation, she was evaluated by the liver transplant service. At that time her PT was elevated to 44.3 seconds. She was intubated and hyperventilated, and received vitamin K, neomycin, and fresh frozen plasma. After her creatinine increased to 6.7 mg/dL and she became anuric, she was hemodialyzed. Her mental status deteriorated and her intracranial pressure was 11 cm H_2O. On her third hospital day, she seized. A CT scan of her head was negative for an intracranial bleed. Early on the fourth hospital day, the intracranial pressure rapidly rose from 35 to 115 cm H_2O over a few minutes and she died. Postmortem examination showed severe hepatic necrosis (primarily centrilobular with severe bile stasis), moderate to gross cerebral edema, and adult respiratory distress syndrome with marked acute pulmonary vascular congestion. Postmortem toxicologic analysis was positive for acetaminophen only.

Case 237. A thirty-five-year-old man presented to the ED approximately 2 hours after an intentional overdose of aspirin. He had been binging on alcohol for the previous 9 days and on the day of his overdose he had purchased a bottle of aspirin, containing 300 tablets, 325 mg each. On arrival, the patient was diaphoretic, pale, and tachycardic. Laboratory results included "normal electrolytes"; glucose, 200 mg/dL; WBC count, 21,000/μL; arterial pH, 7.37. Toxicologic analysis showed a 2-hour salicylate level of 78 mg/dL and an ethanol level of 5 mg/dL. The patient underwent gastric lavage. Thirteen hours after admission to the ICU, the patient's mental status deteriorated and he had Kussmaul breathing at 40 breaths/min. In addition, his urine output decreased. Laboratory results showed sodium, 129 mEq/L; potassium, 3.3 mEq/L; bicarbonate, 10.5 mEq/L. Salicylate level 15 hours after the ingestion was 112 mg/dL. Eighteen hours after the ingestion, arterial blood gases on 2

L O_2 by nasal cannula sho[illegible] pH, 7.49; Pco_2, 17 mm Hg; Po_2, 84 mm Hg; bicarbonate, 13 mEq/L. Transfer for hemodialysis was recommended but declined. Twenty hours after the ingestion, the patient was intubated and mechanically ventilated. He had no urine output. Twenty-two hours after the ingestion, the patient developed malignant hyperthermia, had a respiratory arrest followed by a cardiac arrest, and died.

Case 265. A 40-year-old man with cirrhosis ingested approximately 15 tablets of **colchicine**, 0.6 mg, and 10 capsules of **diphenhydramine**, unknown strength, at an unknown time. In the ED, he was alert and oriented and had normal sinus rhythm. He received ipecac syrup, but the emesis volume was small with no pill fragments. He refused any further GI decontamination and laboratory evaluation. On arrival at the ICU, he was in normal sinus rhythm and had a blood pressure of 105/64 mm Hg. He had a large emesis and became progressively more lethargic. A complete blood count and electrolytes were unremarkable. Arterial blood gases on 2 L O_2 showed pH, 7.40; Pco_2, 30 mm Hg; Po_2, 61 mm Hg; bicarbonate, 19 mEq/L. Urinalysis showed bilirubin and protein. On the second hospital day, he had a respiratory rate of 48 breaths/min and became comatose. Arterial blood gases on 2 L O_2 showed a pH of 7.0 and Po_2 of 59 mm Hg. He was intubated, mechanically ventilated, and given sodium bicarbonate. His pulse increased to 100 beats/min with a blood pressure of 110/70 mm Hg. His pupils were fixed and dilated. He became anuric and developed watery, foul-smelling diarrhea. His rhythm deteriorated into ventricular tachycardia and then progressed to asystole. Cardiopulmonary resuscitation was initiated. The patient was defibrillated and received epinephrine and atropine. He died 31 hours after arriving at the ED.

Case 273. An 18-month-old girl ingested an unknown amount of her grandmother's medications, which included **morphine sulfate, diphenoxylate/atropine**, and **levorphanol**. The grandmother was not immediately aware of the ingestion, and when the child became drowsy, she put her to bed. Two hours later the grandmother found her pills scattered on the floor. The child was then found to be unresponsive. On physical examination in the ED, she was comatose and unresponsive to painful stimuli. Despite receiving 30 to 40 mg of naloxone, she remained unresponsive. She was placed on a naloxone infusion but remained comatose with only minimal reflexes. She was also intubated. After the patient did not respond to naloxone over 24 hours, a head CT scan was performed. It showed cerebellar infarction, presumably from hypoxic insult. Toxicologic analysis on an admission urine sample was positive only for an unidentifiable opiate. The patient died 7 days after the ingestion. Postmortem examination showed cerebellar herniation and infarction.

Case 282. A 15-year-old girl drank up to 480 mL of a first-aid liquid containing 2.5% **lidocaine** and then barricaded herself in the bathroom. She was found seizing and in respiratory arrest. She was dead on arrival at the ED. Postmortem examination showed large amounts of gastric contents in the trachea and bronchi. Postmortem examination confirmed the cause of death to be aspiration of gastric contents secondary to lidocaine intoxication. Postmortem serum lidocaine level was 18 μg/mL.

Case 283. A 2-month-old 5.5 kg boy was taken to the operating room for repair of bilateral inguinal hernias. The patient was induced with intramuscular ketamine and then intubated. Fifty-five minutes after the surgery began, the patient's heart rate fell from 136 to 90 beats/min. The surgeon stopped retracting the peritoneum, believing this was the cause of the drop in the heart rate. However, there was no improvement. Over the next 5 minutes a total of 0.2 mg of IV atropine was administered, but his heart rate dropped to 45 beats/min. The infant then developed ventricular fibrillation. Cardiopulmonary resuscitation was initiated and he was defibrillated. In addition, he received both IV and intracardiac epinephrine. Approximately an hour after the patient's heart rate started to decrease, it was learned that approximately 100 mL of a 0.4% solution of lidocaine [illegible] been infused instead of a solution of 5% dextrose ar .45% normal saline. The lidocaine was discontinued and the patie received calcium chloride, atropine, epinephrine, isoproterenol, an albumin. In addition, an adult external cardiac pacemaker was use without success.

Case 292. A 22-month-old 11 kg boy with a known seizure disord was taken to the ED after having four seizures that day. He was ale with a blood pressure of 92/60 mm Hg, respirations of 40 breath min, and temperature of 37°C. He had another seizure in the EL which was controlled with lorazepam. He was then admitted, awak and alert, but 6 hours later he had myoclonic seizures controlle briefly by lorazepam. Fifteen minutes later his vital signs were sys tolic blood pressure, 80 mm Hg; pulse, 140 beats/min; respirations 36 breaths/min; temperature, 37.7°C. A physician then started t administer 1,150 mg of IV **phenytoin**. Over the ensuing 15 minutes the pulse increased to 160 beats/min and the respirations to 5 breaths/min. Two minutes later, his respirations became irregula and decreased to 8 breaths/min. Approximately 5 to 10 minute later, he had a cardiopulmonary arrest. Cardiopulmonary resuscita tion was initiated and he was intubated. He was given epinephrine atropine, fluids, and albumin. In addition, phenobarbital and paral dehyde were administered for persistent seizures. Approximately 5: minutes into the code, a transthoracic external pacemaker wa. placed and an epinephrine infusion was started. The systolic blooc pressure was 50 mm Hg and pulse was 78 beats/min. Arterial blooc gases showed pH, 6.98; Pco_2, 23 mm Hg; Po_2, 230 mm Hg. Despite sodium bicarbonate and hyperventilation, he remained acidotic (pH 6.97 to 7.0). Treatment also included dobutamine and transvenous pacing, but resuscitative efforts were unsuccessful. Toxicologic analysis showed phenytoin, 51.8 μg/mL; carbamazepine, 10.9μg/ mL; valproic acid, 153.4 μg/mL.

Case 329. A 25-year-old woman presented in her physician's office with lethargy after ingesting 5 g of **bupropion**. She was transported to the ED and underwent gastric lavage followed by activated charcoal and a cathartic. A pink substance was found in the gastric contents, but no pill fragments were evident. An hour after admission she had a respiratory arrest and developed a widened QRS complex and ventricular tachycardia. Cardiopulmonary resuscitation was initiated and she was intubated. Postresuscitation, she had a palpable systolic blood pressure of 98 mm Hg, pulse of 95 beats/min, and rectal temperature of 36°C. During the next 4 hours, the patient again developed a wide QRS complex and sustained a cardiac arrest. She was resuscitated and an EEG indicated there was brain activity. A urine drug screen was positive for diphenhydramine, acetaminophen, cimetidine, nicotine, and caffeine. She developed continuous generalized tonic-clonic seizures that were resistant to phenobarbital and phenytoin. The patient died 16 hours after hospitalization. It was believed that her death was due to pump failure. Toxicologic analysis of blood drawn on admission showed a bupropion level of 1,445 ng/mL, trace amounts of diphenhydramine, and high concentrations of bupropion metabolites.

Case 330. A 32-year-old man presented to the ED after ingesting an estimated 15 g of **bupropion**. The patient had multiple seizures that were refractory to IV diazepam. The patient developed bradycardia that was unresponsive to atropine and pacing. Within 8 hours of admission he sustained a cardiopulmonary arrest. Toxicologic analysis of urine was negative for other drugs.

Case 332. A 72-year-old man with Parkinson's disease was found unconscious at home. His medications included verapamil, allopurinol, and **l-deprenyl** (a selective monoamine oxidase [MAO] inhibitor). In the ED, **meperidine** was administered for a suspected myocardial infarction. Over the next 60 minutes, his temperature increased to 41.7°C and his blood pressure was 220/110 mm Hg. A CT scan of his head showed a subarachnoid hemorrhage. CPK initially increased to 13,500 IU/L and then to 42,000 IU/L. Dantrolene was administered but the patient remained in critical condition with hypocalcemia, vasomotor instability, acidosis, and respiratory failure.

Although his blood pressure and temperature returned to normal on the following day, the patient remained comatose and required ventilatory support. He died on the fourth hospital day.

Case 333. A 10-month-old girl ingested 5 or 6 tablets of desipramine, 100 mg. An hour after the ingestion, her mother reported the infant was drowsy and "in a daze." In the ED 90 minutes after the ingestion, she was alert with a blood pressure of 100/60 mm Hg, pulse of 164 beats/min, and respirations of 24 breaths/min. During gastric lavage with a 12F Salem sump, her heart rate increased to greater than 200 beats/min for 2 to 3 minutes, and then her rhythm deteriorated to ventricular fibrillation. Arterial blood gases showed a pH of 6.9 and Pco_2 of 68 mm Hg. Cardiopulmonary resuscitation was initiated and she died an hour after presentation to the ED.

Case 414. An 11-month-old child aspirated a 50 mg trazodone tablet. Details are sketchy, but airway obstruction by the foreign body ensued.

Case 420. An 11-month-old girl with Beckwith-Wedeman syndrome ingested an unknown amount of diphenhydramine 25 mg capsules. An hour after the mother became aware of the ingestion, she saw her daughter shaking. On arrival at the ED, the patient was seizing. Despite receiving a total of 4 mg of diazepam, she continued to seize. She was then intubated and physostigmine was administered. Five hours after the ingestion she was transferred to a tertiary health-care facility. She developed bradycardia which responded to atropine. Her seizures were controlled with diazepam and phenobarbital. She remained unresponsive. After brain death was confirmed, life support was discontinued. The patient died 3 days after the exposure.

Case 435. A 61-year-old man with a history of chronic obstructive pulmonary disease and ethanol abuse ingested 70 long-acting theophylline tablets at an unknown time. On arrival at the ED, the patient arrested and seized. He was intubated and mechanically ventilated. Initial arterial blood gases showed a pH of 7.20, Pco_2 of 74 mm Hg, and Po_2 of 60 mm Hg. Admission theophylline level was 116 μg/mL. Six hours after admission, posthemodialysis, his theophylline level had increased to 163 μg/mL. Hemoperfusion could not be performed at this health-care facility. The patient also received multiple doses of charcoal every 2 hours. The patient became hypotensive to 70/30 mm Hg despite receiving fluids and dopamine. Because of persistent hypotension, the patient could not be dialyzed. Sixteen hours after admission, his theophylline level had decreased to 105 μg/mL. He was hypotensive with a systolic blood pressure in the 40s and tachycardic to 170 beats/min. His capillary wedge pressure was 17 cm H2O. On 100% O_2, his arterial blood gases showed a pH of 7.34. Pco_2 of 50 mm Hg, and Po_2 of 40 mm Hg. The patient developed seizures that were treated with diazepam. The patient also developed an ileus. He became unresponsive and remained hypotensive despite fluids, dopamine, and norepinephrine. A repeat theophylline level 24 hours after admission was 109 μg/mL. He died about 40 hours after admission.

Case 454. A 29-year-old man with a history of alcohol abuse ingested approximately 7 g of his mother's long-acting theophylline. In the ED, 8 hours after the ingestion, he was nauseated and vomiting. His vital signs were blood pressure, 80/50 mm Hg; pulse, 196 beats/min; respirations, 40 breaths/min. The initial laboratory studies showed a potassium of 1.8 mEq/L and a CPK of 4,955 IU/L. Toxicologic analysis showed a theophylline level of 202.7 μg/mL and blood ethanol level of 140 mg/dL. He underwent gastric lavage and received activated charcoal and a cathartic. He experienced a generalized tonic-clonic seizure that continued for 3 minutes, followed by runs of ventricular tachycardia. He was intubated, placed on mechanical ventilation, and given pancuronium, dopamine, phenobarbital, and potassium. On arrival at a second health-care facility, he was unresponsive but withdrew from deep pain. Vital signs were blood pressure, 87/34 mm Hg; pulse, 168 beats/min; respirations, 16 breaths/min. He had coarse crackles in his lungs, decreased bowel sounds, and intermittent tremors. Treatment for recurrent ventricular tachycardia included cardioversion, lidocaine, esmolol, and magnesium sulfate. Vasopressors and multiple doses of activated charcoal were also administered. The theophylline level was 199 μg/mL 15 hours after the ingestion and potassium was 1.9 mEq/L. Hemodialysis was initiated and continued intermittently. The theophylline level was 75 μg/mL 24 hours after the ingestion and 23 μg/mL 29 hours after the ingestion. By the second hospital day the patient was awake, cooperative, and acknowledged that he had tried to commit suicide. He spiked a fever to 38.2°C and a chest roentgenogram showed a right upper lobe density that was treated with antibiotics. Over the next 10 days, attempts at weaning the patient from the ventilator failed and his condition deteriorated. He became obtunded and developed septic shock with blood cultures positive for Gram-positive diplococci, adult respiratory distress syndrome, disseminated intravascular coagulation, liver failure, and renal failure. An EEG on the tenth hospital day showed a severe, widespread disturbance with absence of normal background. A head CT scan showed bilateral posterior fossa infarcts. Life support was discontinued and the patient died 12 days after the ingestion. Postmortem examination showed centrilobular hepatic necrosis, bilateral bronchopneumonia, diffuse alveolar damage, cerebral infarcts, and bilateral renal infarcts.

Case 460. A 3-month-old girl with ventricular and atrial septal defects, an overriding aorta and mild coarctation of the aorta underwent surgical closure of both septal defects after failing medical care. Subsequent weaning from cardiopulmonary bypass was delayed due to poor left ventricular function. Amrinone therapy was initiated with a loading bolus of 0.75 mg/kg followed by a continuous infusion of 200 μg/kg/min (usual dosing range is 5 to 10 μg/kg/min). Continuous infusions of epinephrine and dobutamine were also initiated. She was weaned successfully from bypass and transferred to the postoperative unit. The amrinone infusion was continued at this rate for 11 hours, then decreased to 120 μg/kg/min for the next 22 hours, after which the dosing error was recognized and the infusion discontinued. Anuria developed approximately 17 hours following the initiation of amrinone therapy. A metabolic acidosis also developed. The initial arterial blood gases were pH, 7.37; Pco_2,42 mm Hg; Po_2, 69 mm Hg; bicarbonate, 24 mEq/L and later arterial blood gases were pH, 7.12 to 7.36; Pco_2, 27 to 41 mm Hg; Po_2, 70 to 127 mm Hg; bicarbonate 13 to 15 mEq/L. Hypotension became more prominent at 30 hours, with the blood pressure falling from 61/37 to 33/24 mm Hg. The hypotension, anuria, and acidosis persisted despite discontinuation of amrinone and continuing therapy with epinephrine, dobutamine and dopamine infusions. Ten hours following the discontinuation of amrinone therapy, the patient experienced repeated episodes of profound hypotension and electromechanical dissociation eventually resulting in death. Amrinone concentrations while on therapy were 75.9 μg/mL (therapeutic concentrations 0.5 to 6.0 μg/mL).

Case 522. A 17-year-old woman ingested 6 to 8 tablets of an over-the-counter cold preparation containing phenylpropanolamine, 75 mg, and chlorpheniramine, 12 mg. Her family found her on the floor 18 hours later. She had a decreased level of consciousness and was complaining of a headache and right-sided weakness. On arrival at the ED 23 hours after the ingestion, she was lethargic with a blood pressure of 110/70 mm Hg, pulse of 94 beats/min, respirations of 16 breaths/min, and a temperature of 36°C. On neurological examination, her speech was fluent, pupils were 5 mm and reactive to light, and she was flaccid on the right side. Head CT scan showed a moderate size intraparenchymal cerebral hemorrhage in the centrum semiovale in the left frontoparietal region with extension into the lateral and fourth ventricles. In addition, a small amount of blood was present in the left sylvian fissure. There was only mild mass effect with shift of the septum pellucida. The patient received dexamethasone and was admitted to the ICU. Although her vital signs remained stable over the next 2 days, she was intermittently agitated, complained of a severe headache, and her speech became less

fluent with only single wo[illegible]ossible at times. Approximately 48 hours after admission, she [illegible]denly arrested, had frothy sputum, and died.

Case 525. A 25-year-old man extracted **propylhexedrine** from a nasal inhaler using **hydrochloric acid**. He then attempted to inject the extracted material into his right external jugular vein. Instead of experiencing his usual "rush", he developed the rapid onset of pain with increasing edema, chills and fever to 39.4°C. On physical examination 32 hours later, he was febrile to 39.4°C and had massive edema of the right side of his neck, requiring urgent nonsurgical airway management. Extensive necrotic tissue was noted on surgical exploration of the wound. His WBC count was elevated at 41,000/μL with 73% segmented neutrophils and 18% band neutrophils. ECG showed sinus tachycardia. All results of cultures before and after antibiotic treatment remained negative. Urine drug screen was negative for amphetamines and other drugs of abuse. The patient was treated with ceftriaxone, metronidazole, and ampicillin/sulbactam. The patient developed renal failure without apparent rhabdomyolysis (peak CPK of 2,815 IU/L, MB). On the second hospital day, the patient was poorly perfused clinically, had a cardiopulmonary arrest, and died. Postmortem examination showed marked swelling and induration of his neck, which was microscopically variegated, hemorrhagic and edematous. Kidneys showed mild vascular congestion and autolysis. The myocardium was microscopically normal.

Case 527. A 10-month-old girl was brought to the ED because of shortness of breath and vomiting of a dark, foul-smelling substance. In the ED, the patient was limp, hypotensive, and in respiratory distress with bilateral wheezing. It was learned the patient ingested **ferrous sulfate** tablets. She was stabilized and transferred. On arrival at the second hospital, the patient had no detectable blood pressure and aggressive blood pressure support followed. Laboratory studies included hemoglobin, 4.6 g/dL; hematocrit, 12.9%; WBC count, 17,100/μL; blood glucose, 266 mg/dL; PT, > 50 seconds; PTT, > 150 seconds; serum iron, 18,930 μg/dL. Treatment included deferoxamine (total dose, 96 mg/kg), vitamin K, and fresh frozen plasma. The patient was subsequently transferred to a pediatric medical center. On arrival at the third hospital, her vital signs were systolic blood pressure, 64 mm Hg; pulse, 194 beats/min; respirations, 15 breaths/min. Admitting laboratory studies showed hemoglobin, 4.2 g/dL; hematocrit, 13%; WBC count, 8,200/μL; platelets, 83,000/μL; sodium, 151 mEq/L; potassium, 3.4 mEq/L; glucose, 112 mg/dL; AST, 2,024 IU/L; ALT 706 IU/L; alkaline phosphatase, 390 IU/L; LDH, >43,000 IU/L; CPK, >32,000 IU/L; PT, >46 seconds; PTT, >99 seconds. The patient remained hypotensive despite vasopressors, albumin, blood transfusions, and fresh frozen plasma. The patient then became unable to oxygenate with Po_2 levels of 40 to 50 mm Hg while receiving 100% forced inspiratory oxygen. Fourteen hours after admission, the patient became bradycardic with no detectable blood pressure. Cardiopulmonary resuscitation was unsuccessful.

Case 528. An 11-month-old girl was taken to the ED after being found with one **ferrous sulfate** tablet in her mouth. Two hours after the exposure, an abdominal roentgenogram showed many iron tablets present. The infant was receiving dopamine and had an initial serum iron concentration of 10,000 μg/dL. A repeat iron level demonstrated continued iron absorption with a level of 14,000 μg/dL. The child received deferoxamine, dopamine, and dobutamine. Exchange transfusion was also performed twice. Despite aggressive therapy, the infant died.

