

WASTE ANESTHETIC GAS EXPOSURES ABOARD LARGE DECK AMPHIBS

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What are Waste Anesthetic Gases?

- The anesthetic gases and vapors that leak into the surrounding room during medical procedures

Common agents used

- Halogenated - Sevoflurane, Isoflurane, Desflurane
- Nitrous oxide

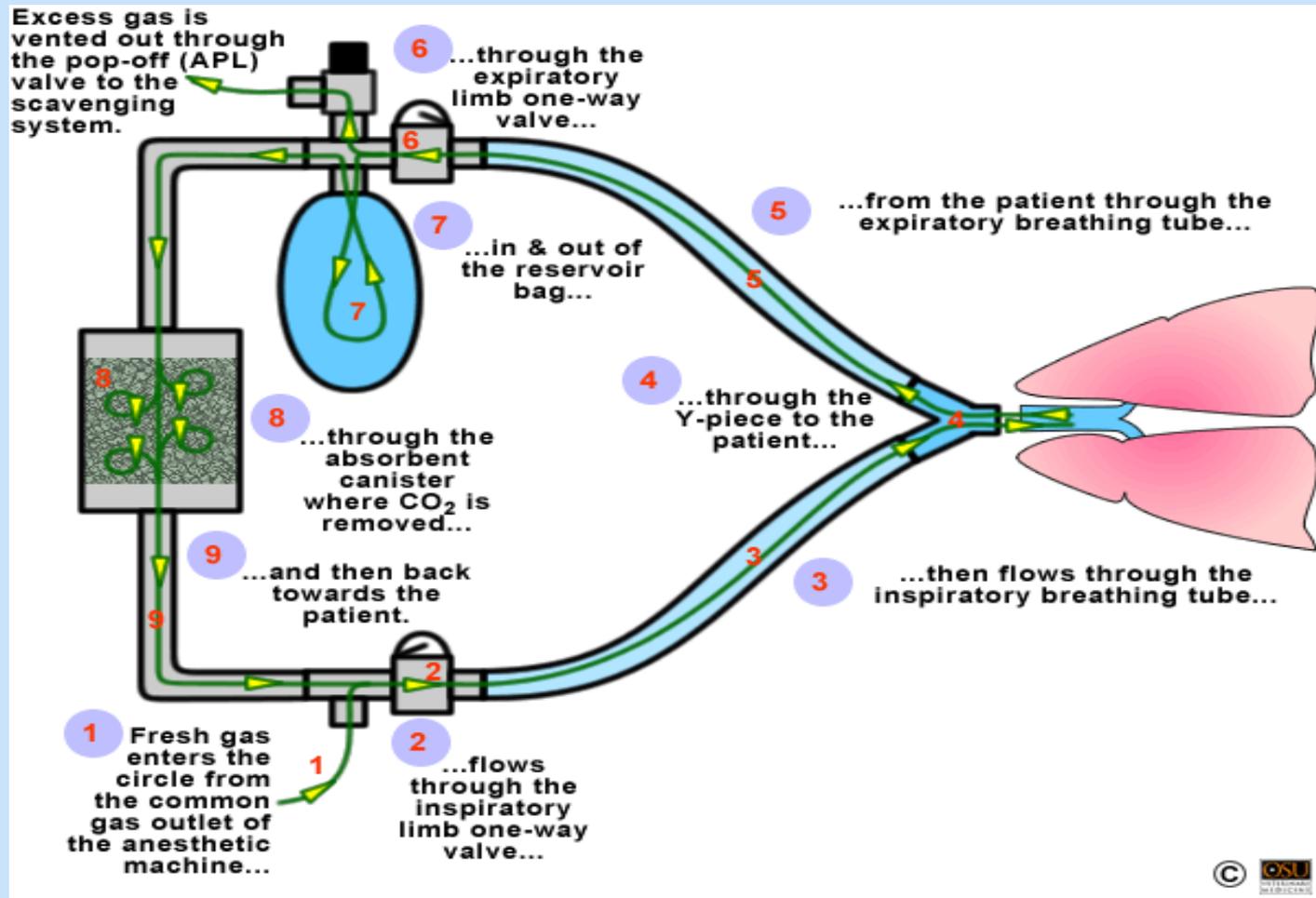
How are they controlled?

- **Method of delivery – masking vs. intubation**
- **Active scavenging system**
- **Anesthesia machine maintenance**

Anesthesia machines

- Nitrous oxide gas is supplied to the anesthesia machines from gas cylinders.
- Halogenated agents are added to the anesthesia machine in liquid form and vaporized.
- Most of the exhaled gas is recirculated through the anesthesia machines back to the patient after passing through a CO₂ scrubber.
- Any excess gas is removed by the scavenging system to the central vacuum system.

Anesthetic Breathing Circuit



BACKGROUND

- **OR's aboard US warships do not currently have active waste anesthetic gas scavenging systems**
- **HVAC Systems are 100% recirculating during surgical procedures**
- **No records have been identified that characterize WAG exposure for shipboard operating room personnel on large deck amphibs - CVNs, LHDs, LHAs**

Shore OR's



Shore Scavenging System

Waste anesthetic gases are scavenged through the central vacuum system



Ship OR's



Ship Scavenging System

Waste anesthetic gases are scavenged through the recirculating HVAC system



Ship vs. Shore



PURPOSE

The intent of this study was two fold:

- 1) To determine waste anesthetic gas exposures for personnel working in the operating rooms aboard ship**
- 2) To determine if there are detectable airborne concentrations of waste anesthetic gases in work areas that share the same air handling unit.**

SAMPLING STRATEGY

- Collect anesthetic gas samples aboard each of the following ship classes: CVN, LHA, LHD
- Collect Personal Breathing Zone samples on operating room staff
- Collect General Area samples – one in the Operating Room and one in a work space off the same HVAC system

ISSUES TO RESOLVE

1. Sampling supplies

- What to use -

Passive badges



- Who will fund? -

NMC Portsmouth IH Dept

ISSUES TO RESOLVE

2. Who will perform the sampling?

- Procedures not generally scheduled
- IH can't deploy with the fleet
- IHO / Ship Safety
- Fleet Surgical Team?