Case 529. A 14-month-old boy ingested an unknown amount of **ferrous sulfate**. The boy was taken to the ED 2 hours after the ingestion and his serum iron level was 10,000 μg/dL. Deferoxamine therapy was begun and a second serum iron level 4 hours after the ingestion was 8,000 μg/dL. Six hours after the ingestion, the boy was more responsive. Laboratory studies showed that the boy was acidotic and that his serum iron level had decreased to 1,900 μg/dL. An exchange transfusion was performed. One week after the exposure the [illegible]remained intubated and respiratory distress syndrom had deve[illegible]d. Liver function tests were elevated. Two weeks aft the ingestion, he remained intubated and also had a chest tube i serted. Laboratory studies showed BUN, 11 mg/dL; AST, 38 IU/L ALT, 67 IU/L. Three weeks after admission the child arrested an was resuscitated. He required dopamine and dobutamine and ha three chest tubes in place. He was improving slowly and neede positive end-expiratory pressure. His condition deteriorated ove the next week and he required two additional chest tubes. He die 53 days after the ingestion.

Case 530. A 15-month-old boy was brought to the ED with hema temesis and guaiac-positive diarrhea that were described as smellin like metal and rotten fish. Laboratory studies included a WBC coun of 20,000/μL, blood glucose level of 168 mg/dL, and prolonged P and PTT. An abdominal roentgenogram showed questionable whit spots. Iron ingestion was suspected and deferoxamine administered The serum iron was 383 μg/dL and the total iron binding capacit was 411 μg/dL. The boy's father thought that his son might hav ingested the iron approximately 10 hours prior to presentation. Th patient had gastric bleeding and oliguria. He became icteric and o the fourth hospital day was transferred to a tertiary care facility. B the sixth hospital day, he had developed acute respiratory distress hepatomegaly, and encephalopathy. Laboratory studies, includin hemoglobin, hematocrit, coagulation studies, and liver enzyme were normal. The patient was also evaluated for an underlying met abolic disorder. However, cardiac failure and shock lung develope and he died 1 week after the ingestion.

Case 531. A 16-month-old girl ingested as many as 30 tablets o ferrous sulfate, 325 mg, at an unknown time. On arrival at the ED she was lethargic and hypotensive. Arterial blood gases showed pH 7.27; Pco_2, 30 mm Hg; bicarbonate, 16 mEq/L. Gastric lavag yielded a large number of tablets and blood. The patient also deve oped bloody diarrhea. Fluids were initially given by the intraosseou route as IV lines could not be placed. After a surgical cutdown wa performed, the patient received dopamine and IV deferoxamine Because an abdominal roentgenogram showed numerous residua tablets in the GI tract, gastric lavage was repeated. A second roen genogram showed no tablets remaining in the stomach. Serum iro level 3 hours after presentation was 8,500 μg/dL. Forty-eight hou later, the patient developed abnormal liver function tests and clo ting studies. Norepinephrine was required for blood pressure mai tenance. Over the next 24 hours, she developed respiratory distres syndrome, severe metabolic acidosis, profound hypotension, activ hemorrhaging, and decreased cardiac output. She died on the fourt hospital day. Postmortem examination showed hemorrhagic gastr enteritis, stiff lungs with diffuse alveolar damage, hepatomegal with centrilobular necrosis, ascites, and jaundice.

Case 532. A 64-year-old woman ingested **potassium chloride** tal lets, each containing 8 mEq, in a suicide attempt. She was hype tensive and had diarrhea 2.5 hours after the ingestion. Ipecac wa administered. The serum potassium was 9.8 mEq/L. Treatment i cluded insulin, glucose, sodium bicarbonate, and sodium polyst rene sulfonate. In addition, she was lavaged, but no tablets we recovered. Three hours after the ingestion, she had a cardiac arres She died an hour later. Postmortem examination recovered 84 p tassium chloride tablets still present in the gastric contents. Pos mortem potassium levels were 44.6 mEq/L in the serum and 13 mEq/L in the vitreous humor.

Case 534. A 62-year-old woman ingested a mixture consisting approximately 500 mL of **sodium bicarbonate** and 250 mL of suga which was meant to be administered rectally. In the ED an ho after the ingestion, she was confused and had mottled skin. Lab ratory results included sodium, 177 mEq/L; pH, 7.67 and bicarbo ate, 54 mEq/L. Hemodialysis was initiated 3 hours after the inge tion. A head CT scan 12 hours after the ingestion showed massi cerebral edema. Repeat electrolytes at this time were sodium of 1 mEq/L and potassium of 3.2 mEq/L. Her blood pressure was bei maintained with dopamine and norepinephrine. She was also rece

ing gentamicin, ceftizoxime, and cimetidine. Arterial blood gases 13 hours after the ingestion were pH, 7.53; Pco_2, 34 mm Hg; Po_2, 118 mm Hg; bicarbonate, 28 mEq/L. By 19 hours after the ingestion, the patient's pupils were fixed and dilated. She was mechanically ventilated and remained hypotensive despite pressor support. She developed diabetes insipidus and was treated with pitressin. She sustained a brain stem hemorrhage and died 3 days after the ingestion.

Case 537. A 42-year-old man who had been taking **disulfiram** for 10 days had one drink of wine, and then called the emergency medical service. When paramedics arrived, he was in cardiopulmonary arrest. He was resuscitated and transported to the hospital. In the ED, he had occasional runs of ventricular tachycardia and ventricular fibrillation. An ECG showed a widened QRS complex. Arterial blood gases showed pH, 7.2; Pco_2, 15 mm Hg; Po_2, 400 mm Hg. Lidocaine, bretylium, and sodium bicarbonate were administered. He also underwent gastric lavage and received activated charcoal and sorbitol. At one point, he was alert enough to write notes to the physician explaining what had happened during the day. However, he became hypotensive, despite receiving wide-open dopamine, and died approximately 2.5 hours after his arrival.

Case 539. A 45-year-old man ingested 90 tablets of **cyclobenzaprine, 10 mg**, and was found several hours later in the parking lot of a doctor's office. On arrival at the ED, he was comatose. He was intubated and underwent GI decontamination consisting of gastric lavage, activated charcoal, and sorbitol. IV glucose, thiamine and naloxone were administered without effect. Later that evening the patient began to respond to verbal stimuli, but his urine output decreased. Two days after the ingestion, the patient became restless, agitated, and developed a paralytic ileus. Serial cardiac isoenzymes excluded an acute myocardial infarction. Three days after the ingestion he was febrile to 40°C and the chest roentgenogram was consistent with aspiration pneumonia. Dopamine was administered for shock. Four days after the ingestion the patient developed atrioventricular dissociation and later sustained a cardiac arrest and died. Initial toxicologic analysis was positive for cyclobenzaprine in the urine and blood.

Case 578. A 26-year-old man ingested up to 180 mL of a concentrated **cocaine** solution that had been placed in a soft drink bottle. Authorities believe the bottle was part of a drug smuggling scheme that went awry. The patient immediately stated that the substance tasted bad and within several minutes he suffered a generalized tonic-clonic seizure. On arrival at the hospital, the patient was comatose and was placed on a ventilator. He remained comatose and after repeat EEGs that indicated no brain activity, life support was discontinued on the twentieth hospital day.

Case 605. A 40-year-old man with a history of active Hodgkin's lymphoma and drug abuse presented with delirium 12 hours after using an unknown amount of **methamphetamine**. Initial vital signs were pulse rate of 240 beats/min without a palpable blood pressure and temperature of 42.8 °C. After receiving IV propranolol, he developed ventricular tachycardia followed by asystole. The patient was intubated and resuscitated. Subsequent treatment included passive cooling measures, sodium bicarbonate for acidosis, norepinephrine for hypotension, and diazepam and pancuronium for seizures that developed within 2 hours of presentation. Admission toxicology screen showed a serum methamphetamine level of 7.6 μg/mL and a serum amphetamine level of 0.37 μg/mL. Blood culture results were positive for Gram-positive cocci. Fresh frozen plasma was given for disseminated intravascular coagulation. The patient remained unresponsive, tachycardia persisted, and he died 3 days after presentation. Postmortem toxicologic serum levels were methamphetamine, 1.88 μg/mL, and amphetamine, 0.28 μg/mL.

Case 608. An 86-year-old woman drank up to 60 mL of a solution containing 84% ethanol and 10% **camphor** following a family dispute. On arrival at the ED, within an hour of the ingestion, her only complaint was "not feeling well". Physical examination was unremarkable. She underwent gastric lavage with a 40F orogastric tube after the tube placement was confirmed by the return of copious gastric contents. The patient was lavaged until clear and given activated charcoal. Within an hour of lavage, significant subcutaneous emphysema of the neck and face was noted. Because of increasing dyspnea, the patient was intubated. The vocal cords were well visualized and no charcoal was seen in the trachea. Postintubation chest roentgenogram showed pneumomediastinum, right-sided pneumonia and a possible right-sided pleural effusion. A second chest roentgenogram on the following day showed a large right-sided pleural effusion. A thoracentesis showed a large amount of black fluid that appeared quite similar to activated charcoal. Although an esophagram was not performed, it was believed the patient had a perforation of the esophagus into the right chest cavity. History obtained later showed that the patient had bullous dermatitis for which she had been taking prednisone 10 mg/d for more than 10 years. Her hospital course was complicated by the development of mediastinitis, pneumonia, and sepsis. She died on the twenty-fourth hospital day. Postmortem examination confirmed bronchopneumonia secondary to perforation of an esophageal diverticulum with associated mediastinitis and pleuritis.

Case 609. A 2-year-old girl drank up to 10 mL of **oil of wintergreen**. She was given milk and magnesium citrate at home and vomited. In the ED 2 hours after the ingestion, she was slightly agitated. Her pulse rate was 120 beats/min and her respirations were 20 breaths/min. Initial laboratory results included sodium, 129 mEq/L; potassium, 3.9 mEq/L; chloride, 98 mEq/L; bicarbonate, 12 mEq/L; BUN, 9 mg/dL; creatinine, 0.4 mg/dL; an anion gap of 19 mEq/L. Arterial blood gases were pH, 7.51; Pco_2, 15 mm Hg; Po_2, 195 mm Hg. Within an hour of presentation, she had increased lethargy. Her salicylate level was 146 mg/dL 4.5 hours after the ingestion. A second arterial blood gas showed pH, 7.45; Pco_2, 19 mm Hg; Po_2, 136 mm Hg. Treatment included several doses of activated charcoal, which were vomited, and sodium bicarbonate. She was then transferred for hemodialysis. On arrival at the second hospital, she was comatose, unresponsive to deep pain, and had Kussmaul breathing at 44 breaths/min. While she was being prepared for hemodialysis, 8.75 hours postingestion, she had a tonic-clonic seizure, became asystolic, and died. Postmortem examination was remarkable for mild cerebral edema and a strong odor of oil of wintergreen in the abdominal cavity.

Case 611. An 88-year-old woman with a known history of hypertension, treated with beta blockers, accidentally ingested 5-15 mL of **oil of wintergreen**. On physical examination within 2 hours of the ingestion, she was alert, hyperventilating, and had a blood pressure of 210/100 mm Hg. Arterial blood gases showed pH, 7.38; Pco_2, 28 mm Hg; Po_2, 96 mm Hg. An ECG showed sinus bradycardia at a rate of 37 beats/min. She underwent gastric lavage and then was given activated charcoal, a cathartic, and IV sodium bicarbonate. The patient had a cardiac arrest 1 hour 43 minutes after presentation and could not be resuscitated. The serum salicylate level drawn 2 hours after the ingestion was 71.4 mg/dL.

U.S. Department of Agriculture
Food Safety and Inspection Service
Washington, DC 20250

Consumer Information

Winter 1997

The Food Safety Educator

CDC Issues New 5-Year Report of Foodborne Illness Outbreaks

A new five-year report from the Centers for Disease Control and Prevention (CDC) identifies *Salmonella Enteritidis* as a leading cause of foodborne illness and death.

The report, which covered 1988-1992, also notes more multistate outbreaks caused by contaminated produce as well as outbreaks caused by *Escherichia coli* O157:H7.

Because of limitations in the foodborne illness surveillance system, CDC notes that the "report should not be the basis of conclusions concerning the absolute" incidences of foodborne diseases or their causes.

Why is this? The reason is that the surveillance system reports only a fraction of the cases of foodborne disease that occur. In addition, in **59 percent of the outbreaks, the cause of the outbreak is not determined.**

(Note: A new sentinel site surveillance system launched last year should provide more precise information because it will actively gather data instead of serving as a passive reporting system.)

At the same time, the current reporting system provides one of the best pictures we have for identifying problem areas and possible solutions.

Items of interest from this report include:

- In the 41 percent of the outbreaks **where a cause WAS determined, 79 percent were traced to bacterial pathogens.**
- ***Salmonella* caused 69 percent of the bacterial outbreaks.** Of the outbreaks caused by *Salmonella*, 60 percent were traced to *S. Enteritidis*.
- *S. Enteritidis* caused more deaths than any other pathogen. Of these deaths, **85 percent occurred among residents of nursing homes.**
- For each of the years covered in the report, the **most commonly reported** food preparation practice that contributed to illness concerned **improper holding temperature.**
- The **second most commonly** reported practice concerned **poor personal hygiene of food handlers.**

Once again, CDC notes that people can decrease their risks of contracting infections from *S. Enteritidis* by not eating eat raw or undercooked eggs. Nursing homes, hospitals and commercial kitchens should only use pasteurized egg products for all recipes requiring pooled eggs. USDA further recommends that even dishes using pasteurized eggs be thoroughly cooked.

The report was published in the CDC Monthly Morbidity and Mortality Report, Oct. 25, 1996. To access the

complete report on the Internet, go to: *http://www.cdc.gov/epo/mmwr/mmwr_ss.html*

To get a copy of USDA fact sheets on safe handling of eggs, dial in to our FAST FAX at 1/800-238-8281 or check our Home Page at *www.usda.gov/fsis*.

Remember These Dates!

June 12-13, 1997

That's the date of the Food Safety Education Conference.

The conference is titled "Changing Strategies, Changing Behaviors: What Food Safety Communicators Need to Know."

Sponsored by FDA and USDA, the meeting will be here in Washington, D.C.

Topics will include:

- The epidemiology of foodborne illness
- Consumer studies, case studies and social marketing
- Public/private partnerships

Check your mail for conference and registration information.

USDA's Meat and Poultry Hotline Answers Millionth Caller!

From novice cooks wondering how long to safely roast a chicken to more experienced foodhandlers unsure about what kind of cutting board to use, the specialists on the USDA Meat and Poultry Hotline have heard it all--1 million times.

This past November, the Hotline answered its 1-millionth call, a milestone for the toll-free service which Agriculture Secretary Dan Glickman termed "a vital part of USDA's consumer food safety education efforts."

Calls to the Hotline have changed through the years, according to Susan Conley, director of the Food Safety Education and Communications Staff. Conley, one of the first home economists answering calls when the Hotline started, said that in the mid-1980's, calls were more general in nature concerning safe handling of food.

"Today's callers," said Conley "ask more sophisticated questions. They frequently know the names of bacteria many people never heard of ten years ago. As the callers and their questions have changed, we've changed.

"We provide more detailed, technical information. At the same time, we keep stressing the basics of safe food handling, because consumers are still unsure about the basics."

For Bessie Berry, Hotline manager, it was **fitting that the millionth call came during the Thanksgiving season.**

"Traditionally," she said, "this is the Hotline's busiest time of year, with over 20 percent of the year's calls coming in this month."

Over the years, Hotline staffers have gone the distance to provide service, especially in November. "We've

- News releases
- Speeches
- Backgrounders
- Food safety publications

We'll be adding more in the future. So, give us a call and help us keep the connections going.

Mark Your Calendars

March 24-26

"Conference on Emerging Foodborne Pathogens"
Alexandria, Va.
What can be learned from previous outbreaks of foodborne illness and how can those lessons be used to prevent future problems?

Experts will be addressing these questions at a two and a half day conference sponsored by the International Life Sciences Institute (ILSI).

The conference is expected to attract food protection and public health professionals as well as others interested in microbial food safety issues.

For more information, call: (202) 659-0074, ext. 164, Shirlene Brooks.

April 13-15

"The Emerging Health Infrastructure (HII97)"
Washington, D.C.
Sponsored by the Friends of the National Library of Medicine, this year's "HII97" conference will be held in conjunction with another conference--"Partners '97"--sponsored by the Partnership for Networked Consumer Health Information.

Both conferences will include sessions that focus on the use of technology to share professional health information as well as consumer use of the Internet for health care information and interactive applications.

For more information, call: (202)462-0992, ext. 56.

Reader Response: FAX BACK

(202)720-9063

We're interested in your comments, questions, suggestions for new topics. Jot them down and fax them in, attention: Editor, F.S.E.

F.S.E.

The Educator is produced by the Food Safety and Consumer Education Staff of FSIS. For more than 15 years, staff educators have been working with researchers, scientists and marketing and design experts to product educational materials including print, video and teleconferencing services.

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FDA
TALK PAPER

Food and Drug Administration
U.S. Department of Health and Human Services
Public Health Service 5600 Fishers Lane Rockville, MD 20857

FDA Talk Papers are prepared by the Press Office to guide FDA personnel in responding with consistency and accuracy to questions from the public on subjects of current interest. Talk Papers are subject to change as more information becomes available.

T97-5
January 21, 1997

Judith Foulke (202) 205-4144
Broadcast Media (301) 827-3434
Consumer Hotline (800) 532-4440

FDA ALLOWS WHOLE OAT FOODS TO MAKE
HEALTH CLAIM ON REDUCING THE RISK OF HEART DISEASE

FDA will display at the Federal Register a final rule allowing health claims on the labels of foods containing soluble fiber from whole oats (rolled oats, oat bran and oat flour) noting that these foods, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease. The following may be used to answer questions.

FDA regulates health claims on food labels under provisions of the Nutrition Labeling and Education Act of 1990 to ensure that claims are accurate and not misleading to consumers. The law allows the agency to authorize a health claim only if there is significant scientific agreement that the claim is true.

In allowing this health claim, FDA concluded that the beta-glucan soluble fiber of whole oats is the primary component responsible for the total and LDL blood cholesterol-lowering effects of diets that contain these whole oat-containing foods at appropriate levels. This conclusion is based on review of scientific evidence indicating a relationship between the soluble fiber in these whole oat-containing foods and a reduction in the risk of coronary heart disease.

Food products eligible to bear the health claim include oat bran and rolled oats, such as oatmeal, and whole oat flour. Oat bran and rolled oats were the two food products named in a petition submitted by The Quaker Oats Company in March 1995. FDA added whole oat flour to this final rule in response to data provided in comments following the agency's publication of the proposed rule on January 4, 1996. The data submitted showed that whole oat flour is nutritionally equivalent to rolled oats and, more importantly, has similar effects on serum lipids.

In the final rule, FDA acknowledges that sources of beta-glucan soluble fiber other than from whole oats, and certain soluble fibers other than beta-glucan, are also likely to affect blood lipid levels. However, FDA must await evidence on these other sources before making a judgment on their effects.

To qualify for the health claim, the whole oat-containing food must provide at least 0.75 grams of soluble fiber per serving. The amount of soluble fiber needed for an effect on cholesterol levels is about 3 grams per day. Adding whole oat

flour to the list of substances eligible to be the subject of a claim means that many products will qualify for the claim, thus making it possible that oat-containing products could be consumed as many as 4 times a day.

Examples of how the newly allowed health claim may be used are:

> "Soluble fiber from foods such as oat bran, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease." or
> "Diets low in saturated fat and cholesterol that include soluble fiber from oatmeal may reduce the risk of heart disease."

The words, "Diets low in saturated fat and cholesterol" must be included in any such health claim because FDA concluded, after reviewing comments, that consumers might otherwise be misled into thinking that eating a diet high in oats is all that is necessary to reduce the risk of heart disease.

The final rule will be published later this week in Federal Register.

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FDA HOME PAGE

ANSWERS
01/11/1996

<TITLE> FDA PROPOSES HEALTH CLAIMS FOR OATMEAL AND OAT BRAN
</TITLE>
<PRE>

T96-3 Brad Stone
Jan. 11, 1996 (202) 205-4144

FDA PROPOSES HEALTH CLAIMS FOR OATMEAL AND OAT BRAN

A new FDA proposal would allow manufacturers of foods containing oatmeal or oat bran to claim on the labels that diets high in these grain products and low in saturated fat and cholesterol may reduce the risk of coronary heart disease. This proposal was published today in the Federal Register. The following may be useful for answering questions.

FDA regulates health claims on food labels under provisions of the Nutrition Labeling and Education Act of 1990 to ensure that claims are accurate and not misleading to consumers. The law allows the agency to authorize a health claim only if there is significant scientific agreement that the claim is true.

In March 1995 Quaker Oats Co. petitioned FDA to allow claims of health benefits on products containing oatmeal or oat bran. In response, the agency reviewed more than 37 clinical studies on the effects of oatmeal and oat bran in reducing serum cholesterol levels in the body and lowering risk of coronary heart disease.

FDA also reviewed an evaluation of studies on the health effects of oatmeal and oat bran conducted by the Federation of American Societies for Experimental Biology (FASEB). The FASEB

- more -

review was published in a 1987 FASEB report entitled, "Physiological Effects & Health Consequences of Dietary Fiber."

FDA found that the studies demonstrated significant scientific agreement on the beneficial effects of oatmeal and oat bran. FDA is in agreement with most dietary experts in its conclusion that eating oatmeal or oat bran can reduce the risk of coronary heart disease when part of an overall diet that is low in saturated fat and cholesterol.

However, based on the scientific evidence, FDA cannot conclude that eating oatmeal or oat bran in and of itself reduces risk of heart disease.

FDA's model health claim reads as follows: "Diets high in oatmeal or oat bran and low in saturated fat and cholesterol may reduce the risk of heart disease."

Manufacturers of food products containing oatmeal and oat bran may develop their own language for the health claim, subject to FDA review and provided that the wording is in accord with the evidence indicating that a reduction of heart disease risk is associated with consumption of oatmeal and oat bran only when incorporated with other healthy dietary and lifestyle practices.

In the United States, coronary heart disease is the underlying cause of more than 500,000 deaths each year, and is a contributing factor in about 250,000 others. About 20 percent of adults from 20 to 74 years old are estimated to have serum cholesterol levels high enough to put them at high risk for

coronary heart disease.

This proposal was published Jan. 4 in the Federal Register. Written comments on the proposal may be submitted within 90 days of that date to the FDA Dockets Management Branch, HFA-305, 12420 Parklawn Drive, Rockville, MD 20857-0001.

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ANSWERS
11/09/1995

<TITLE> FDA PROPOSES LABELING REFORM FOR DAIRY FOODS </TITLE>
<PRE>

T95-60
Nov. 9, 1995

Brad Stone
(202) 205-4144

FDA PROPOSES LABELING REFORM FOR DAIRY FOODS

FDA is proposing to place "lowfat" and other nutrient content claims used for milk and dairy products under the same labeling rules that apply to nearly all other foods. This action aims at reforming outdated regulations and promoting greater consistency in food labeling standards.

The proposed regulation would remove the standards of identity mandated for many dairy products -- some dating back to the 1940s. These standards established minimum levels and maximum levels of milkfat in these dairy products, and set particular definitions for terms like "lowfat milk," "nonfat yogurt" and "skim milk."

In some cases, definitions for "lowfat" and "nonfat" in dairy products differ considerably from those established for nearly all other foods by the Nutrition Labeling and Education Act of 1990 (NLEA). For example, since most milk products have been exempt from NLEA's nutrient claims definitions, a milk product labeled as "lowfat" contains 2% milkfat -- a fat level far in excess of the standard applied to all other "lowfat" foods.

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Under the proposed regulation, NLEA definitions would cover nutrient claims made for milk and dairy products. Thus "lowfat" milk would have to meet the same standards as other "low fat" foods -- less than 3 grams of fat per serving.

The proposal would also allow the term "skim" to be used as a synonym for "nonfat" or "fat free" milk products -- in recognition of the public's longstanding perception of what these terms mean.

The proposed regulation responds to citizen petitions submitted to the agency in May and August 1995 by a consumer organization and several dairy industry groups. These petitions stressed that repealing the standards of identity would help end consumer confusion over disparities in the use of nutrient content claims in the labeling of dairy products and other foods, and would promote a movement toward consuming healthier dairy products.

Some of the petitioners also argued that the standards of identity were an impediment to introducing lower fat dairy products to the market. They argued that regulatory reform would spur greater innovation in the food industry.

FDA will accept comments on the proposed regulation for 75 days following its publication in the Federal Register. Written comments may be submitted to:

FDA Dockets Management Branch
Food and Drug Administration

Rm. 1-23
12420 Parklawn Drive
Rockville, MD 20857

####

Food poisoning

Food poisoning can be caused by eating foods contaminated with bacteria or bacteria-produced toxins. It can also result from eating foods that contain a naturally-occurring poison such as certain types of mushrooms and fish.

The most common bacteria that causes food poisoning is staphylococci (staff-fillo-cock-i), which grows on dairy products and in cooked meat and fish. Symptoms begin two to six hours after the food is eaten and include nausea, vomiting, stomach cramps, and diarrhea.

Botulism (BOTCH-you-lizm) is a rare, but extremely severe type of food poisoning caused by foods that haven't been properly canned or preserved. Symptoms of nausea, vomiting, and diarrhea usually appear within eighteen to thirty-six hours after eating the contaminated food. Other symptoms may include paralysis, double vision, and difficulty swallowing. Botulism can be fatal, so call a doctor or seek emergency treatment immediately.

Salmonella (sal-mon-ella) infections are caused by eating meat, poultry, or eggs that carry bacteria. Wash your hands thoroughly before preparing these foods. Make sure they are thoroughly cooked and promptly refrigerate them after eating. Symptoms of salmonella poisoning may include headache, shivering, diarrhea, and vomiting. Severe cases may require the use of antibiotics to fight the infection.

For more information about food poisoning, contact your health care provider.

to your health / physician finder / key services / resources / house calls / newsstand / we're in your neighborhood / what's new / one a day

Pork - Trichinella
Beef - E Coli
Salmonella
Seafood - Cyanotoxin
Hepatitis
Peanuts - Aflatoxin
Fish - Toxin
Mushroom TOXINS

IASR

The Topic of This Month Vol.18 No.3(No.205)

Salmonella, Japan, 1994-1996

According to the Statistics of Food Poisoning in Japan compiled by the Statistics and Information Department, Minister's Secretariat, the Ministry of Health and Welfare, cases of bacterial food poisoning numbered 29,513 in 1994 and 22,329 in 1995, surpassing 19,089 in 1993. Cases due to *Salmonella* as an etiological agent accounted for 36% in 1993 (6,954 cases), 49% in 1994 (14,410 cases) and 36% in 1995 (7,996 cases), being still ranked top. In number of outbreaks, those due to *Vibrio parahaemolyticus* were ranked top and those due to *Salmonella* second in 1994 and 1995. Regarding cases per outbreak, however, those due to *Vibrio parahaemolyticus* numbered 26 and 23 in each of these years, while those due to *Salmonella* outnumbered these, being 70 and 45, respectively, showing the same tendency as usual.

Reports on isolation of *Salmonella* sent in from prefectural and municipal public health institutes in the whole country have been the largest in number among those of all pathogens dealt with by IASR. The reports on isolation of *Salmonella* from human sources during 1986-1995 show a tendency that after an increase during 1986-1989, they have remained on the same level, although minor fluctuations can be seen. In regard to the predominant serovars, however, such a tendency can be seen that *S.* Enteritidis has been increasing, while *S.* Typhimurium and other serovars have been decreasing (**Fig. 1**).

Such a tendency is clearly shown also by the predominant serovars that provoked outbreaks of *Salmonella* food poisoning. There were 10 to 12 different serovars among the isolates from outbreaks involving 10 or more cases reported to IASR in every year during 1993-1996. Of these outbreaks, those due to *S.* Enteritidis numbered 41 in 1993 (55%), 75 in 1994 (70%), 69 in 1995 (71%), and 84 in 1996 (76%), indicating a continuously increasing tendency (**Table 1**).

Increase in *S.* Enteritidis isolation is also shown clearly by the 15 most common serovars of human isolates in this country (**Table 2**). The proportion of *S.* Enteritidis isolates to the total *Salmonella* isolates increased suddenly from 5% in 1988 to 24% in 1989, and thereafter increased gradually year after year (see IASR, Vol. 16, No. 1). It was isolated in as high as 47% in 1993 and the proportion changed to 56% in 1994 and again to 47% in 1995.

S. Enteritidis isolates involved in outbreaks were sent to the National Institute of Health for phage-typing (**Table 3.**). The predominant phage types (PT) during the period from 1990 to 1996 were PT1, which increased to 32% in 1992 (35/110) and gave an average rate of 41% during the following five years, PT4, which suddenly increased to 57% in 1990 (26/46) and gave an average rate of 40% during the following seven years, and PT34, which gave a rate of 26% in 1990 (12/46) and decreased gradually until none was isolated in 1996. Thus, the sum of the rates of PT1 and PT4 isolates attained 84% in 1996, indicating the prevalence of these two PTs of *S.* Enteritidis. The isolates from sporadic cases and the environment are of various PTs and no one can deny the possible future emergence of *S.* Enteritidis food poisoning with these PTs.

Since the rate of *S.* Enteritidis isolation is continuously high, collection of detailed information including that of epidemiology seems to be essential to comprehend its trend.

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IASR

The Topic of This Month Vol.17 No.7 (No.197)

Vibrio parahaemolyticus, Japan, 1994-1995

Vibrio parahaemolyticus food poisoning, incidents of which used to account for nearly half of all those of bacterial food poisoning, markedly decreased in 1992 and 1993 and was outnumbered by *Salmonella* food poisoning in incidents and cases. This was due to the markedly increased cases of *Salmonella* food poisoning caused by ingestion of hen's eggs laid by layers originating from imported chicks contaminated with *Salmonella* Enteritidis.

In 1994, incidents of *V. parahaemolyticus* food poisoning again slightly outnumbered those of *Salmonella* food poisoning; in 1995, those tended to increase further. The number of cases of *Salmonella* food poisoning, however, is still being outstanding (**Figs. 1 and 2**; from the statistics of food poisoning in Japan by the Ministry of Health and Welfare). This fact indicates that the scale of *Salmonella* food poisoning is likely becoming larger.

According to the statistics of food poisoning, all the outbreaks in 1994 totaled 830 (151% of those in the preceding year), involving 35,735 cases (139%) and two deaths (both were due to biotoxins). Outbreaks and cases with agents identified numbered 709 and 29,894, respectively. Incidents of *V. parahaemolyticus* food poisoning numbered 224 (32%), followed by those of *Salmonella* food poisoning, numbering 205 (29%). Cases of *Salmonella* food poisoning, being 14,410 (48%), however, largely outnumbered those of *V. parahaemolyticus* food poisoning, being 5,849 (20%).

In 1995, outbreaks of food poisoning totaled 699 (84% of those in the preceding year) involving 26,325 cases (74%) and five deaths (three were due to biotoxins, another to *Salmonella*, and the other to *Staphylococcus aureus*), thus outbreaks as well as cases decreased in number. The agents were identified in 627 outbreaks involving 22,660 cases. Of these outbreaks, those of *V. parahaemolyticus* food poisoning numbered 245 (39%) involving 5,515 cases (24%) and those of *Salmonella* food poisoning 179 (29%) involving 7,996 cases (35%). As was the case in the preceding year, *V. parahaemolyticus* food poisoning exceeded *Salmonella* food poisoning in number of outbreaks but were outnumbered in number of cases.

In 1994 and 1995, reports from prefectural and municipal public health institutes on isolation of *V. parahaemolyticus* from human sources numbered 1,280 (including those from 108 imported cases) and 1,304 (85 imported ones), respectively. The monthly reports on isolation of *V. parahaemolyticus* in 1994 were 271 (21%) in July, 577 (45%) in August, and 222 (17%) in September; those in 1995 were 230 (18%) in July, 624 (48%) in August, and 335 (26%) in September. As usual (see IASR, Vol. 15, No. 8, 1994), both years showed the summer-prevalent tendency with the most cases in August (**Fig. 3**).

Of the outbreaks of *V. parahaemolyticus* food poisoning reported in IASR during 1994 and 1995, those involving more than 10 cases are shown by scale in **Table 1**. Such outbreaks counted 157 in the two years; 79 in 1994 and 78 in 1995. Of these outbreaks, 121 (77%) were small-scale ones with 10-49 cases. According to the previous Topic of This Month on *V. parahaemolyticus* (see IASR, Vol. 15, No. 8, 1994), of 533 outbreaks with more than 10 cases having occurred during 1987 through 1993, small-scale outbreaks with 10-49 cases accounted for 82%. The corresponding ratio during the last two years did not differ significantly from that in the preceding years. During the last two years, 11 of such large-scale outbreaks involving 101-400 cases were reported, but no such extraordinarily large-scale outbreak involving more than 500 cases was reported.

Food poisoning outbreaks in this country, however, tend to be in such an extraordinarily large scale involving more than 500 or even more than 1,000 cases in recent years. It seems that food poisoning outbreaks tend to become larger in scale. School lunches have been incriminated for such large-scale food poisoning outbreaks, but no *V. parahaemolyticus* food poisoning due to school lunch has recently been reported. *V. parahaemolyticus* food poisoning in this country seems to be restricted in relatively a small scale.

Of the serotypes of *V. parahaemolyticus* isolated in outbreaks involving more than 10 cases, O4:K8 was highly prevalent in both years accounting for 48% (38 outbreaks) in 1994 and 24% (19 outbreaks) in 1995. The tendency was also the case with the matching incidents during 1987-1993, yielding isolates of O4:K8 in 26%. This indicates that O4:K8 is the most important serotype responsible for food poisoning in this country.

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IASR *Infectious Agents Surveillance Report*

iasr-proc@nih.go.jp

Cover Page
Japanese

Regulatory and Toxicity Information.....Lignin Sulfonates

Lignin Sulfonate products are essentially non-toxic. They are not phytotoxic when in contact with foliage and roots of most plants. They are biodegradable and not harmful to most aquatic animals and plants unless present in excessive amounts.

FDA Citations for Lignin Sulfonate

21 CFR Citation	Use
172.715	In or on food as dispersing agent and stabilizer in pesticides for certain food crops, e.g. bananas
175.105	In adhesive used in contact with foods
176.170	As components of coatings for paper and paperboard used in packaging, processing, transporting, etc of food
176.210	Residues of the following materials are exempted from the requirement of a tolerance when used in accordance with good agricultural practice as inert ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest....lignosulfonates...ammonium...calcium...salts
573.600	In animal feed up to 4%. As a pelleting aid..up to 4% of finished pellets. As a binding aid in the flaking of feed grains.up to 4% of the flaked grain. As a surfactant in molasses used in feeds..up to 11%. As a source of metabolizable energy, in the liquid or dry form...up to 4% of the finished feed

The long acceptance of Lignin Sulfonates in foods and food-related usages and the many regulations which specifically permit this indicate them to have very low toxicity and to be essentially harmless.

WTL Home Page

U. S. Food and Drug Administration
Center for Food Safety and Applied Nutrition
December 1, 1995

DIETARY SUPPLEMENT HEALTH AND EDUCATION ACT OF 1994

For decades, the Food and Drug Administration regulated dietary supplements as foods, in most circumstances, to ensure that they were safe and wholesome, and that their labeling was truthful and not misleading. An important facet of ensuring safety was FDA's evaluation of the safety of all new ingredients, including those used in dietary supplements, under the 1958 Food Additive Amendments to the Federal Food, Drug, and Cosmetic Act (FD&C Act). However, with passage of the Dietary Supplements Health and Education Act of 1994 (DSHEA), Congress amended the FD&C Act to include several provisions that apply only to dietary supplements and dietary ingredients of dietary supplements. As a result of these provisions, dietary ingredients used in dietary supplements are no longer subject to the premarket safety evaluations required of other new food ingredients or for new uses of old food ingredients. They must, however, meet the requirements of other safety provisions.

Signed by President Clinton on October 25, 1994, the DSHEA acknowledges that millions of consumers believe dietary supplements may help to augment daily diets and provide health benefits. Congress's intent in enacting the DSHEA was to meet the concerns of consumers and manufacturers to help ensure that safe and appropriately labeled products remain available to those who want to use them. In the findings associated with the DSHEA, Congress stated that there may be a positive relationship between sound dietary practice and good health, and that, although further scientific research is needed, there may be a connection between dietary supplement use, reduced health-care expenses, and disease prevention.

The provisions of DSHEA define dietary supplements and dietary ingredients; establish a new framework for assuring safety; outline guidelines for literature displayed where supplements are sold; provide for use of claims and nutritional support statements; require ingredient and nutrition labeling; and grant FDA the authority to establish good manufacturing practice (GMP) regulations. The law also requires formation of an executive level Commission on Dietary Supplement Labels and an Office of Dietary Supplements within the National Institutes of Health.

These specific provisions of the DSHEA are synopsized below.

DEFINITION OF DIETARY SUPPLEMENT

FDA traditionally considered dietary supplements to be composed only of essential nutrients, such as vitamins, minerals, and proteins. The Nutrition Labeling and Education Act of 1990 added "herbs, or similar nutritional substances," to the term "dietary supplement." Through the DSHEA, Congress expanded the meaning of the term "dietary supplements" beyond essential nutrients to include such substances as ginseng, garlic, fish oils, psyllium, enzymes, glandulars, and mixtures of these.

The DSHEA established a formal definition of "dietary supplement" using several criteria. A dietary supplement:

- is a product (other than tobacco) that is intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by man to supplement the diet by increasing the total daily intake, or a concentrate, metabolite, constituent, extract, or combinations of these ingredients.

- is intended for ingestion in pill, capsule, tablet, or liquid form.
- is not represented for use as a conventional food or as the sole item of a meal or diet.
- is labeled as a "dietary supplement."
- includes products such as an approved new drug, certified antibiotic, or licensed biologic that was marketed as a dietary supplement or food before approval, certification, or license (unless the Secretary of Health and Human Services waives this provision).

SAFETY

The DSHEA amends the adulteration provisions of the FD&C Act. Under DSHEA a dietary supplement is adulterated if it or one of its ingredients presents "a significant or unreasonable risk of illness or injury" when used as directed on the label, or under normal conditions of use (if there are no directions). A dietary supplement that contains a new dietary ingredient (i.e., an ingredient not marketed for dietary supplement use in the U.S. prior to October 15, 1994) may be adulterated when there is inadequate information to provide reasonable assurance that the ingredient will not present a significant or unreasonable risk of illness or injury. The Secretary of HHS may also declare that a dietary supplement or dietary ingredient poses an imminent hazard to public health or safety. However, like any other foods, it is a manufacturer's responsibility to ensure that its products are safe and properly labeled prior to marketing.

LITERATURE

The DSHEA provides that retail outlets may make available "third-party" material s to help inform consumers about any health-related benefits of dietary supplements. These materials include articles, book chapters, scientific abstracts, or other third-party publications. These provisions stipulate that the information must not be false or misleading; cannot promote a specific supplement brand; must be displayed with other similar materials to present a balanced view; must be displayed separate from supplements; and may not have other information attached (product promotional literature, for example).

NUTRITIONAL SUPPORT STATEMENTS

The DSHEA provides for the use of various types of statements on the label of dietary supplements, although claims may not be made about the use of a dietary supplement to diagnose, prevent, mitigate, treat, or cure a specific disease (unless approved under the new drug provisions of the FD&C Act). For example, a product may not carry the claim "cures cancer" or "treats arthritis." Appropriate health claims authorized by FDA--such as the claim linking folic acid and reduce risk of neural tube birth defects and the claim that calcium may reduce the risk of osteoporosis--may be made in supplement labeling if the product qualifies to bear the claim. Under DSHEA, firms can make statements about classical nutrient deficiency diseases--as long as these statements disclose the prevalence of the disease in the United States. In addition, manufacturers may describe the supplement's effects on "structure or function" of the body or the "well-being" achieved by consuming the dietary ingredient. To use these claims, manufacturers must have substantiation that the statements are truthful and not misleading and the product label must bear the statement "This statement has not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease." Unlike health claims, nutritional support statements need not be approved by FDA before manufacturers market products bearing the statements, however, the agency must be notified no later than 30 days after a product that bears the claim is first marketed.

INGREDIENT AND NUTRITION INFORMATION LABELING

Like other foods, dietary supplement products must bear ingredient labeling. This information must include the name and quantity of each dietary ingredient or, for proprietary blends, the total quantity of all dietary ingredients (excluding inert ingredients) in the blend. The label must also identify the product as a "dietary

supplement" (e.g., "Vitamin C Dietary Supplement"). Labeling of products containing herbal and botanical ingredients must state the part of the plant from which the ingredient is derived. If a supplement is covered by specifications in an official compendium and is represented as conforming, it is misbranded if it does not conform to those specifications. Official compendia include the U.S. Pharmacopeia, the Homeopathic Pharmacopeia of the United States, or the National Formulary. If not covered by a compendium, a dietary supplement must be the product identified on the label and have the strength it is represented as having.

Labels also must provide nutrition labeling. This labeling must first list dietary ingredients present in "significant amounts" for which FDA has established daily consumption recommendations, followed by dietary ingredients with no daily intake recommendations. Dietary ingredients that are not present in significant amounts need not be listed. The nutrition labeling must include the quantity per serving for each dietary ingredient (or proprietary blend) and may include the source of a dietary ingredient (for example, "calcium from calcium gluconate"). If an ingredient is listed in the nutrition labeling, it need not appear in the statement of ingredients. Nutrition information must precede ingredient statements on the product label.

NEW DIETARY INGREDIENTS

Supplements may contain new dietary ingredients--those not marketed in the United States before October 15, 1994--only if those ingredients have been present in the food supply as an article used for food in a form in which the food has not been chemically altered or there is a history of use, or some other evidence of safety exists that establishes that there is a reasonable expectation of safety when the product is used according to recommended conditions of use. Supplement manufacturers must notify FDA at least 75 days before marketing products containing new dietary ingredients, providing the agency with the information on which the conclusion that a dietary supplement containing the new dietary ingredient "will reasonably be expected to be safe" was based. Any interested party, including a manufacturer of a dietary supplement, may petition FDA to issue an order prescribing the conditions of use under which a new dietary ingredient will reasonably be expected to be safe.

GOOD MANUFACTURING PRACTICES (GMPs)

DSHEA grants FDA the authority to establish GMP regulations governing the preparation, packing, and holding of dietary supplements under conditions that ensure their safety. These regulations are to be modeled after current good manufacturing practice regulations in effect for the rest of the food industry. FDA intends to work with the supplement industry and other interested persons to develop GMPs and, in doing so, will seek public comment as to their scope.

COMMISSION ON DIETARY SUPPLEMENTS

The DSHEA requires the formation of a Commission to conduct a study and make recommendations on the regulation of label claims and statements for dietary supplements and procedures for the evaluation of the claims. The members of the Commission will evaluate how best to provide truthful, scientifically valid, and not misleading information to consumers so that they can make informed and appropriate health care choices. The Commission will be composed of seven members, appointed by the President, with experience in dietary supplements and in the manufacture, regulation, distribution, and use of supplements. Three members must be qualified by scientific training and experience to evaluate supplements' health benefits, and one of these must be trained in pharmacognosy, medical botany, traditional herbal medicine, or other related sciences. All Commission members and staff should be unbiased about supplement use.

On October 2, 1995, the White House announced the names of the seven individuals the President intends to appoint to the Commission. The members include nutritionists, industry representatives, a pharmacognosist, and attorneys.

The Commission will submit a final report including recommendations and legislation related to label claims for dietary supplements to the President and Congress within two years of convening.

OFFICE OF DIETARY SUPPLEMENTS

The HHS Secretary will establish an office within the National Institutes of Health to explore the potential role of supplements to improve health care in the U.S. The office will also promote scientific study of supplements and their value in preventing chronic diseases; collect and compile scientific research, including data from foreign sources and the NIH Office of Alternative Medicine; serve as a scientific adviser to HHS and FDA; and compile a database of scientific research on supplements and individual nutrients.

EFFECTIVE DATE

DSHEA's provisions for use of nutritional support statements and third-party literature became effective when the law was signed. The effective date for other labeling provisions and any FDA implementing regulations is after December 31, 1996, although manufacturers may label their products consistent with provisions of DSHEA until that date.

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Hypertext updated by dms 8/24/96

T96-01
January 2, 1996

Brad Stone
(202) 205-4144

FDA PUBLISHES DIETARY SUPPLEMENT RULES

FDA has proposed standards for nutritional labeling formats and terms that would apply to dietary supplement products. These proposed standards implement some major provisions of the Dietary Supplement Health and Education Act of 1994, which covers regulation of these products.

This Act requires FDA to develop labeling requirements specifically designed for dietary supplement products -- products containing ingredients such as vitamins, minerals, herbs or amino acids intended to supplement the diet.

FDA is proposing that the labeling follow the same basic format as that used on processed food labels. The "Supplement Facts" panel that would be on dietary supplement labels, like the "Nutrition Facts" panel now on food labels, would provide nutrition information about certain vitamins and minerals as well as information about the level of other dietary ingredients.

The proposal would also provide for some differences: For example, dietary supplement labels could list non-essential dietary ingredients, such as herbs, on their labels and could also use smaller type sizes in some instances.

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Another proposal would set definitions for the terms "antioxidant" and "high potency" on dietary supplement labeling.

In addition, FDA has published a final rule establishing Reference Daily Intakes (RDIs) for vitamin K, selenium, manganese, chromium, molybdenum and chloride. RDIs are reference values developed to help consumers gauge the relative amounts of certain essential nutrients in a product. This rule will become effective immediately.

The proposed rules dealing with food labeling formats and definitions will undergo a 90 day public comment period. Written comments on these proposals may be submitted to:

FDA Dockets Management Branch
(HFA-305)
12420 Parklawn Drive
Rockville, MD 20857-0001

Under the Act, labeling rules for dietary supplements must be finalized and in effect by Jan. 1, 1997.

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Cyanobacterial Toxins

The cyanobacteria are proving to be a source of a large number of novel organic compounds with biological activity. Among the many compounds found and characterised to date, many are toxic and have been suspected as the cause of deaths in animals (including humans). Below are links to further information on some of these toxins and their biological targets. Information on other toxins will be added to the list in the future.

Microcystins

Anatoxins

Nodularin

1. Name of the Organism: *Salmonella spp.*

   Salmonella is a rod-shaped, motile bacterium -nonmotile exceptions *S. gallinarum* and *S. pullorum*-, nonsporeforming and Gram-negative. There is a widespread occurrence in animals, especially in poultry and swine. Environmental sources of the organism include water, soil, insects, factory surfaces, kitchen surfaces, animal feces, raw meats, raw poultry, and raw seafoods, to name only a few.

2. Nature of Acute Disease:

   S. typhi and the paratyphoid bacteria are normally septicemic and produce typhoid or typhoid-like fever in humans. Other forms of salmonellosis generally produce milder symptoms.

3. Nature of Disease:

   Acute symptoms - Nausea, vomiting, abdominal cramps, diarrhea, fever, and headache. Chronic consequences - arthritic symptoms may follow 3-4 weeks after onset of acute symptoms.

   Onset time - 6-48 hours.

   Infective dose - As few as 15-20 cells; depends upon age and health of host, and strain differences among the members of the genus.

   Duration of symptoms - Acute symptoms may last for 1 to 2 days or may be prolonged, again depending on host factors, ingested dose, and strain characteristics.

   Cause of disease - Penetration and passage of Salmonella organisms from gut lumen into epithelium of small intestine where inflammation occurs; there is evidence that an enterotoxin may be produced, perhaps within the enterocyte.

4. Diagnosis of Human Illness:

   Serological identification of culture isolated from stool.

5. Associated Foods:

   Raw meats, poultry, eggs, milk and dairy products, fish, shrimp, frog legs, yeast, coconut, sauces and salad dressing, cake mixes, cream-filled desserts and toppings, dried gelatin, peanut butter, cocoa, and chocolate.

   Various Salmonella species have long been isolated from the outside of egg shells. The present situation with *S. enteritidis* is complicated by the presence of the organism inside the egg, in the yolk. This and other information strongly suggest vertical transmission, i.e., deposition of the organism in the yolk by an infected layer hen prior to shell deposition. Foods other than eggs have also caused outbreaks of *S. enteritidis* disease.

6. Relative Frequency of Disease:

   It is estimated that from 2 to 4 million cases of salmonellosis occur in the U.S. annually.

   The incidence of salmonellosis appears to be rising both in the U.S. and in other industrialized

nations. *S. enteritidis* isolations from humans have shown a dramatic rise in the past decade, particularly in the northeast United States (6-fold or more), and the increase in human infections is spreading south and west, with sporadic outbreaks in other regions.

7. Complications:

S. typhi and *S. paratyphi* A, B, and C produce typhoid and typhoid-like fever in humans. Various organs may be infected, leading to lesions. The fatality rate of typhoid fever is 10% compared to less than 1% for most forms of salmonellosis. *S. dublin* has a 15% mortality rate when septicemic in the elderly, and *S. enteritidis* is demonstrating approximately a 3.6% mortality rate in hospital/nursing home outbreaks, with the elderly being particularly affected.

Salmonella septicemia has been associated with subsequent infection of virtually every organ system.

Postenteritis reactive arthritis and Reiter's syndrome have also been reported to occur generally after 3 weeks. Reactive arthritis may occur with a frequency of about 2% of culture-proven cases. Septic arthritis, subsequent or coincident with septicemia, also occurs and can be difficult to treat.

8. Target Populations:

All age groups are susceptible, but symptoms are most severe in the elderly, infants, and the infirm. AIDS patients suffer salmonellosis frequently (estimated 20-fold more than general population) and suffer from recurrent episodes.

9. Food Analysis:

Methods have been developed for many foods having prior history of Salmonella contamination. Although conventional culture methods require 5 days for presumptive results, several rapid methods are available which require only 2 days.

10. Major Outbreaks:

Salmonellosis outbreaks of varying size caused by all *Salmonella spp.* occur rather regularly throughout the U.S.

In 1985, a salmonellosis outbreak involving 16,000 confirmed cases in 6 states was caused by low fat and whole milk from one Chicago dairy. This was the largest outbreak of foodborne salmonellosis in the U.S. FDA inspectors discovered that the pasteurization equipment had been modified to facilitate the running off of raw milk, resulting in the pasteurized milk being contaminated with raw milk under certain conditions. The dairy has subsequently disconnected the cross-linking line. Persons on antibiotic therapy were more apt to be affected in this outbreak.

In August and September, 1985, *S. enteritidis* was isolated from employees and patrons of three restaurants of a chain in Maryland. The outbreak in one restaurant had at least 71 illnesses resulting in 17 hospitalizations. Scrambled eggs from a breakfast bar were epidemiologically implicated in this outbreak and in possibly one other of the three restaurants. The plasmid profiles of isolates from patients all three restaurants matched.

The Centers for Disease Control (CDC) has recorded more than 120 outbreaks of *S. enteritidis* to date, many occurring in restaurants, and some in nursing homes, hospitals and prisons.

In 1984, 186 cases of salmonellosis (*S. enteritidis*) were reported on 29 flights to the United States on a single international airline. An estimated 2,747 passengers were affected overall. No specific food item was implicated, but food ordered from the first class menu was strongly associated with disease.

S. enteritidis outbreaks continue to occur in the U.S. (Table 1). The CDC estimates that 75% of those

outbreaks are associated with the consumption of raw or inadequately cooked Grade A whole shell eggs. The U.S. Department of Agriculture published Regulations on February 16, 1990, in the Federal Register establishing a mandatory testing program for egg-producing breeder flocks and commercial flocks implicated in causing human illnesses. This testing should lead to a reduction in cases of gastroenteritis caused by the consumption of Grade A whole shell eggs.

****NOTE - Consumers should be aware that raw eggs, like other raw foods of animal origin, may cause Salmonella infections.** Based on this, consumers should avoid eating raw eggs and foods containing raw eggs. Raw eggs should be handled and stored in the same manner as other raw foods of animal origin. Eggs should be stored at 7.2oC (45oF) or below. Raw eggs ought *NOT* be considered "health foods," particularly for the hospitalized, the elderly, the immunocompromised, and perhaps pregnant women. Cracking single eggs for use, rather than "pooling" several eggs, greatly lessens the chances of illness. Recipes calling for raw eggs (e.g., home-made ice cream, Caesar salad, Hollandaise sauce, mayonnaise, etc.) should be considered potentially hazardous if they are not heated sufficiently to kill Salmonella. Commercially produced mayonnaise and sauces are safe since they are prepared with pasteurized eggs and are adequately acidified to prevent the growth of *S. enteritidis*. Whenever possible, pasteurized, liquid eggs should be substituted for raw eggs if they are destined for high risk individuals.

**GUIDELINES FOR COOKING EGGS:

Consumers are advised to cook eggs and foods containing eggs thoroughly. Eggs should be cooked until the yolk and white are firm. There may be some risk in eating eggs lightly cooked, e.g., soft-cooked, soft-scambled, or "sunny-side-up." Eggs should be cooked throughout to 60oC (140oF) or above.

Scrambled eggs should be cooked at least 1 minute at 121oC (250oF). After 1 minute, the temperature of the scrambled eggs should be 73.9oC (165oF).

Poached eggs should be cooked for 5 minutes in boiling water.

Sunnyside fried eggs should be cooked with the frying pan at 121oC (250oF) for the following times:

Uncovered - Fry for at least 7 minutes.
Covered - Fry for at least 4 minutes.

Eggs fried "over easy" should be cooked with the frying pan at 121oC (250oF) for the following times:

Fry for at least 3 minutes on one side.
Fry for at least 2 minutes on the other.

Boiled eggs in the shell should be cooked while completely submerged in boiling water for 7 minutes.

*** The word "*should*" has been used throughout because ther are uncontrollable variables, such as the starting number of organisms in the eggs. **The above guidelines must be considered in that context, i.e., the cooking times suggested cannot totally assure safety under all circumstances.**

Salmonellosis associated with a Thanksgiving Dinner in Nevada in 1995 is reported in MMWR 45(46):1996 Nov 22.

MMWR 45(34):1996 Aug 30 reports on several outbreaks of *Salmonella enteritidis* infection associated with the consumption of raw shell eggs in the United States from 1994 to 1995.

A recent report of an outbreak of *Salmonella* Serotype Typhimurium infection associated with the consumption of raw ground beef may be found in MMWR 44(49):1995 Dec 15.

MMWR 44(42):1995 Oct 27 reports on an outbreak of Salmonellosis associated with beef jerky in New Mexico in 1995.

There is an FDA fact sheet on Bamba Snacks with Peanuts and associated outbreaks of *Salmonella agona* in Europe.

The report on the outbreak of Salmonella from commercially prepared ice cream is found in MMWR 43(40):1994 Oct 14.

A recent outbreak of *S. enteritidis* in homemade ice cream is reported in this MMWR 43(36):1994 Sep 16.

A series of *S. enteritidis* outbreaks in California are summarized in the following MMWR 42(41):1993 Oct 22.

For information on an outbreak of Salmonella Serotype Tennessee in Powdered Milk Products and Infant Formula -- see this MMWR 42(26):1993 Jul 09.

Summaries of Salmonella outbreaks associated with Grade A eggs are reported in MMWR 37(32):1988 Aug 19 and MMWR 39(50):1990 Dec 21.

There is an index of selected research on Salmonella enteritidis available through NIH's Entrez database.

A Loci index for genome Salmonella enteritidis is available from GenBank.

The CDC provides an informational brochure on preventing Salmonella enteritidis infection

The Food Safety and Inspection Service of the U.S. Department of Agriculture has produced a background document on salmonella.

Links to this Handbook's Table of Contents and to the
Center for Food Safety and Applied Nutrition's Foods Page
Text last edited: 6 Jan 92
Hypertext last edited: 22 Nov 96 mow@vm.cfsan.fda.gov

U.S Department of Agriculture / Food Safety and Inspection Service
Background Document January 1988

SALMONELLA AND FOOD SAFETY

Chicken, turkey, pork, beef, and other meat and poultry products are important sources of protein and other nutrients. Unfortunately, these foods--like eggs, raw milk, and all raw foods of animal origin--may also carry salmonella and other bacteria. The good news is that these bacteria don't have to cause illness. Routine food safety practices can destroy salmonella and other bacteria.

The Food Safety and Inspection Service (FSIS) oversees the processing of meat and poultry from the time animals enter the slaughter plant until packaged products leave the plant. FSIS also conducts a comprehensive food safety education program, including a toll-free hotline. FSIS requires manufacturers of raw and partially pre-cooked meat and poultry products to provide safe food handling labels to remind consumers about thorough cooking and safe handling of meat and poultry products.

Consumers have a right to meat and poultry that is as free as possible of bacteria. However, after more than 20 years of research, it is still economically impossible to produce "salmonella-free" raw meat and poultry. With or without a breakthrough, good sanitation and careful food handling will always be necessary to prevent bacteria on raw products from causing illness--just as toothbrushing is necessary to prevent other bacteria from causing dental cavities.

What is salmonella?

This FSIS backgrounder answers common questions about salmonella and offers some tips for safe handling of meat and poultry to prevent food-borne illness.

The salmonella family includes about 2,000 different strains of bacteria, but only 10 strains cause most reported salmonella infections. Strains that may cause no symptoms in animals can make people sick, and vice versa. A salmonella bacterium is a one-celled organism that can't be seen, touched or tasted. The bacteria are common in the intestinal tracts and waste of livestock, poultry, dogs, cats, rats, and other warm-blooded animals.

What is salmonellosis?

Salmonellosis, or a salmonella infection, is the illness that can occur if live salmonella bacteria enter the body--usually through food. Most reported outbreaks of food-borne illness are caused by bacteria, and salmonellosis is the most common bacterial food-borne illness. Salmonellosis is usually preventable.

How can salmonella bacteria on raw meat and poultry make people sick?

First, "food abuse" allows bacteria to survive and often to multiply. For example, if the meat knife is ued to cut the salad lettuce without first being washed, the lettuce can be contaminated by any bacteria on the meat. The person who eats the salad then also eats the bacteria.

Next, if the bacteria survive the stomach acid, they reproduce themselves in the small intestine. Once cell becomes two, two become four, four become sixteen, and so on. When there are "enough" bacteria, they cause a salmonella infection.

How many bacteria does it take to make people sick?

There is no exact number, but the more bacteria consumed, the more likely a person is to get sick.

Healthy adults have eaten food containing millions of bacteria without getting sick. Other people have gotten sick from as few as 10 bacteria in their food.

What are the symptoms of salmonellosis?

According to the Centers for Disease Control, stomach pain occurs within 6 to 48 hours after the food was eaten. Most people get diarrhea, and many people have upset stomachs, chills, fever, or headache. Most people feel better within 3 to 5 days. Many persons with salmonellosis may believe they have the flu and may never see a doctor.

How many people get sick from salmonellosis?

At least 40,000 salmonella infections are reported every year, but experts believe that between 400,000 and 4 million persons each year actually contract salmonellosis.

How does the doctor know a person has salmonellosis?

The only way to tell for sure is to conduct laboratory tests on the stools of the person who got sick, a process that takes several days.

How many people die from salmonellosis?

Salmonella infections can be life-threatening for the very young, the very old and for persons already weakened by other serious diseases, such as AIDS. Reports show about 2 deaths for every 1,000 known cases of salmonellosis, but experts believe that about 500 persons each year actually die from salmonella infections.

What foods are most likely to make people sick?

Foods don't make people sick--bacteria do. Any raw food of animal origin--meat, poultry, raw milk, fish, and shellfish--may carry salmonellae. The bacteria can survive to cause illness if these specific foods are not thoroughly cooked. The bacteria can also cause illness if they contaminate any other food that comes in contact with the raw food, either directly or byway of dirty hands or dirty equipment. Salmonellosis is a world-wide, food- chain problem that can't be "blamed" on any one food.

Wouldn't less bacteria on animals mean less human illness?

FSIS and the National Academy of Sciences agree with this logical assumption. However, there will always be some risk of bacterial contamination on raw foods of animal origin. So, food safety will always be necessary to prevent bacteria on raw foods from causing illness.

Are Kosher chickens lower in salmonella bacteria?

FSIS does not know of any valid scientific information showing that Kosher chickens carry more or fewer salmonella bacteria than other poultry.

ANTI-SALMONELLA STRATEGY

Bacteria on raw foods of animal origin do not have to cause illness. Investigations of actual outbreaks reported tot he Centers for Disease Control show that *BACTERIA + FOOD SAFETY MISTAKES CAN = ILLNESS.*

Errors during food shopping, transport, preparation, serving, or storage can enable bacteria to grow or even just survive. If foods are prepared a day or more ahead of time and food handlers make mistakes, the chance of illness can increase, because bacteria have more time to multiply. In outbreaks traced to bacteria or other

COOK IT.

Salmonellae -- however many there are -- do not survive when beef or pork is cooked to an internal temperature of at least 160 degrees F, or when poultry is cooked to 185 degrees F. (Some experts believe that this country's passion for rare beef explains why beef -- which carries very low levels of salmonella bacteria -- is involved in more reported salmonellosis outbreaks than poultry.) Always cook meat and poultry thoroughly, and be just as careful when microwaving as when using traditional ovens.

- Use a Meat thermometer to check "doneness." If meat is too thin for a thermometer, follow the recipe and cook till the juices have no pink.
- Never interrupt cooking--it's a "half-baked idea" that can make you sick. If thawing foods in the microwave, cook them immediately.
- If reheating leftovers, cover and reheat thoroughly to 165 degrees F just in case bacteria survived in the food during refrigeration or freezing. Let sauces and gravies reach a rolling boil.
- Don't store the latecomer's cooked meat and poultry dinner in an off or warm oven. Hold the food above 140 degrees F. (But, within 2 hours after doing, refrigerate the food.)

COOL IT.

Refrigeration and even freezing do not kill all salmonella or other bacteria, but proper cooling can usually prevent salmonellae from multiplying.

- Refrigerate raw meat and poultry as soon as possible after you take it out of the grocery meat case.
- Refrigerate food containing cooked meat or poultry within 2 hours after cooking.
- Refrigerate or freeze cooked meat or poultry casseroles in covered shallow pans rather than deep pots. Leave space around the containers to let cold air circulate.
- Never thaw frozen and poultry on the kitchen counter. Thaw it in the refrigerator or, if you are in a hurry, in a bag under could running water.
- Remember that refrigeration or freezing cannot be counted on to kill many salmonella bacteria. It can't "fix" a mistake such as leaving cooked turkey at room temperature for more than 2 hours-- it can only postpone the risk of illness. If in doubt, throw the food out.

Do you have other questions about meat and poultry food safety or labeling?

Consumers: Call the toll-free Meat and Poultry Hotline at 1-800- 535-4555, 10 a.m. to 4 p.m., Eastern Standard Time. Press inquiries: Please call (202) 720-9113.

United States Department of Agriculture Food Safety and Inspection Service
Background Document January 1988

Public Health Association of Australia Inc

Media Release

30 May 1996

Salmonella Meningitis - A Major Foodborne Disease

Haemolytic uraemic syndrome is a severe, although rare, foodborne disease in Australia, but there are other severe forms of foodborne disease, including some salmonella syndromes.

Salmonella infections will be discussed in a paper to be presented at the Public Health Association of Australia conference ***Unravelling the Maze - Food safety in Australia*** held at the Carlton Crest Hotel in Melbourne today.

The authors of the paper are Dr Jeff Hanna and Dr Ross Messer of the Tropical Public Health Unit in Cairns and the paper will be presented by Dr Hanna.

Salmonella gastroenteritis can cause death in the elderly. Among children, a rare but extremely severe form of salmonella is salmonella meningitis.

Salmonella meningitis is an important cause of bacterial meningitis in some developing countries, such as Thailand, but is seldom recognised in Australia.

Salmonella infections are particularly common in Far North Queensland. A particularly virulent and invasive strain - Salmonella Virchow is reportedly more common in Far North Queensland than elsewhere in Australia.

Over the past 10 years, seven children with salmonella meningitis have been treated in Cairns.

A paper to be presented at the conference will discuss the clinical features of these children revealing a significant prevalence of brain damage.

For more information contact PHA on 06 285 2373.

Return to: PHA Media Releases

Public Health Association

The Food Safety Consortium Newsletter
Winter 1997
Vol. 7 No. 1

Articles in this issue:

Industry, Government Face Change,

FSIS Official Tells FSC

The new federal rules covering meat inspection represent a "cultural change" in the food processing industry and among government inspectors, Craig Reed, associate administrator of the U.S. Department of Agriculture Food Safety and Inspection Service, told researchers of the Food Safety Consortium at its annual meeting in Kansas City in October.

Reed was the keynote speaker for the Consortium's two-day conference. In his position at FSIS, Reed concentrates on inspection operations and field operations. He was previously.FSIS deputy administrator for inspection operations and director of the science division of the USDA Agricultural Marketing Service. He holds a doctor of veterinary medicine degree.

FSIS associate administrator Craig Reed explains coming changes.

Hazard Analysis and Critical Control Point (HACCP) systems will govern meat inspection procedures under the new rules. The system is a science-based process that places the burden of preventive measures on the industry in the early stages of food production rather than depending heavily on U.S. Department of Agriculture inspectors at the end of the processing line.

Much is riding on the new system's success, Reed noted. The failure of the HACCP system's implementation could result in a push by some advocates for a "total control" system of inspection, he said.

FSIS is reorganizing itself in response to implementation of the new system. Reed said the agency is reîts number of district offices from 46 to 18 to streamline the mangement structure and to bring about greater consistency in advice offered from region to region. A service center is also being established to offer technical expertise and advice to field employees regarding the interpretation, application and enforcement of regulations, policies and systems. The center will also answer technical questions from industries and groups outside of FSIS.

The "scientific underpinning" that is HACCP's foundation is a necessary element that enables industries to explain their food safety-related decisions, Reed said. Without that base, the public will lose faith in the procedures, he added, pointing out that science provides foodborne illness data and a basis for determining if there is actually a relationship between a particular outbreak of illness and food. Science also provides the basis for the farm-to-table approach to food safety, he noted.

Employees in modern food processing plants must be educated in some basic food science and hygiene, Reed said. "The turnover is some of those plants is incredible," he said. Employees who are not properly trained to appreciate the special aspects of their jobs may begin to regard their jobs as working with "production units" rather than food that people actually consume.

"If you drop a 'production unit' on the floor, it's the same as dropping food," he said.

Industry Reps Review New HACCP Rules

The new rule implementing Hazard Analysis and Critical Control Point (HACCP) standards was the major development in food safety, industry representatives said in addresses to the Food Safety Consortium annual meeting in Kansas City in October. The new standards were announced in July by the U.S. Department of Agriculture.

A cooperative effort is necessary between industry and the Food Safety and Inspection Service to make the new system work, said Ellis Brunton, Tyson Foods group vice president for research and quality assurance. "We now have the opportunity to set new

standards based on science and the HACCP principles," said Brunton, a Consortium steering committee member representing the poultry industry.

Brunton advised that sanitation standard operating procedures are prerequisites to implementing a HACCP program, followed by meeting performance standards or microbiological standards for raw species of meat.

Brunton warned that the new system still has undetermined elements. "They (the government) will take action if you fail to meet the criteria," he said. "We don't know what the action will be."

The Russian embargo on U.S. poultry imports was the other food safety issue that his industry faced, Brunton said. He explained that some out-of-condition products were shipped to Russia, prompting meetings between USDA and Russian agriculture ministry officials. The Russians conducted an investigation of 50 U.S. poultry plants and concluded that none of them met Russian food safety standards. After threatening to ban poultry imports from the U.S. within 30 days, the Russians and the USDA negotiated new poultry inspection criteria and later found that 200 U.S. poultry plants now meet their standards, Brunton said.

"But now we must test for Salmonella above and beyond what we normally do," Brunton said of the outcome of the agreement with the Russians. "I believe that food safety will continue to be a primary concern for exporting meat and poultry."

Representing the beef industry, Jim Riemann of Excel Corp. said the new HACCP regulations mean industry must educate its own workers and make them feel free to stop operations in a plant if a particular area needs to be cleaned. "Up until now, we could pass the buck to USDA inspectors," he said.

Bernie Daniels (left) of Arkansas and Curtis Kastner of Kansas State at annual meeting.

Both line workers and USDA inspectors must understand the potential consequences of allowing situations to get out of control in processing plants, Riemann said, noting that an undesirable situation exists if employees and inspectors without adequate education are allowed to implement a science-based inspection system.

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Both line workers and USDA inspectors must understand the potential consequences of allowing situations to get out of control in processing plants, Riemann said, noting that an undesirable situation exists if employees and inspectors without adequate education are allowed to implement a science-based inspection system.

Riemann, a member of the Consortium steering committee, said there is a need for the development of new and simpler technologies in plants because of the predominance of workers who are not well educated and in some cases do not speak English. Small plants will need to be shown how to perform the new required testing procedures or be directed to a testing lab to do the work, he said.

The pork industry needs to work with FSIS to increase awareness of pork processing standards and procedures that differ from those of other species, said Margaret Hardin of the National Pork Producers Council. Such steps will be necessary to insure that pork processors can meet the new performance criteria and implement the standards in plants, she said.

"Our current research will be looking at Salmonella levels on the farm and how these levels transfer to the plant and ultimately to the final product," Hardin said.

"Much of what we've done previously with regard to food safety research has been on the farm. In assuming responsibilities previously held by the National Livestock and Meat Board, the National Pork Producers Council is now starting to look into the plant as well as along the entire food continuum to address food safety concerns for the entire pork industry."

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Report From the Coordinator

By Charles J. Scifres

The Food Safety Consortium experienced a busy stretch of public activity during October. On a Thursday in Little Rock, Consortium investigators presented the entire day's program for the food safety component of the U.S. Animal Health Association's national convention. On the following Sunday through Tuesday, Consortium investigators, graduate students, government officials and industry representatives gathered in Kansas City for the annual meeting with numerous reports and presentations on the agenda.

The Consortium's personnel stay busy throughout the year, frequently finding themselves on the road presenting their research to conferences related to food safety or their own particular disciplines. Getting so many of them together in one place - at both the annual meeting and the USAHA convention - was a beneficial experience for everyone, not to mention a logistical feat in itself.

The annual meeting provides Consortium personnel the opportunity to become better acquainted with their colleagues' work through formal presentations and their progress reports published in the meeting's proceedings. The informal atmosphere of fellowship offers opportunities for researchers from different universities to discuss their work and exchange ideas. It was gratifying to observe many such encounters at this fall's meeting.

The poster session was a major highlight of this year's meeting. Investigators and graduate students from all the Consortium's institutions displayed nearly 25 posters highlighting their research. The posters, on display throughout the meeting in the same room where all meeting sessions were held, attracted considerable attention and discussion right up until the

last ones were dismantled to make way for the hotel's next event.

The annual meeting has long been the chance for the Consortium to show its work to its own people. The USAHA convention was an opportunity to do so for numerous scientists from around the nation to become familiar with the Consortium's work. Another opportunity to show the Consortium's accomplishments to others will occur in 1997 during the food safety symposium for industry that will be held at the University of Arkansas.

The Consortium continues to attract outside recognition. One recent example came from Congress, which mandated the Consortium's establishment nearly nine years ago. Before Congress adjourned last fall, Rep. Pat Roberts of Kansas, the outgoing chairman of the House Committee on Agriculture, asked the Consortium to review the USDA Economic Research Service report on matters pertaining to food safety. The chairman said the committee would benefit from an expert review of USDA's report as its members attempt to evaluate the costs and benefits of any proposed changes in food safety inspection laws or regulations.

The Consortium is grateful for such confidence in its expertise expressed at such high levels of government. That confidence would not be there without the continued excellent day-in and day-out work performed by the researchers, work that many of us see for the first time during the presentations at our annual meetings. The nation is paying attention to what our people are doing and we will continue to maintain a high level of confidence.

Children and Industry Benefit From FSC Outreach

The accomplishments of scientific research at the front of the food safety chain can be undone at the end of the line if food preparers or consumers fail to perform some vital tasks - proper hand washing among them. So Food Safety Consortium personnel in Arkansas have taken their message to groups that can benefit from some basic presentations.

For the poultry industry, the Consortium presents workshops to bring poultry plant managers up to date on the changes in procedures that new federal rules will mandate in phases over the next three years. For consumers, the Consortium is working with Cooperative Extension Service personnel and directly with child care providers to spread the word about hygiene and food safety.

The Consortium program at the University of Arkansas supports the workshops held periodically on campus for the poultry industry. These sessions review the changes resulting from the newly mandated Hazard Analysis and Critical Control Point (HACCP) procedures. "The feedback has been excellent," said John Marcy, a UA food science specialist in the Center of Excellence for Poultry Science and a Consortium principal investigator.

The U.S. Department of Agriculture has ordered that meat and poultry processors implement the science-based HACCP procedures in their plants. Plants are required to identify points in their processing systems in which chemical, physical or microbiological hazards can occur. The plants must establish controls to prevent, eliminate or minimize the hazards and maintain records that show the controls are working. USDA inspectors at the plants will verify each plant's plan and its effectiveness.

The HACCP implementation courses at the university have attracted poultry industry personnel from all processing plants in Arkansas and some from Texas. "We've filled two classes," Marcy said. "We give them lots of reference books and we send them through a process. The primary focus is keeping it real simple."

In preparation for the effective date of the new sanitation regulations in January 1997, the Consortium sponsored two HACCP workshops that included sanitation. In March, another workshop will be oriented toward poultry plant suppliers.

The official regulation implementing HACCP fills only 18 pages of text in the *Federal Register*. Its length isn't so much a source of potential bewilderment for industry personnel as its implications could be.

"The main thing is interpretation," Marcy said. "Almost all USDA regulations are worded that loosely. The final say goes to the inspector in the plant."

Food safety researchers also know that an outreach program to consumers is vital, and two groups of people who serve large quantities of food are prime targets: food service personnel and child care providers.

Marcy and Amy Waldroup, a UA poultry science professor and a Consortium principal investigator, worked with the Arkansas Hospitality Association and the Arkansas Department of Health to develop a program that trains Cooperative Extension Service personnel in the basics of food safety education. With personnel in all 75 Arkansas counties, the Extension Service and the Hospitality Association appeared to be the logical place to ensure that a wide net was cast.

A network of 50 teams of Extension home economists worked in clusters to offer training to restaurant and food service personnel. The university researchers were able to help the home economists relate their knowledge to the needs of the commercial marketplace.

"Home economists are good adult educators but they usually don't have the background to relate directly to a restaurateur," Marcy said. "They know a lot about food science, kitchens, cooking and food safety, but more from the consumer's end. When you get into the quantity in a commercial kitchen, it's considerably different."

The UA team used a similar concept when they took their project to child care providers.

Using a cost-recovery program, the researchers developed a 10-hour course in which Extension personnel would train child-care workers in food safety procedures applicable to day-care centers. They consulted with child-care providers to find out what they believed they needed to learn. The is`the researchers was, "How do we market this so it's user friendly and they'll want to use it?" Waldroup said.

"We didn't develop any new curriculum," Marcy said. "We pulled things together that were already out there. This is straightforward basic education. But it's more than just giving them a pamphlet."

Extension agents have been trained in each county and they will provide training to day care centers in their home counties to meet the demand.

The program covers more than food safety, Waldroup explained. It has a component on early childhood nutrition, child development and meal management with a health unit included in the food safety portion.

Teaching assistant Tammi Cagle of Arkansas Better Chance day-care center at Jefferson Elementary School in Fayetteville has taken the 10-hour course and learned how to apply the important aspects of nutrition and cleanliness to her center. Cagle sponsored a family day at the center as parents were invited to participate in showing their children how to wash their hands properly before meals. Cagle also learned how to apply Waldroup's puppeteering skills to her classroom after Waldroup demonstrated the use of food safety-conscious puppets to the class.

"She showed me the puppet show and now I do it for the kids," Cagle said. "The kids seem to listen to the puppets."

Kansas State University

To Host Rapid Methods Workshop

The 17th annual Rapid Methods and Automation in Microbiology International Workshop will be held July 11-18 at Kansas State University. Dr. Daniel Fung, a principal investigator with the Food Safety Consortium and a KSU professor of food science, is the workshop director.

The workshop is designed for microbiologists, food scientists, medical technologists, consultants, quality assurance and control managers, laboratory directors and researchers. It will focus on the practical application of conventional and new commercial systems of rapid identification of microorganisms from medical specimens, food, water, and the environment. Workshop participants will receive eight days of intensive theoretical and hands-on training in microbiological automation under the direction of Fung, an

internationally known authority in the field.

A special two-day mini-symposium will be offered July 11 and 12 as an integral part of the workshop. Workshop participants must attend both the symposium and the workshop. Some individuals may opt to attend the symposium only.

For information about registration, call 1-800-432-8222 from within the U.S. or 1-913 532-5575 from outside the U.S.; send an e-mail message to ksuconf@dce.ksu.edu, or write to Rapid Methods and Automation in Microbiology - Registration, Kansas State University Division of Continuing Education, 131 College Court Building, Manhattan, Kan. 66506-6015.

Papers and Presentations

Cesar Compadre, Philip Breen, E. Kim Fifer and **Hamid Salari** of the University of Arkansas for Medical Sciences presented a paper on "Chemical Methods for Contamination Reduction on Meat" at the United States Animal Health Association meeting in Little Rock, Ark. They also presented a paper on "Quaternary Ammonium Compounds: Basic and Applied Studies to Prevent Bacterial Attachment" at the Food Safety Consortium annual meeting in Kansas City, Mo. **Michael Slavik, Yanbin Li,** and **Phillip Matsler,** all of the University of Arkansas, Fayetteville, and **Breen, Compadre** and **Salari** presented a paper at the FSC annual meeting on "Bacterial Potency of Cetylpyridinium Chloride for Reducing *Salmonella typhimurium* on Pre-Chill Chicken Carcasses."

Steve Gorton, James Kliebenstein and **George Beran** of Iowa State University presented papers on "A Discussion of an Epidemiologic and Economic Consideration in HACCP Evaluation: An Application of *Salmonella"* at the Symposium on Salmonella in the Food Chain at the National Animal Disease Center in Ames, Iowa, and on "HACCP On-Farm Salmonella Validation Testing: An Economic Comparison by Farm Size" at the FSC annual meeting in Kansas City.

Jeff Zimmerman, Tanya Roberts, James Kliebenstein, S. Patton, C. Faulkner, V. Diderrich, A. Assadi-Rad and **P. Davies** of Iowa State published *"Seroprevalence of* Toxoplasma gondii in Hogs in the National Animal Health Monitoring System (NAHMS)" in the October 1996 edition of *Eukaryotic Microbiology*. **Kliebenstein, Zimmerman, Patton** and **Roberts** published *"Prevalence of* Toxoplasma gondii Antibodies in Hogs, Farm Management Practice Relationships, and Economic Costs" in the 1995 Swine research Report, ASL-R1318, released in January 1996 by Iowa State.

Dermot Hayes, Jason Shogren, S.Y. Shin and **James Kliebenstein** of Iowa State published "Valuing Food Safety in Experimental Auction Markets" in the February 1995 edition of the *American Journal of Agricultural Economics.*

Eugene Pirtle and **George Beran** of Iowa State published "Stability of Porcine Reproductive and Respiratory Syndrome Virus in the Presence of Fomites Commonly Found on Farms" in Vol. 28, No. 3 edition of the Journal of the American Veterinary Medicine Association.

Harley Moon of Iowa State published "Bovine Spongiform Encephalopathy: Hypothetical Risk of Emergence as a Zoonotic Foodborne Epidemic" in the *Journal of Food Protection*, Vol. 59 (10). He also delivered a presentation on bovine spongiform encephalopathy on Nov. 15 at the Iowa Dietetic Association annual meeting.

Harley Moon and **M.J. Wannemuehler** of Iowa State, Brad Bosworth of the National Animal Disease Center and **J.T. Samuel of** Texas A&M University received a $772,000 grant from the National Institutes of Health for the study of "Intervention in *E. Coli Verotoxemia*: Swine Model" from 1996 to 2001.

Bradley Marks, Michael Johnson and **Haiqing Chen** of Arkansas received a $38,900 grant from the U.S. Poultry and Egg Association for "Visible/Near-Infrared Spectroscopy for Rapid Non-Destructive Evaluation of Process Lethality in Poultry Cooking Systems."

Gordon Schutze, H.A. Fawcett, M.J. Lewno, Ellie Flick and **Russell Kirby** of Arkansas Children's Hospital published "Prevalence of Salmonella enteritidis in Poultry Egg Shells in Arkansas" in the *Southern Medical Journal*, 1996, Vol. 89.

Amy Waldroup of Arkansas delivered a presentation on "Chemical Disinfection of Poultry" on Oct. 17 at the United States Animal Health Association annual convention in Little Rock, Ark., and on Nov. 4 at the Poultry Processors Workshop in Fayetteville, Ark. Waldroup also received $10,000 grants each from Los Alamos Technical Associates and Bavaria Corp. She was also interviewed by *Meat and Poultry* magazine.

David Marsh of Arkansas recently completed his master of science degree on "The Use of Chlorine Dioxide in Poultry Processing Plants" and has gone to work for Miller Aldrich.

Curtis Kastner of Kansas State delivered a presentation on "Meat Safety Issues and research" Jan. 9-10 at the Western Regional Project W-177 meeting in Denver.

Curtis Kastner, Daniel Fung, R.K. Podolak and **J.F. Zayas** of Kansas State published "Reduction of Bacterial Populations on Vacuum-Packaged Ground Beef patties with Fumaric and Lactic Acids" in the Journal of Food Protection, Vol. 59, No. 10. They also published "Inhibition of *Listeria monocytogenes* and *Escherichia coli* O157:H7 on Beef by Application of Organic Acids" in the Journal of Food Protection, Vol. 59, No. 4.

Kelly Karr, Elizabeth A.E. Boyle, Curtis Kastner, James Marsden, Randall Phebus, Ram K. Prasai, and **C.M. Garcia Zepeda** of Kansas State and **W. Payton**

Pruett Jr. Of Webb Technical Group in Raleigh, N.C., published "Standardized Microbiological Sampling and Testing procedures for the Beef Industry" in the *Journal of Food Protection, Vol. 59, No. 7*

Food Safety Digest

By Dave Edmark

The 1996 survey of the public's perception of food safety issues shows that Americans take those issues more seriously than they did previously. Among consumers surveyed, 82 percent viewed the preparation and handling of food in the home as very important, up from 59 percent who said so in 1995. Newspaper editors who decide how food safety articles will play in their publications weren't quite as emphatic but they have definitely caught on to the subject in a year's time. The survey showed that 69 percent of editors believed food handling and preparation is an important issue to the public at large, up from 14 percent who held that opinion in 1995.

The survey is done annually by CMF&Z Public Relations in Des Moines, Iowa. The agency found that editors and consumers have different views on the importance of overall food safety issues beyond the narrower matter of food handling in the home.

Among food editors, 48 percent said food safety is an important issue to consumers, down from 57 percent in 1995. Meanwhile, more than 80 percent of consumers considered food safety to be an important issue.

"The implications of the widening difference in perceptions between consumers and editors regarding the overall importance of food safety means that communicators need to work differently with editors, by being better prepared to respond to scares or crises, rather than relying solely on communicating in more traditional ways, said Carol Bodensteiner, CFM&Z president.

When asked whether food safety rules are tough enough, 67 percent of the consumers and 58 percent of the editors said they were not. The survey was conducted before the U.S. Department of Agriculture announced the implementation of new rules strengthening meat and poultry inspection procedures and instituting the science-based Hazard Analysis and Critical Control Points system.

The question of who is doing a good job of ensuring food safety brought these responses: More than half of the consumers and editors said supermarkets, producers and farmers were doing an excellent job; editors ranked restaurants in third place and consumers in fourth place; consumers ranked themselves third and restaurants fourth; and less than 40 percent of editors and consumers rated gave votes of confidence to government agencies and meat and poultry packers.

The survey found that the public is not aware of much information about the irradiation of meat. Forty-five percent of consumers believed irradiation would be effective, but 20 percent of consumers had no idea what irradiation is. More than half of the consumers were unable to provide any details when asked what they had seen or heard about meat irradiation.

* * *

It's not apparent that anyone has done such a poll, but Dr. Charles Beard suspects that if consumers were asked to name a foodborne illness and its most frequent source, most respondents would say, "salmonella from chickens." Beard, vice president of research and technology with the U.S. Poultry & Egg Association, said in a speech in October to the National Meeting on Poultry Health and Processing that there is some encouraging news that may help change that perception.

Beard noted that the USDA Food Safety and Inspection Service conducted a microbiological survey of processed whole broilers in plants around the nation. The survey showed that no salmonella was recovered from 80 percent of the 1,297 broiler samples. Of the 20 percent that tested positive, more than 87 percent of that segment had less than 0.3 bacteria per milliliter of rinse fluid, and 96.5 percent of the positive-testing broilers had three or fewer bacterial cells per milliliter of fluid.

Beard said it was remarkable that the poultry industry had achieved such a low level and incidence of salmonella on a product that must be cooked before being consumed.

"Faced with the reality that salmonella is present in essentially all of the animal species and, therefore, in the environment all around us, it is highly unlikely that the industry can produce, with 100 percent assurance, a constant supply of broilers that are completely free of salmonella," Beard said. "It is also likely that both the levels and incidence of salmonella will continue the overall downward trend interspersed with occasional periods that show increased spikes associated with weather or unknown factors."

The most the poultry industry can do, Beard said, is to get the incidence and levels of salmonella on all raw chicken as low as humanly possible. "There is no way that industry alone can quickly change the public perception of the salmonella-chicken connection," Beard said. "We can only continue to improve the poultry products to the point that when salmonella foodborne outbreaks occur, the investigators will have to look at the uncooked foods and institutional abuses as the likely source of the problem. There is nothing to be gained by debating the pros and cons of reducing the presence of salmonella on poultry products even more. We need to just get going and get it done."

Letter to the Editor

Editor,

Reference is made to the Vol. 6, No. 3, issue of the Consortium newsletter and the article about HACCP. This is a good article and gets into the recent issues in the application of HACCP, in particular its application to meat and poultry. I have a hard time with the title of the article ("HACCP Has Origins in the Early 1980s"). The Pillsbury Co. which is mentioned in the article did reduce to practice the concept of HACCP. The concept was imposed on Pillsbury by NASA contract requirements and I was the sole scientist in charge of flight food and nutrition at NASA Houston when this requirement (the first to be imposed on the food industry measurement and monitoring of food pathogens) occurred.

First CCP was a requirement for all Apollo program components. This management tool was requirement in all activity pertaining to Apollo systems. With the help of NATICK Labs, I had required the measurement of food pathogens in Project Gemini and these were part of the specifications (chemical, physical and microbiological) that were developed. I used these for Apollo because the only difference was feeding one more astronaut and I could not justify reinvention for Apollo purposes. The contract to implement all this went first to Melpar Corp. with Pillsbury as the subcontractor. When costs got ridiculous, the contract was reissued directly to Pillsbury. Dr. Howard Bauman (a microbiologist) and director of research led the Pillsbury team that reduced the requirements to the practice subsequently labeled HACCP. Pillsbury had been one of the subcontractors (for bakery-type items) in Project Gemini so they already had some experience with some of the specifications.

Now you have the full history of HACCP. Incidentally, the U.K. food company Mark and Spencer implemented HACCP before the end of the Apollo program and has an extensive experience with many types of food and yet no one in the U.S.A. has tapped this experience.

Paul A. Lachance, Ph.D.

Professor and Chair

Department of Food Science

Rutgers University

Return to the Food Safety Consortium Newsletter index page.

APPENDIX B

MEMORANDUM

To: Dockets Management Branch (HFA-305)
Food and Drug Administration
12420 Parklawn Dr., rm. 1-23
Rockville, MD 20857

From: Steve H. Hanke, Ph.D.
Professor of Applied Economics
The Johns Hopkins University
Baltimore, MD 21218

and Stephen J.K. Walters, Ph.D.
Professor of Economics
Loyola College in Maryland
Baltimore, MD 21210

Re: "Current Good Manufacturing Practice in Manufacturing, Packing, or Holding Dietary Supplements"--Comments
[Docket No. 96N-0417]
RIN 0910-AA59

Date: May 7, 1997

1. Introduction

The FDA is considering whether to institute rulemaking to develop current good manufacturing practice (CGMP) regulations for dietary supplements and dietary supplement ingredients. This economic assessment is offered in support of comments to be filed with the Food and Drug Administration.

We conclude that the proposed regulations will not produce an increase in public safety--and may even reduce it. In addition, such regulations will lead to a more concentrated, less competitive industry; this will raise prices to consumers and significantly reduce the gains from exchange in this market. Finally, such regulations will significantly reduce research productivity and the rate of innovation in this dynamic industry. In sum, consumers will pay more for a restricted array of products, and in return will receive no greater level of safety from product defects than they currently enjoy. Clearly, regulatory resources are limited; there must be many higher-valued uses of the resources which would be consumed should the proposed CGMP regulations be implemented.

In the remaining sections of this memorandum, we will discuss the anticipated effects of

the CGMP regulations in more detail, supporting our analysis with references to authoritative research. Section 2 briefly discusses the current status of the dietary supplement industry. Section 3 describes the ways in which consumers are protected from unsafe or low-quality goods in unregulated markets. Section 4 summarizes some evidence on how regulation (or, in some cases, deregulation) has affected consumer safety, and offers some forecasts about safety should regulation come to the dietary supplement industry. Section 5 assesses the competitive impact of regulation on market structure and firm conduct (e.g., pricing). Section 6 discusses the impact of regulation on the rate of innovation. Section 7 contains concluding remarks.

2. Brief Overview of the Industry

In its current form, the natural products industry (of which the dietary supplements industry is a part) approaches what economists might call a "competitive ideal." There are many producers, all acting independently, and none exercising appreciable market dominance or monopoly power. There are no artificial barriers to entry. Pricing is very competitive, and the rate of product innovation is admirably high.

Though the natural products industry is large in absolute dollar terms, with natural product sales exceeding $11 billion in 1996, it accounts for only about 2% of the overall grocery market. Nevertheless, sales growth has been a very robust 22% per year since 1991. Dietary supplements (a designation which encompasses vitamins, supplements, natural medicines, and herbs) make up almost 80% of dollar sales at the average small, supplement-focused store, and about 20% of sales at large, natural-products supermarkets; there are currently 6,600 natural/health food retail outlets, about half of which are small (under 2,000 square feet).[1]

The market is expanding rapidly not just in terms of dollar sales, but in the variety of products available to consumers. By one estimate, there were 4,000 to 5,000 new product introductions in the natural products industry in 1995. One major distributor currently carries an average of 15,000 items in its warehouses, and estimates it will need to increase this number by about one-third within the next few years.[2]

Despite the industry's rapid growth and extraordinary rate of innovation, there is no evidence that consumer safety has been compromised. To our knowledge, the only supplement-related public health problem in recent years involved the development of eosinophilia-myalgia (EMS) in association with the ingestion of supplements containing the amino acid tryptophan in

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[1]See: "Market Overview, 1995" and "Market Overview Preview, 1996," *Natural Foods Merchandiser*.

[2]*Ibid.*

1989.[3] EMS resulted in 38 deaths and about 1,500 cases of illness. By contrast, there are approximately 9,000 deaths annually from contaminated foods.

In sum, the market for natural products and dietary supplements appears to be functioning about as well as any real-world market can. The gains from exchange in this market are large and growing rapidly; this growth signals a high level of consumer satisfaction that appears to be a direct function of competitive pricing, strong service, and a most impressive rate of innovation. If it is possible to improve performance in this market--from the standpoint of consumer welfare--it would be very difficult indeed to describe how.

3. Market-Based Safety and Quality-Assurance Mechanisms

It is common to suppose that, absent some sort of regulatory mechanism, consumers will be vulnerable to unscrupulous producers of unsafe or merely shoddy products. It is certainly true that consumers are vulnerable; there are virtually no products about which consumers are as well-informed as are the goods' producers. What is often overlooked, however, is that consumers are aware of their informational disadvantage vis-a-vis sellers, and commonly take steps to assure that sellers have strong incentives not to take advantage of them.

The most important mechanism in this regard is consumer reliance on brand-names.[4] Simply put, a firm's brand-name or reputation serves as collateral--more formally, as a *forfeitable collateral bond*--that will depreciate if consumers are disappointed in the quality of the product the firm provides. Before risking their money (or safety) on the purchase of a product about which they know relatively little (compared to the seller, who likely knows whether the product has actually been produced using "good practice" or not), consumers want to know that the seller has something to lose if the product proves to be of lower-than-anticipated quality. Thus, consumers rationally resist buying the products of "unknown" sellers. Sellers' brand-names or reputations are useful to consumers because, once a name or reputation has been created--often at considerable expense--it is an asset that depends for its value on consumers' continued favorable opinion of the firm. In seeking to maintain the value of their brand-name assets, firms will have very strong incentives to satisfy consumers expectations about product quality and safety.

Many studies have documented that this mechanism works extraordinarily well. For example, in the airline industry, carriers which are responsible for crashes are punished with

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[3]See: Belongia, *et al.*, "An Investigation of the Cause of the Eosinophilia-Myalgia Syndrome Associated with Tryptophan Use," *New England Journal of Medicine*, (August 9, 1990), pp. 357-65, and Kamb, *et al.*, "Eosinophilia-Myalgia Syndrome or Fibromyalgia with Eosinophilia -- A Reply," *Journal of the American Medical Association*, (June 23-30, 1993), pp. 3108-09.

[4]For a more detailed summary of this mechanism, see: Stephen J.K. Walters, *Enterprise, Government, and the Public*, McGraw-Hill Book Co. (1993), New York, pp. 309-312.

significantly reduced patronage and huge equity losses, while crashes which are not the airlines' fault (resulting from, e.g., climatic conditions) suffer no reputational losses.[5] Airlines' brand-name assets are so important to their performance that airline deregulation has not led to compromises in consumer safety.[6] And in the over-the-counter drug market, the tremendous amount of brand-name capital that the Johnson & Johnson Co. had at risk with its *Tylenol* brands led the firm to take strong measures to protect public safety in the aftermath of the 1982 and 1986 poisonings.[7] Of course, the best evidence that the market mechanism is effective at providing safe, high-quality products is the relative scarcity of such events.

Reinforcing and supplementing this quality- and safety-assurance mechanism are private certification agencies and the courts. Private certification agencies, including producers' insurance carriers and a variety of independent information-gathering and bonding agencies (e.g., Underwriters' Laboratories--the familiar "UL" label), help to reassure consumers that firms have "posted a bond" in markets where traditional means of creating brand awareness (commonly, mass advertising) are less useful. And, of course, tort law exists to ensure that firms which sell products that result in harm to consumers will suffer large losses.

The key question which must be answered prior to implementing any new safety regulations is whether the regulations will add anything to these pre-existing quality- and safety-assuring mechanisms. Regulatory resources are scarce; we certainly do not want to squander them where there will be little incremental benefit to the public. And, as a review of the evidence on regulatory performance shows, regulation sometimes has the capacity actually to reduce consumer safety.

4. Regulation and Safety: Retrospect and Prospect

Safety regulation has produced some notable triumphs. For example, if we had done nothing to tighten auto safety standards, it is possible that the number of annual highway fatalities would be about 60,000 rather than 40,000-45,000.[8] But a careful review of the literature on health and safety regulation cannot help but leave one disappointed with overall

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[5]Mark L. Mitchell and Michael T. Maloney, "Crisis in the Cockpit? The Role of Market Forces in Promoting Air Travel Safety," *Journal of Law and Economics*, 32 (October 1989), pp. 329-55.

[6]Steven Morrison and Cliff Winston, "Enhancing the Performance of the Deregulated Air Transport System," *Brookings Papers: Microeconomics*, The Brookings Institution (1989), Washington, DC, pp. 84-99.

[7]Mark L. Mitchell, "The Impact of External Parties on Brand-Name Capital: The 1982 *Tylenol* Poisonings and Subsequent Cases," *Economic Inquiry*, 27 (October 1989), pp. 601-18.

[8]Robert W. Crandall, *et al.*, *Regulating the Automobile*, The Brookings Institution, Washington, DC, 1986.

performance in this area.[9] For example, most studies of the effects of Occupational Safety and Health Administration regulations on occupational illness and injury rates have found *no* favorable effects--though more recent studies have found small improvements in the incidence of minor injuries.[10] Other studies have found no safety benefits of the Consumer Product Safety Commission's mattress flammability[11] and bicycle safety[12] standards.

Most vexing, however, are the studies documenting *negative* effects of safety regulation. One study of the CPSC's "childproof safety cap" regulation found that total poisoning rates were higher than would have been the case absent the regulations.[13] The CPSC's flammability standards for carpets have actually been associated with a doubling of carpet-related injury rates.[14] And an international comparison of mortality data from drug consumption has found that, all else constant, there are more poisoning deaths in countries that rigorously enforce prescription regulation.[15]

The culprit here is what appears to be "offsetting behavior" by consumers. Simply put, consumers--feeling that regulators have "solved" safety problems for them--are less vigilant than they otherwise would be, or modify their behavior in potentially risky ways. The safety cap regulations, for example, led some parents to be less careful about where they stored potentially harmful products, or the caps' inconvenience caused some to leave the caps off entirely; absence of safety caps on some products led some consumers to (erroneously) conclude the products were totally safe. Even where there are net positive effects of regulation on safety,

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[9]See, e.g., Steve H. Hanke and Stephen J.K. Walters, *Social Regulation: A Report Card*, National Chamber Foundation (1990), Washington, DC.

[10]W. Kip Viscusi, "The Impact of Occupational Safety and Health Regulation, 1973-83," *Rand Journal of Economics*, 17 (Winter 1986), pp. 567-80.

[11]Peter Linneman, "The Effects of Consumer Safety Standards: The 1973 Mattress Flammability Standard," *Journal of Law and Economics*, 23 (October 1980), pp. 461-79.

[12]Ross D. Petty, "The Consumer Product Safety Commission's Promulgation of a Bicycle Safety Standard," *Journal of Products Liability*, 10 (1987), pp. 25-50.

[13]W. Kip Viscusi, "The Lulling Effect: The Impact of Child Resistant Packaging on Analgesic Ingestions," *American Economic Review*, 74 (May 1984), pp. 324-27.

[14]W. Kip Viscusi, "Consumer Behavior and the Safety Effects of Product Safety Regulation," *Journal of Law and Economics*, 28 (October 1985), pp. 527-53.

[15]Sam Peltzman, "The Health Effects of Mandatory Prescriptions," *Journal of Law and Economics*, 30 (October 1987), pp. 207-38.

there is evidence of some partially-offsetting behavior by consumers.[16]

The key question in this case is whether the proposed CGMP regulations pose the risk of some offsetting behavior by consumers. We believe they do.

Note first that the dietary supplement industry is one where consumers are generally skeptical of the efficacy and safety claims of sellers; as a result, consumers rely heavily on brand-name capital and the reputations of firms and trusted experts in the field when making their consumption choices. Given the extraordinarily low accidental death rate in this industry, it is fair to say that this safety- and quality-assurance mechanism has worked well.

The proposed regulations, however, are likely to upset this equilibrium. Under regulation, consumers may be more apt to risk purchasing "unbranded" products or the products of "unknown" producers. The idea that "the government wouldn't let them sell it if it wasn't safe and effective" will take root. Of course, regulatory enforcement resources are limited; it will be essentially impossible for regulators to authenticate the claims of all producers. Nevertheless, the *appearance* of oversight by regulators will give a boost to "fly-by-night" sellers; they will no longer need to make heavy investments in brand-name or reputation in order to induce trials by consumers.

Unless the regulatory authority is willing to commit massive resources to enforcement, then, the safety implications of the proposed regulations are, at best, ambiguous. Replacing the market-based safety- and quality-assurance mechanism with a regulatory system that is enforced with less than perfect efficiency may reduce the probability that the products of an established seller are unsafe or ineffective, but will also certainly increase the probability that a consumer will buy the product of an unscrupulous seller.[17] We believe there is a great probability that the latter effect will dominate, and that regulation will have a negative net effect on safety in this market--as it has in several others.

5. Regulatory Effects on Industry Structure and Conduct

The proposed regulations will have unambiguous and negative effects on industry structure and conduct. Since regulatory compliance costs will add to firms' fixed or overhead costs, they will impose a greater relative burden on small firms, which produce smaller volumes

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[16]Sam Peltzman, "The Effects of Automobile Safety Regulation," *Journal of Political Economy*, 83 (July-August 1975), pp. 667-725; Robert W. Crandall and John D. Graham, "Automobile Safety Regulation and Offsetting Behavior: Some New Empirical Estimates," *American Economic Review*, 74 (May 1984), pp. 328-31.

[17]This is because the seller is (a) indifferent to the long-run implications of consumer dissatisfaction when he has little or no brand-name capital at risk, and (b) aware that regulatory enforcement is imperfect, and so the probability of paying a penalty for defying the regulations is less than 1.0.

over which to spread these costs. Thus, the regulations will cause average costs to rise for all, but the increase will be proportionately greater for small firms. As a result, the proposed regulations undoubtedly will tilt the competitive playing field in this industry toward larger firms.

The result will be that the number of competitors in this industry will fall, because smaller firms will be forced out of this market by larger firms which will now have a competitive advantage and because the regulations will raise new barriers to market entry over time. In consequence, this market will move away from its current atomistic structure and will become significantly more concentrated and less competitive; thus, prices and margins will rise and the gains from exchange in this market will be significantly reduced.[18]

Given that the proposed CGMP regulations actually were submitted by "representatives of the dietary industry,"[19] it is quite likely that these effects are well understood by industry insiders--and, indeed, may have motivated the proposals. There is ample empirical research showing that firms sometimes embrace regulation as a competitive tactic. The key here is what economists have dubbed *enforcement asymmetries*, in which regulatory requirements or costs have a disproportionate impact on a subset of firms, leaving remaining firms to enjoy enhanced market demand, diminished competition, and competitive advantage.

The best-known example has to do with the 1977 amendments to the Clean Air Act, in which environmentalists lobbying for regulations to force western public utilities to install smokestack scrubbers found they had some unexpected allies: eastern coal mining companies (and their legislators). The reason was that eastern coal contains about 16 times as much sulfur as western coal; eastern producers knew if they could get Congress to require installation of sulfur dioxide *scrubbers* rather than merely specifying how much sulfur dioxide could be *emitted* from stacks, their cheaper, higher-sulfur coal would be easier to sell. Despite an EPA report noting that *compliance costs and sulfur emissions levels would be higher* under a scrubbing requirement than under a feasible alternative, the requirement passed.[20]

In other industries, EPA and OSHA regulations have been used to protect older, unionized firms in northeastern states from the competition of younger, non-unionized firms in

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[18]For a review of the evidence on the relationship of market concentration to prices and profits, see Walters, *op. cit.*, pp. 186-89.

[19]See "Memorandum of Meeting, Center for Food Safety and Applied Nutrition, Food and Drug Administration," Washington, DC, November 30, 1995.

[20]Bruce A. Ackerman and William T. Hassler, *Clean Coal/Dirty Air, or How the Clean Air Act Became a Multi-Billion Dollar Bail-Out for High-Sulfur Coal Producers and What Should Be Done About It*, Yale University Press (1981), New Haven, CT.

southern states.[21] In some cases, CPSC regulations have been used to protect domestic firms from foreign competition.[22]

Such unwholesome use of the regulatory process--dubbed "predation through regulation" or "predatory use of government" by some economists[23]--damages consumer welfare in two ways. First, as has already been noted, it reduces the gains from exchange in affected markets by raising prices and reducing quantity demanded. Second, it diverts regulatory enforcement resources from activities where they may have a high return to where they have a low or negative return. In this case, there is a very real likelihood that regulatory resources which have the capacity to significantly improve safety levels in food and pharmaceutical markets will be misallocated toward markets where they will, in effect, be used to prop up a cartel rather than enhance public safety.

6. Regulatory Effects on Innovation

There is a wealth of evidence that regulation can have a large negative impact on the rate and timing of product innovations.[24] Such "regulatory lag" has been especially important in the pharmaceutical industry, where, for example, the 1962 amendments to the Food, Drug, and Cosmetic Act have been blamed for a stunning reduction in the rate of introduction of new drugs in the U.S.

Of course, reducing the rate of introduction of new chemical entities was the *goal* of the 1962 amendments; it is commonly assumed that the drugs kept off the market by these regulations were of dubious safety and efficacy, and that, on net, the regulations enhanced welfare. Yet a variety of studies have shown that, in fact, the regulations did not significantly reduce the proportion of new drugs that proved ineffective, and that the absolute reduction in

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[21]Ann P. Bartel and Lacy Glenn Thomas, "Predation through Regulation: The Wage and Profit Effects of the Occupational Safety and Health Administration and the Environmental Protection Agency," *Journal of Law and Economics*, 30 (October 1987), pp. 239-64; B. Peter Pashigian, "Environmental Regulation: Whose Self Interests Are Being Protected?" *Economic Inquiry*, 23 (October 1985), pp. 551-84.

[22]Nina Cornell, *et al.*, "Safety Regulation," in H. Owen and C.L. Schultze, *Setting National Priorities: The Next Ten Years* (1976), pp. 457-504.

[23]See Bartel and Thomas, *op. cit.*, and William J. Baumol and Janusz Ordover, "Use of Antitrust to Subvert Competition," *Journal of Law and Economics*, 28 (May 1985), pp. 247-65.

[24]There is also ample evidence that regulation has contributed to the productivity slowdown in the U.S. For a review of this empirical evidence, see Hanke and Walters, *op. cit.*, pp. 21-23.

the number of effective drugs introduced has significantly reduced consumer welfare.[25]

More recently, research has shown that FDA regulations have differential impacts on pharmaceutical firms of various sizes. Specifically, smaller U.S. pharmaceutical firms had suffered devastating reductions in research productivity as a result of FDA regulations; research productivity also declined for large firms, but the revenue effects of this decline were more than offset by sales gains resulting from reduced competition in this industry.[26] In sum, large firms are willing to pay slightly higher R&D costs as a result of regulation because they know their smaller rivals' R&D costs will skyrocket; thus, the larger firms' profits will be enhanced. The problem is that, in the drug market, consumers will suffer not only from higher prices but reduced availability of therapies. We anticipate that the proposed CGMP regulations would produce similar effects in the dietary supplements industry.

7. Concluding Remarks

We conclude that the proposed CGMP regulations are unnecessary and undesirable. Existing regulatory practice appears to be consistent with an equilibrium in the dietary supplements industry that involves a high level of safety, competitive prices, and a very rapid pace of innovation.

The proposed regulations have, in our view, a very high probability of damaging consumer safety rather than enhancing it. Replacing market-based quality- and safety-assurance mechanisms with apparent regulatory oversight poses significant risks of offsetting behavior by consumers; such behavior could well lead to lower levels of safety and product satisfaction than currently prevails in this industry. In addition, the regulations will undoubtedly tilt the playing field in the industry in favor of large firms, putting smaller firms at a severe competitive disadvantage; this will lead to higher prices, reduced sales volumes, higher profits, and reduced rates of innovation as the larger firms exercise their market power. This will significantly reduce consumer welfare.

Ultimately, we believe this is the hidden motive of the industry insiders who have proposed the regulations. As in many other cases, these regulations have been offered not to enhance the public interest, but to advance the interests of a subset of firms in the an industry where competition is currently very vigorous. Regulatory resources are extremely valuable and have the capacity to significantly improve welfare; it would be an unconscionable waste of these resources to use them to limit competition in this dynamic market.

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March 1997

- RESUME -

GENERAL

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Birth Date: 29 December 1942

Family: Married, 2 children

EDUCATION

1964	B.S.	University of Colorado Boulder, Colorado
1969	Ph.D.	University of Colorado Boulder, Colorado

PROFESSIONAL EXPERIENCE

Academic Appointments

1966 - 1969	Assistant Professor (1968-69) and Instructor (1966-68) Colorado School of Mines Golden, Colorado
1974 - 1975	Visiting Associate Professor Graduate School of Public Policy University of California Berkeley, California
1969 - Present	Professor of Applied Economics (1975-Present) [formerly Assistant Professor (1969-73) and Associate Professor (1973-75)] The Johns Hopkins University Baltimore, Maryland 21218

Private Sector Appointments

1985 - 1995	Vice President and Chief Economist FCMI Financial Corporation Toronto, Canada
1993 - Present	Columnist Forbes New York, New York

1995 - Present	Vice Chairman Friedberg Mercantile Group, Inc. New York, New York
1995 - Present	President Toronto Trust Buenos Aires, Argentina
1997 - Present	President FCMI NZ Financial Corporation, Ltd. Auckland, New Zealand

Public Sector Appointments

1976 - 1980	Member Governor's Council of Economic Advisors Annapolis, Maryland
1981 - 1982	Senior Economist President's Council of Economic Advisors Washington, D.C.
1984 - 1986	Senior Advisor Joint Economic Committee U.S. Congress Washington, D.C.
1985 - 1987	Member Presidential Task Force on Project Economic Justice Washington, D.C.
1990 - 1991	Personal Economic Advisor Deputy Prime Minister The Socialist Federal Republic of Yugoslavia Belgrade
1991 - 1992	Special Adviser on Currency Reform Deputy Prime Minister The Republic of Albania Tirana, Albania
1994 - 1996	State Counselor on Monetary and Financial Issues Republic of Lithuania Vilnius, Lithuania
1994 - 1995	Economic Adviser Office of the President Republic of Kazakhstan Alma Ata, Kazakhstan
1995 - 1996	Adviser to The Minister Ministry of Economy and Public Works and Services Republic of Argentina Buenos Aires

1995 - 1996	Adviser Fundo de Inversiones de Venezuela Caracas
1997 - Present	Adviser to the President Republic of Bulgaria Sofia, Bulgaria

Research Appointments

1972	Research Associate National Museums of Kenya Nairobi, Kenya
1978	Visiting Scholar Centre de formation internationale a la gestion des resources en eau Sophia Antipolis, France
1979 - 1980	Associate Research Scholar International Institute for Applied Systems Analysis Schloss Laxenburg, Austria
1981	Distinguished Visiting Scholar Lund Institute of Technology University of Lund Lund, Sweden
1983	Senior Fellow The Heritage Foundation Washington, D.C.

Other Professional Activities

1975 - 1985	Member Editorial Board Land Economics
1976 - 1979 1985 - 1987	Associate Editor Water Resources Research
1980 - 1982	Economics Editor Water Engineering and Management (formerly Water and Sewage Works)
1981 - 1982	Member Editorial Board Water Resources Bulletin
1982-Present	Member Advisory Board Reason Foundation Los Angeles, California
1982-Present	Fellow The Institute for Humane Studies George Mason University Fairfax, Virginia

1982-Present	Adjunct Scholar The Heritage Foundation Washington, D.C.
1982-Present	Adjunct Scholar The Cato Institute Washington, D.C.
1983-1987	Associate Editor Water Resources Bulletin
1983-Present	Member Editorial Board The Cato Journal
1985-Present	Senior Fellow The Ludwig von Mises Institute Auburn University Auburn, Alabama
1985-Present	Contributing Editor Friedberg's Commodity and Currency Comments
1985-Present	Associate Editor Review of Austrian Economics
1985-Present	Member Academic Advisory Board Atlas Economic Research Foundation Fairfax, Virginia
1985-Present	Member Board of Advisors Pacific Institute for Public Policy San Francisco, California
1988-Present	Senior Fellow Institute for Advanced Strategic and Political Studies Jerusalem, Israel
1988-1993	Member Economic Policy Committee U.S. Chamber of Commerce Washington, D.C.
1988-Present	Member National Advisory Board National Center for Privatization Wichita, Kansas
1988-Present	Member Editorial Advisory Board Privatization
1989-Present	Member International Board of Advisors Carl Menger Institut Vienna, Austria

1989-Present	Principal and Associated Person (Registered) National Futures Association Chicago, Illinois

Other Professional Activities (continued)

1989-1992	Member Board of Review Journal of Economic Growth
1989-Present	Member Advisory Board Competitive Enterprise Institute Washington, D.C.
1989-Present	Co-Editor Policy Studies Institute for Advanced Strategic and Political Studies Jerusalem, Israel
1990-1993	Consulting Editor and Member of the Board of Review Journal of Regulation and Social Costs
1990-1995	Member Board of Directors Acton Institute Grand Rapids, Michigan
1990-Present	Member Pennsylvania Privatization Council Commonwealth Foundation Harrisburg, Pennsylvania
1990-Present	Member Advisory Board The Discussion Club St. Louis, Missouri
1990-Present	Member Academic Advisory Committee Institute for Research on the Economics of Taxation Washington, D. C.
1990-Present	Member Steering Committee The G7 Council Washington, D. C.
1991-Present	Member Advisory Council Centre for Research Into Communist Economies London
1991-Present	Member Scientific Advisory Council International Centre for Research Into Economic Transformation Moscow

1991-Present	Member International Board of Advisors Terra Nova
1991-Present	Member Advisory Council Communist Economies and Economic Transformation
1991-Present	Contributing Editor and Member of the Editorial Board of Advisors The International Economy
1991-1994	Contributing Editor La Gaceta de los Negocios Madrid, Spain
1991-Present	Member Advisory Board Blue Ribbon Commission on the Economic Reconstruction of Cuba Washington, D. C.
1992-Present	Member Advisory Board Privatization Center Reason Foundation Los Angeles, California
1994-Present	Member The Reinventing Bretton-Woods Committee New York
1994-Present	Member Political-Economic Working Group American-Ukraine Advisory Committee Center for Strategic and International Studies Washington, D.C.
1994-Present	Visiting Fellow Institute on International Political Economy The Catholic University of America Washington, D.C.
1994-Present	Forum Fellow World Economic Forum Geneva, Switzerland
1994-Present	Member The Investable Commodity Index Committee Intermarket Management, Inc. Somerset, New Jersey
1995 - Present	Member Academic Board of Advisors International Treasurer
1995 - Present	Member Board of Governors Philadelphia Stock Exchange

1995-Present	Member Board of Directors Maryland Business for Responsive Government Baltimore
1995-Present	Member Board of Advisors The Independent Institute Oakland, California
1996-Present	Contributing Editor El Economista Mexico City
1996-Present	Contributing Editor El Cronista Buenos Aires
1996-Present	Contributing Editor El Universal Caracas

PUBLICATIONS
(See separate listing)

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PERSONAL

Born December 20, 1953, Salem, MA. Married, two children.

EDUCATION

1982: Ph.D., Economics, University of California, Los Angeles
1977: M.A., Economics, University of California, Los Angeles
1975: B.A., Economics, University of Pennsylvania

EMPLOYMENT HISTORY

1993- :	Professor and Economics Department Chair, Loyola College in Maryland.
1986-93:	Associate Professor of Economics, Loyola College in Maryland.
1981-86:	Assistant Professor of Economics, Loyola College in Maryland.
1980-81:	Lecturer in Economics, California State University, Northridge.
1979-80:	Lecturer in Economics, Santa Monica College.
1979-80:	Research Analyst, Kotin & Regan, Inc., Economic Consultants, Los Angeles.
1977-79:	Teaching Associate in Economics, University of California, Los Angeles.
1975-76:	Senior Research Assistant, Dept. of Research, Federal Reserve Bank of Philadelphia.

FIELDS OF SPECIALIZATION

Research: Industrial organization and regulation; economic analysis of law; public policy analysis; privatization; corporate valuation; pricing strategy.

Teaching: Microeconomics (introductory and intermediate); industrial organization; business and government; American economic history; managerial economics.

PUBLISHED ARTICLES

[1] "Reciprocity, Rebating, and Regulation," *Southern Economic Journal*, v. 51, no.

3 (January 1985), pp. 766-75.

[2] "Reciprocity Reexamined: The Consolidated Foods Case," *Journal of Law & Economics*, v. 29, no. 2 (October 1986), pp. 423-38.

[3] "Privatization and Natural Monopoly: The Case of Waterworks," *Privatization Review*, v. 3, no. 1 (Spring 1987), pp. 24-31 (with Steve H. Hanke).

[4] "Effects of Department Size and Organization on the Research Productivity of Academic Economists," *Economics of Education Review*, v. 7, no. 2 (1988), pp. 251-55 (with John M. Jordan and Mark Meador).

[5] "Recent Controversies in the Valuation of Utility Property," *Public Utilities Fortnightly*, v. 122, no. 2 (July 21, 1988), pp. 22-26 (with Steve H. Hanke). Reprinted in *Valuation*, v. 35, no. 1 (January 1990), pp. 28-34.

[6] "Is the NFL an Illegal Monopoly?" *University of Detroit Law Review*, v. 66, no. 1 (Fall 1988), pp. 5-32 (with John A. Gray).

[7] "How Plaintiffs' Experts Can Exaggerate Salary Losses," *The Practical Lawyer*, v. 35, no. 6 (September 1989), pp. 17-29 (with Steve H. Hanke).

[8] "Academic Research Productivity, Department Size, and Organization: Further Results," *Economics of Education Review*, v. 8, no. 4 (1989), pp. 345-52 (with John M. Jordan and Mark Meador).

[9] "Business Climate and Measured Poverty: The Evidence Across States," *Atlantic Economic Journal*, v. 18, no. 1 (March 1990), pp. 20-26.

[10] "Social Regulation: A Report Card," *Journal of Regulation and Social Costs*, v. 1, no. 1 (September 1990), pp. 5-34 (with Steve H. Hanke).

[11] "Academic Research Productivity: Reply, Still Further Results," *Economics of Education Review*, v. 11, no. 2 (1992), pp. 161-67 (with John M. Jordan and Mark Meador).

[12] "Unions and Productivity: Evidence from Academe," *Journal of Labor Research*, v. 15, no. 4 (Fall 1994), pp. 373-86 (with Mark Meador).

[13] "Tax Appraisal in Evolving Industries: An Econometric Approach," *Journal of Legal Economics*, v. 5, no. 2 (Fall 1995), pp. 43-55 (with Steve H. Hanke).

BOOKS, BOOK CHAPTERS, MONOGRAPHS

"Privatizing Waterworks," in Steve H. Hanke, ed., *Prospects for Privatization*, New York: Academy of Political Science (1987), pp. 104-13 (with Steve H. Hanke).

"Social Regulation: A Report Card," Washington, DC: The National Chamber Foundation (1990), 47 pp. (with Steve H. Hanke).

"Privatization and Public Choice: Lessons for the LDCs," in Dennis Gayle and Jonathan Goodrich, eds., *Privatization and Deregulation in Global Perspective*, Westport, CT: Greenwood Press (1990), pp. 97-108 (with Steve H. Hanke).

Enterprise, Government, and the Public, New York: McGraw-Hill Book Co. (1993).

Instructor's Manual for Enterprise, Government, and the Public, New York: McGraw-Hill Book Co. (1993).

"H_2Ownership: Privatizing Waterworks in Theory and Practice," in Gary Bowman, *et al.*, eds., *Privatization of State and Local Government Services*, forthcoming.

BOOK REVIEWS

Review of: Thomas J. Trebat, *Brazil's State-Owned Enterprises: A Case Study of the State as Entrepreneur*, *Southern Economic Journal*, v. 52, no. 2 (October 1985), pp. 593-94.

Review of: Michael B. Katz, *In the Shadow of the Poorhouse*, *Southern Economic Journal*, v. 54, no. 1 (July 1987), pp. 261-62.

Review of: Alan Ehrenhalt, *The Lost City: Discovering the Forgotten Virtues of Community in the Chicago of the 1950s*, *The Freeman*, v. 46, no. 7 (July 1996), pp. 530-31.

UNPUBLISHED WORKING PAPERS, MANUSCRIPTS

"Vertical Market Division: Notes and Cases." Working Paper 87-1, Sellinger School of Business and Management, Loyola College in Maryland.

"Free Agent Sports Franchises and Antitrust: The Raiders Case." Working Paper 88-3, Sellinger School of Business and Management, Loyola College in Maryland.

"Why Is College So Damned Expensive?" Paper presented at the Eastern Economic Association Annual Meeting, March 1995 (with Daniel L. Vazzana).

NEWSPRINT, GENERAL-INTEREST ARTICLES

"Protectionist Illusions," Baltimore *Sun*, Dec. 29, 1982.

"U.S. labor faces tough decisions," Baltimore *Evening Sun*, Feb. 28, 1983.

"Protectionists are coming! Protectionists are coming!" Baltimore *Evening Sun*, Apr. 5, 1983.

"Baltimore becomes one of the '10 poorest'; what went wrong?" Baltimore *Evening Sun*, Apr. 19, 1983.

"We don't need a 'hostile takeover' law," Baltimore *Evening Sun*, June 21, 1983.

"A Baltimore Catholic challenges the bishops' letter," Baltimore *Evening Sun*, Sept. 23, 1983.

"Some unorthodox ideas on the harvesting of crabs," Baltimore *Evening Sun*, Oct. 20, 1983 (with K. Anders).

"Behind bus strike: deregulation," Baltimore *Evening Sun*, Nov. 8, 1983.

"A tale with many morals, but not a moral tale," Baltimore *News American*, Nov. 29, 1983.

"'Equal pay for equal work' isn't that simple," Baltimore *Evening Sun*, Nov. 30, 1983.

"Does the UMW forget its own jobless?" Baltimore *Evening Sun*, Jan. 17, 1984.

"Subminimum wage for Maryland teenagers?" Baltimore *Evening Sun*, Feb. 20, 1984.

"Hostility to teen subminimum wage keeps young people jobless," Baltimore *Evening Sun*, May 23, 1984.

"Reagan's tax cuts successfully defy Mondale's logic," Baltimore *News American*, Sept. 21, 1984.

"Why has Maryland lost 71,000 industrial jobs since '69?" Baltimore *Evening Sun*, Oct. 23, 1984.

"The Bishops on the Economy," *Loyola* Magazine, Spring 1985; *Catholic Review*, July 17, 1985.

"Understanding the S & L Crisis," Baltimore *Sun*, Sunday, May 19, 1985.

"'Limousine liberals' fight to keep tax deduction," Baltimore *Evening Sun*, June 13, 1985.

"Let consumer's skepticism be his protection," *Catholic Review*, Aug. 21, 1985.

"Maryland has bet heavily on unions--and lost," Baltimore *Evening Sun*, Dec. 2, 1985.

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"Baltimore's renaissance: Figures distorted picture," Baltimore *Sun*, Sunday, Aug. 17, 1986.

"Congress will bilk consumers to serve special interests," Baltimore *Evening Sun*, Dec. 3, 1986.

"What Schaefer has to do for Maryland's economy," Baltimore *Evening Sun*, Jan. 15, 1987.

"Daring to challenge business," Baltimore *Evening Sun*, October 5, 1988.

"Takings in Annapolis," Baltimore *Evening Sun*, March 13, 1989.

"Why is gas so high?" Baltimore *Evening Sun*, Aug. 10, 1990.

"The Sky Isn't Falling!" Baltimore *Sun*, Nov. 12, 1991 (with Mark Meador).

"Maryland Will Rise Again," Loyola Institute for Business and Economic Research *Executive Business Outlook*, June 1992.

"Making Cal Ripken richer will not make the rest of us poorer," Baltimore *Evening Sun*, Aug. 28, 1992.

"Though it may be a case of dumb luck, Clinton's plan looks like a winner," Baltimore *Evening Sun*, March 31, 1993.

"Is BUILD trying to tear down?" Baltimore *Evening Sun*, June 22, 1994.

"The NFL: Have money? Will travel," San Diego *Union Tribune*, November 16, 1995; *Newsday*, November 24, 1995; Cincinnati *Post*, December 15, 1995.

Author of over 50 additional articles in metropolitan weekly newspapers.

HONORS, AWARDS, MEMBERSHIPS, APPOINTMENTS

Inducted as Honorary Member, Alpha Sigma Nu (National Jesuit Honor Society), 1987; awarded Loyola College Faculty Research Grants, 1985-87, 1989-90, 1992, and Sellinger School, Board of Sponsors Research Grant, 1988; awarded Smith-Richardson Fellowship in Political Economy, 1980, and California Regents Fellowship in Economics, 1976-77.

Appointed to Maryland Governor's Advisory Council on Unemployment Compensation, 1990; member, American Economic Association and American Law and Economics Association.

SERVICE AS REFEREE

The Journal of Legal Economics
The Cato Journal
The Dryden Press

APPENDIX C

pure encapsulations™, inc.
manufacturers of hypo-allergenic nutritional supplements

May 5, 1997

Claudia Lewis, Esq.
Emord & Associates
by fax to: 202-466-6938

Dear Claudia:

Pure Encapsulations is a manufacturer of dietary supplements in hard shell capsule and bulk powder form.

Our company employs 35 people, and operates from a modern 20,000 sq. ft. facility in Sudbury, Massachusetts.

Pure Encapsulations is privately held. Based on the definitions summarized in section III., Economic Issues (Docket No. 96N-0417), the company is classified as "small."

Pure Encapsulations objects to any proposal which would cause a manufacturer of a dietary supplement to duplicate the scientific testing and validation performed on a dietary ingredient. The manufacturer of an ingredient is in the best position to economically and accurately validate the properties of the dietary supplement ingredients that it manufacturers and sells. Sophisticated testing of dietary ingredients is costly, and is best amortized by having a single set of tests performed on each manufacturing lot, before it is included in a finished dietary supplement.

Small manufacturers of dietary supplements rely on the ability to produce quality supplements in small lots. A small lot could be as low as 25,000 tablets or capsules. The cost to duplicate extensive validation on a supplement which may contain 30 or more ingredients would be prohibitive, anti-competitive and unlikely to produce a result as precise as would be achieved with pre-production validation.

The adoption of the proposed regulations might require Pure Encapsulations to:

1. eliminate up to 35% of our product offerings, or
2. increase pricing, or
3. increase batch sizes.

490 Boston Post Road · Sudbury, MA 01776 USA
800-753-2277 · 508-443-1959 · Fax: 508-443-9664

The cost of eliminating 35% of our product offerings could mean an economic loss of $1.5million - $5.0 million dollars in sales per year. We could also be forced to terminate the employment of 7 - 8 of our manufacturing and clerical staff.

The increase in our pricing to absorb the costs directly attributable to the proposal for supplement validation would range from $0.01 to $0.15 per capsule, or $0.60 to $9.00 per bottle of sixty capsules. Some of our supplements are sold for as little at $3.50 per bottle. The additional costs could mean an increase the selling price by 30 - 200% for some supplements.

The cost to increase our minimum batch sizes would be substantial. The cost would be measured in the increased carrying cost of inventory. The carrying cost could be limited to bank interest, or it could require the infusion of additional equity capital. The amount of additional inventory would range from $500,000 to $1,500,000.

If financed by bank borrowings, if available, the carrying cost is estimated at $60,000 to $200,000 per year. It is not practicable to estimate the cost or assure the availability of equity capital for non-public small companies such as Pure Encapsulations.

Sincerely,

Ray Hamel

Raymond F. Hamel
General Manager

APPENDIX D

Expert Evaluation on the Technical and Economic Burden of the Proposed Rulemaking on Dietary Supplements

Prepared by Lincoln D. Metcalfe and Linsley S. Gray
Alpha Consulting Laboratories, Inc.
Lombard, Illinois

Expert Evaluation on the Technical and Economic Burden of the Proposed Rulemaking on Dietary Supplements

Introduction

This document is in response to the 21 CFR, Ch. 1, FDA, Feb. 6, 1997 notice of proposed rulemaking, "Current Good Manufacturing Practice in Manufacturing, Packing, or Holding Dietary Supplements". The concern of manufacturers with regard to the proposed rule is whether they can meet certain requirements of the rule, specifically those that require considerable analytical and technical effort on the part of all of the manufacturers. Large manufacturers have in-house laboratories with complex instrumentation, and highly skilled human resources that could meet these requirements. A great economic burden would be placed on all other manufacturers who do not have or cannot afford the technical resources needed. This document outlines some of the technical and expense difficulties the other manufacturer would encounter.

Most dietary supplements and ingredients are natural products, are made from natural products, or are a synthesized copy of natural products. These would include vitamins, minerals, herbs, plant and animal extracts, coming from many sources. The variety and concentration range of all the possible ingredients is enormous. The analysis of all possible ingredients down to the PPM range would be a tremendously difficult analytical problem. The more complex the dietary supplement, the more difficult the problem.

The industry is very diverse. Some manufacturers simply repackage material purchased in bulk by bottling, tableting, or otherwise breaking it to consumer usable form. Others may mix several materials which they purchase and then again package it in consumer form. Some manufacturers prepare and purify extracts from various sources to market to others who repackage, but may also sell consumer forms themselves. There are those who synthesize dietary supplement ingredients and must purify them to remove starting reaction materials and byproducts. The potentials for risk are quite different among these various types of manufacture.

Almost every conceivable analytical technique would have to be applied to this problem, when one considers the broad range of available dietary supplements. In general, many of the most common techniques that probably would have to be used will be outlined. Later in the report some specific applications of these techniques will be addressed. Essentially the analytical techniques involved are wet chemical measurements, separation procedures, and identification techniques. Some of these can be accomplished by using ordinary glass laboratory equipment, which is very labor intensive, but may require modern complex analytical instrumentation. The latter instrumentation can be very expensive and requires skilled personnel. The proposed rule for dietary supplements would require chemical analysis of the products. Large companies could meet these proposed requirements with some difficulty and significant expense. Smaller companies would have a very difficult, if not impossible, task to meet them.

A. Classical Wet Chemical Analysis Techniques

These simple techniques may or may not be applicable to complex systems:

1. Volumetric Analysis
   a. Acidimetry and Alkalimetry (Dye Indicator)
   b. Oxidation and Reduction
   c. Potentiometric Titrations
   d. Precipitation Titrations ($AgNO_3$)
2. Gravimetric Analysis
3. Electroanalysis
4. Colorimetry
5. Functional group Analysis

These analytical techniques can be done relatively inexpensively and usually can be performed by a good chemical technician. However, to develop the methodology requires a very skilled analytical chemist. Much instrumentation is available to do these analyses. Automatic titrators typically cost about $20 K. Simple colorimeters typically cost $1-3 K.

B. Separation Techniques

In order to analyze complex materials in mixtures, it is usually necessary to make separations of the materials that are to be determined and follow that by identification and quantification using other techniques. Below are some of the most common separation techniques:

1. Gas Chromatography (organics)	$15-30 K
2. High Performance Liquid Chromatography (organics)	>$30 K
3. Thin Layer Chromatography (only qualitative)	
4. Ion Chromatography (largely inorganics)	>$30 K
5. Macrocolumn Chromatography	
6. Distillation (organics)	
7. Liquid Extraction (organics and some inorganics)	
8. Filtration (organics and some inorganics)	
9. Precipitation (organics and some inorganics)	

These methodologies require a skilled chemist to either develop and run them or to closely supervise their use.

C. Identifying Techniques

Once a substance is separated it must be identified. Once this is accomplished, routine methodology can often be developed, depending on the nature of the chemical. The most common instrumental techniques are as follows:

1. Infrared Spectroscopy (organics and some inorganics)	$25-50 K
2. Nuclear Magnetic Resonance (organics)	$100-400 K

3.	Spectrophotometry (Visible-Ultraviolet)	$7-25 K
4.	Mass Spectrometry (organics)	$100-200 K
5.	Gas Chromatography-Mass Spectrometry	$100-200 K
6.	Gas Chromatography-Infrared Spectrometry	>$50 K
7.	X-ray Spectrometry (inorganics)	$90-200 K
8.	X-ray Diffraction (crystalline materials)	>$150 K
9.	Melting Point (inexpensive but not very specific)	
10.	Atomic Absorption Spectroscopy (elements)	>$25 K
11.	Inductively Coupled Plasma Spectroscopy (low conc. elements)	>100 K
12.	High Performance Liquid Chromatography-Mass Spectrometry	>200-400 K

Most of these techniques require highly skilled specialists. Many would also require investment in computer searchable spectrum libraries, which can easily cost more than $10 K.

Specific Applications of Analytical Techniques to Analysis of Dietary Supplements

The analytical instrumentation and techniques mentioned in the previous sections are not exhaustive but do represent the most common basic analytical procedures used to separate and identify chemicals of all types. How these techniques can be applied to analyze the ingredients of dietary supplements will be addressed.

Common dietary ingredients the FDA is concerned with are listed as follows:

1. Vitamins
2. Minerals
3. Herbs or other botanicals
4. Amino acid(s)
5. Metabolites or extracts of foods, food constituents, herbs, and botanicals
6. Spices
7. Flavorings

Impurities in dietary supplements also concern FDA. These are as follows:

1. Filth (animal feces, insect parts, etc.)
2. Pesticide residues
3. Harmful contaminants
4. Microorganisms (will not be addressed here)

Vitamins

Many analytical methods for vitamins have been developed over the years. The Official Methods of the American Association of Official Analytical Chemists[1] is a primary reference source. The National Formulary[2] is also a good source for some vitamin methods. This document will not address specific methods for vitamins. Vitamins are, in general, extracted from the substrate with a solvent, often after saponification. This is followed by a cleanup procedure. This is usually a column chromatographic step. When the vitamin is isolated, the final analysis, depending on the vitamin, is accomplished by colorimetry, fluorimetry, gas chromatography or high performance liquid

chromatography. These methods require skilled personnel and expensive instrumentation If the sample contains vitamins that must be identified the problem becomes more complex.

If a company knows what vitamins are present, a vitamin assay done in-house requires a skilled chemist and certain analytical instrumentation. The instrumentation usually used for these analyses are liquid chromatographs and gas chromatographs. The instrument costs will be around $60 K. Personnel costs will be approximately $100 K per year per chemist To set up a clean routine control laboratory will cost about $200 K. Preparing and running a single sample will take approximately eight hours at a cost of about $800 per sample, assuming a cost of $100 per hour. Multiple samples run at nearly the same time will reduce this cost somewhat. Total instrument and laboratory costs will run about $260 K plus $100 K for one all-around person. To set up a control lab ready to go would be about $360 K. A single unknown with trace impurities would cost around $1 5 K per sample.

If unknowns and trace impurities are to be determined, then identification techniques will be involved. The instruments and related computer programs would be very expensive. At a minimum a FTIR spectrophotometer (~$30 K) will be required. Nuclear magnetic resonance (NMR) and a gas chromatograph-mass spectrometer combination are often required for this type of work. The instrument cost would be $300-400 K. A research type laboratory for this work would run around $500 K. At least 2 chemists with the right expertise would be needed at $200 K per year. Total setup and personnel costs would be around $700 K

Minerals

Minerals in dietary supplements can be a great number of inorganic compounds, salts, and metals-organic chelates and complexes. The major difficulty with a multi-mineral mixture is determining what cation is originally combined with which anion. If the inorganic salt or salts are few in number the problem can be relatively simple to solve. If the supplement is liquid this can be estimated at best. Most analytical techniques require that the supplement be solubilized which will cause discrete compound information to be lost

The analysis of minerals can be made by classical wet chemistry. However, this can be a slow and tedious process. Several types of analytical instrumentation are used for inorganic analysis that are far faster. X-ray fluorescence spectrometry (XRF) can be used to determine elements even in the PPM range if the best instruments are used. The actual salt used in the sample cannot be determined. For example, if sulfur is found you cannot tell if it is present as sulfate or sulfite. XRF is best used as a screening tool unless you know what you have.

Atomic absorption spectroscopy (AAS) can be used over a wide concentration range, in some instances in the low PPM range. To use AAS effectively one must know the elements present, because only one element at a time can be determined.

The most recent instrumentation for inorganic salts is ion chromatography. Many cations and anions can be quantified. However, when using this technique cations

cannot be determined at the same time as anions. Again, this means with complex mixtures of minerals you cannot tell which cation belongs to which anion. In other words, the actual salt used is difficult to determine. If there are a small number of salts present you can make an educated guess what salt was used in the supplement. In some instances it is possible to reach the PPM range.

In using all the above testing procedures sample preparation and cleanup are usually required[3]. This is often a fairly complex procedure and requires skilled chemists or well supervised skilled technicians and is often quite time consuming.

If identification of specific minerals or other inorganic species is required in a non-liquid dietary supplement, optical microscopy or X-ray diffraction would be required. A skilled chemical microscopist can usually identify discrete particles of inorganics in a sample but measurements are semiquantitative. Sensitivity is limited because individual particles must be located. X-ray diffraction can provide positive identification of inorganic compounds, but complex mixtures make this very difficult and require substantial background in such work. Several percent of a substance must be present for this to be useful.

If samples have five known minerals, an atomic absorption spectrophotometer would normally be used. The instrument cost would be around $30 K with the required hollow cathode lamps. Minimum personnel costs would be $100 K per year. Laboratory, needed instruments, and personnel costs would be around $330 K to start up. Minerals may be done by classical wet chemical methods, but these methods are very labor intensive The time and labor costs involved for the wet methods are prohibitive.

If unknown elements that might be present must be identified, then XRF spectroscopy or emission spectroscopy must be used. These instruments can cost up to $200 K each. Personnel must be specialists with the appropriate expertise and would cost about $100 K per year per person. A laboratory plus personnel would cost around $400 K to set up. Single sample analysis costs would be approximately $500.

Amino Acids

Specific amino acids may be used in dietary supplements. There are some specific wet chemistry tests for certain amino acids[4]. The most common way to determine amino acids is by gas chromatography (GC), high performance liquid chromatography (HPLC) or by amino acid analyzer, which is an ion exchange-based instrument (IX). If gas chromatography is used the amino acids must be reacted to form a volatile, more sensitive derivative which is stable under the temperature conditions used in GC. Because of this GC is the least popular chromatographic method. HPLC and IX chromatography are now most often used for amino acid analysis. Free amino acids can be analyzed directly using these column chromatographic instruments, but again they are often reacted to form products which are more sensitive for detection. If the amino acids are not free, but are part of peptides or proteins they must be isolated or recovered by a series of chemical steps such as saponification, extraction, etc. Two other chromatographic procedures for amino acid analysis are paper and thin layer chromatography These methods are not as accurate as the previously mentioned techniques but they are useful as semiquantitative screening procedures. Their major

advantage is that they are economical to run, although, again, sample preparation and cleanup of complex mixtures may be very time consuming.

Instrumentation costs would be $30 K for an HPLC. An amino acid analyzer would be $50 K Personnel costs and laboratory setup costs would be similar to vitamins and minerals, with a total cost of about $360 K. A single multiple amino acid analysis would cost about $500

Herbs, Botanicals, Metabolites, Spices, and Flavorings

The analytical problem with these natural products is determining their identity and purity. The best control for these possible dietary supplements is the integrity of the supplier There are probably no available analytical procedures to establish the identity, purity, and potency of all these natural products. These products would probably be in powder or extract form and not present as the original plant that could be easily recognized by a botanist or skilled naturalist. There are analytical techniques that could be used in some cases to establish identity and purity. The materials in question would be extracted. A known sample would be extracted identically. The extracts would be examined by some of the following techniques and compared to the known extract.

1. Infrared Spectroscopy
2. Ultraviolet Spectroscopy
3. Thin-layer Chromatography
4. High Performance Liquid Chromatography-Mass Spectrometry
5. Gas Chromatography-Mass Spectrometry

The reliability of the methods would be greatly dependent on the skill and experience of the analyst.

Since no analytical procedures are available to cover these materials, a research type program is necessary. Cost of laboratory, instruments, and personnel would be at least $500 K. Single analyses could run up to $5 K.

Impurities and Harmful Substances in Dietary Supplements

Filth

Filth[5] is generally defined as any objectionable material contributed by animal contamination of the food supplement such as rodent, bird, and insect parts contributed by unsanitary conditions. There is heavy filth that will sink in chlorinated solvents. Examples are rodent and insect excreta, sand, and soil. There is lighter filth that will float in oil-aqueous mixtures. Examples are insect fragments, insects, rodent hair, and feathers barbules There are almost fifty pages of AOAC methodology dealing with this problem. The techniques involved are almost all physical separations such as filtering, sieving, microscopic analysis, flotation, etc. There are some chemical tests for urine. This area appears simple and relatively inexpensive to implement, but considerable skill and experience are required to perform the tests properly.

The major cost is setting up and operating a clean routine laboratory. Personnel costs and laboratory setup costs would be similar to vitamins and minerals, with a total cost of

about $360 K. Equipment costs would be in the$30-50 K region.

Pesticide Residues

The source of pesticide residues in most food products is plant or animal materials. Dietary supplements would probably be no exception. The pesticides are usually organic compounds that contain chlorine or phosphorous. Polychlorinated biphenyls (PCB) and dioxins are also classified in this category. A tremendous amount of research has gone into developing methodology for pesticide residues. Chapter 29 of the AOAC methods[6] is devoted to pesticide residues in foods. Chlorinated pesticides tend to migrate to and reside in fat in animals.

Analysis of these materials usually requires extensive cleanup procedures. These usually involve extraction followed by column chromatography. Thin-layer chromatography can be used to screen for these pesticides. However, Gas chromatography (GC) is the method of choice for identifying and quantifying these compounds. For chlorinated pesticides, GC using an electron capture detector can readily be used to go down to the PPM range. Organophosphorous pesticides usually require a specific GC detector. This is the potassium chloride thermionic detector. A gas chromatograph-mass spectrometer combination may also be used in pesticide work. There are also some spectrophotometric procedures that are useful for pesticide analysis. The chemist involved must be very skilled and experienced. This analytical work is definitely not for a novice.

A well-equipped laboratory would be necessary to run these samples. A gas chromatograph with an electron capture detector would be the minimum instrumentation and would cost about $40 K, and would be higher if the thermionic detector is also required. Laboratory and personnel costs would be about $300 K. Single sample analyses would be about $1 K.

Microorganisms

To determine if microorganisms exist in dietary supplements requires the abilities of a skilled microbiologist The detection of such organisms in the product and the determination of whether or not they are harmful would be in the precinct of the microbiologist. This would likely be of particular importance in the case of herbs and botanicals, particularly of the 'organic' variety which may have been fertilized with feces.

Sample Impact

If we assume a company produces five multivitamin and mineral products and five herbal preparations and completes one lot of each type per day, we can comment on the costs involved, although the costs involved in the herbal testing are very dependent on what information is needed. The company has several choices. They may elect to set up a laboratory and perform all incoming material and outgoing product analyses themselves. They could as an alternative send all or most of the work out to consulting laboratories.

Most companies will probably not want to set up a microbiological laboratory, but will

send out final lot samples before shipping any product. At two lots per day this would cost about $75-100 K per year. These lots would need to be warehoused apart from already tested product for the 7-10 day turnaround on the test. If incoming materials must also be tested, the company may prefer to spend about $260 K to set up a laboratory and incur annual costs of $100-125 K for one microbiologist and supplies.

If other tests are performed in-house, a minimum of three persons would be required at an annual supply and personnel cost of about $340 K. This would come to annual testing costs of at least $650 per lot plus microbiological tests, and could run much more if identification of all herbal components is needed. Laboratory setup costs would be about $260 K and instrumentation costs would be at least $500 K.

If other tests are all sent out, the annual cost would be significantly higher than doing the testing in-house, but the initial investment would not be required.

Overall Conclusion

To meet the analytical part of the FDA document of Feb. 6, 1997 will require a considerable chemical analysis effort on the part of all manufacturers of dietary supplements. Because of the wide diversity of products, no simple set of analytical methodology or instrumentation would be applicable.

The review of the potential methodology and costs are summarized as follows. The least expensive laboratory to set up would a classical laboratory. The setup costs would be $100-150 K. With skilled chemists or technicians the costs of running such a laboratory would be around $100 per hour. A single simple analysis could easily cost $100. A complicated analysis would run up to $1.5 K. Many types of analyses could not be handled by this type of chemical laboratory.

A more sophisticated that could handle many dietary supplements that are made would cost considerably more. Such a laboratory would need separating and identifying instrumentation. this would include chromatographic systems and infrared spectroscopy. This laboratory would cost around $250 K. Hourly costs of the skilled personnel required would run around $150. A single analysis cost would run from $100 to $500.

The most sophisticated laboratory which could analyze almost all samples would run $1-2 M. This laboratory would have GC-MS, NMR, AAS, XRF and other instrumentation. Obviously such a laboratory would need very skilled personnel. Only the most complex samples would such a sophisticated laboratory. The single sample analysis would be $1 K.

With herbs and botanical samples, the last type of laboratory would be needed because standard methods are not available. The inherent difficulty in analyzing such samples could push the single analysis to anywhere from $1-5 K.

References

1. *Official Methods of Analysis*, Association of Official Analytical Chemists, 14th Ed., 1984, 43.147-43.160 pp 850-861

2. *National Formulary*, American Pharmaceutical Association, XIV Edition, 1975, pp 995-1002

3. *Official Methods of Analysis*, Association of Official Analytical Chemists, 14th Ed., 1984, 43 147 p 850 to 43.160 p 861

4. Ibid, 43.218, 43.264, p 879

5. Ibid, Chapter 44, p 887

6. Ibid, Chapter 29, p 533

Statement of Qualifications

Alpha Consulting Laboratories, Inc. was incorporated in August 1992 by industrial scientists. The three partners have broad experience in many facets of industrial problems with considerable background in environmental work. Alpha specializes in non-routine analytical problems, such as product deformulation, methods development, and measurement of trace contaminants.

Lincoln D. Metcalfe

EDUCATION: B.S. Physics, UCLA
B.S. Chemistry, University of Chicago
Graduate Studies in Chemistry, University of Chicago

ACCOMPLISHMENTS:

Responsible for all analytical chemistry, physical chemistry, and environmental and regulatory work in a major chemical company.

Forty-five years of experience in the analysis of fatty nitrogen compounds, including fatty quaternary ammonium compounds (35 publications on fatty nitrogen derivatives).

Expert in non-aqueous titrations, functional group analysis, gas chromatography, TLC, and HPLC.

Invented cleanup system for fatty quaternaries in plant waste water.

Developed methods for trace analysis of many chemicals in different substrates. Developed process for lowering phenylene diamine to *de Minimis* levels.

Directed corporate compliance with TSCA. Involved with inventory, PMN's, 8E(substantial risk), and Section 4(test rule).

Chairman of Chemical Manufacturers Association panel for oleylamine test rule.

Ran FIFRA compliance program.

Involved in design, methods development, sample analysis, and submission of FDA food additive petitions.

Fifty-one publications, nineteen patents, numerous talks.

Member: American Chemical Society, American Oil Chemists' Society, American Society for Testing Materials, Chicago Chromatography Discussion Group, Sugar Industry Technologists, International Standards Organization

Linsley S. Gray

EDUCATION: Ph.D. Analytical Chemistry, Iowa State University
B.S. Chemistry, Beloit College

ACCOMPLISHMENTS:

Responsible for physical chemistry work in a major chemical company. This included most spectroscopy, thermal analysis, microscopy, measurement of properties needed for MSDS, etc.

Thiry-five years experience in identification and analysis of fatty nitrogen compounds.

Served as in-house statistical consultant for experiment design, evaluation, and methods testing.

Performed all statistical analyses on data from all plant process waste streams to identify sources contributing to plant outfall. Data included volumes, times, and compositions.

Identified atmospheric pollutants by infrared analysis of trapped air samples.

Developed scrubbing systems to remove odor components in gases from covered bioponds used to treat process waste streams. Work included trapping and identification of component gasses.

Tested flocculants for clarifying effluent from process waste stream bioponds.

Used GC-FTIR to identify trace odor causing components.

Represented worldwide corporation for over six years on international research-funding panel dealing with the chlorofluorocarbon/ozone issue.

Six publications, one patent, numerous talks

Member: American Chemical Society, American Oil Chemists' Society, Society for Applied Spectroscopy, Coblentz Society, Chicago Chromatography Discussion Group, American Geophysical Union