ISSUES TO RESOLVE

3. How to get the samples to the lab within 14 days within days

Certified from the ship?

or

Store in the freezer until return

What did we accomplish?

- **Collected samples 46 samples
(32 Personal Breathing Zone/14 General Area)
from 27 JAN 2010 to 3 JUN 2011**



- **Both Sevoflurane and Isoflurane**



CVN 77



LHD 3



LHA 4



LHD 5

LHD 3 - USS KEARSARGE

Location	Job Title	Sevoflurane results (mg/m ³)	Isoflurane results (mg/m ³)
		10/18/10	02/15/11
MOR #1	CRNA	31	ND
	Surgeon	37	8.4
	RN	37	9.8
	Surgical Tech	31	ND
	Surgical Tech	28	ND
	Surgical Tech		7.1
	General Area	27	14
ICU/PACU	General Area (Post Air Handler)	26	8.4

ND = None Detected

LHD 5 – USS BATAAN

	Job Title	Sevoflurane results (mg/m ³)	
		5/16/2011	6/03/2011
MOR #1	CRNA	23	13
	Surgeon	19	13
	RN	15	11
	Medical Officer	19	
	Surgical Tech	15	9.5
	Surgical Tech	18	13
	General Area	20	24
Med Consult Room #3	General Area (Post Air Handler)	ND	ND

ND = None Detected

LHA 4 - USS NASSAU

Location	Job Title	Sevoflurane results (mg/m ³)	Isoflurane results (mg/m ³)
		01/27/10	4/10/11
MOR #1	CRNA	25	4.4
	Surgeon	21	3.2
	RN	30	3.3
	Surgical Tech	27	2.2
	General Area	32	2.7
Marine Sick Call	General Area (Post Air Handler)	23	1.4

CVN 77 - USS GEORGE W. BUSH

Location	Job Title	Sevoflurane results (mg/m ³)
		02/15/11
MOR #1	CRNA	57
	Surgeon	40
	General area	ND
Medical Common Space	General Area (Post Air Handler)	ND

ND = None Detected

**What do all these numbers
mean?**

PURPOSE #1 Revisited

- 1) To determine waste anesthetic gas exposures for personnel working in the operating rooms aboard ship

Airborne concentration in the OR

Isoflurane Sample Summary

Location	Job title	Sampling Results (mg/m ³)	
		Isoflurane	
		LHD 3 (10/18/11)	LHA 4 04/10/10)
Operating Room	CRNA	ND	4.4
	Surgeon	8.4	3.2
	RN	9.8	3.3
	Surgical Tech	ND	2.2
	Surgical Tech	7.1	
	General Area	14	2.7

NAVOSH OEL: 15.1 mg/m³ Isoflurane

Statistics – Isoflurane

Samples: 9

Results Range: 2.2 mg/m³– 9.8 mg/m³

Sample Results above the OEL: 0

Mean: 5.1 mg/m³

Standard Deviation: 2.6

95th Percentile: 10.4 mg/m³

OEL for Isoflurane: 15.1 mg/m³

Airborne concentration in the OR

Sevoflurane Sample Summary

Location	Job title	Sampling Results (mg/m ³)				
		Sevoflurane				
		LHD 3 (02/15/11)	LHA 5 (05/16/11)	LHA 5 (06/03/11)	LHA 4 (01/27/10)	CVN 77 (02/15/11)
Operating Room	CRNA	31	23	13	25	57
	Surgeon	37	19	13	21	40
	RN	37	15	11	30	
	Surgical Tech	31	15	9.5	27	
	Surgical Tech	28	18	13		
	General Area	27	20	24	32	ND*

- NAVOSH OEL: 16.4 mg/m³ Sevoflurane

Statistics – Sevoflurane

Samples : 21

Results Range: 9.5 mg/m³- 57 mg/m³

Sample Results above the OEL: 14 (67%)

Mean: 24.5 mg/m³

Standard Deviation: 11.8

95th Percentile: 48.4 mg/m³

OEL for Sevoflurane: 16.4 mg/m³

PURPOSE #2 Revisited

2) To determine if there are detectable airborne concentrations of waste anesthetic gases in work areas that share the same air handling unit.

Airborne concentrations in work areas that share the same air handler

General Area Sample Summary

Location	Sampling Results (mg/m ³)						
	Sevoflurane					Isoflurane	
	LHD 3 (02/15/11)	LHD 5 (05/16/11)	LHD 5 (06/03/11)	LHA 4 (01/27/10)	CVN 77 (02/15/11)	LHD 3 (10/18/11)	LHA 4 (04/10/10)
Operating Room	27	20	24	32	ND*	14	2.7
Room - post air handler	26	ND?	ND?	23	ND*	8.4	1.4

NAVOSH OEL: 16.4 mg/m³ Sevoflurane
15.1 mg/m³ Isoflurane

How do results compare to shore facilities ?

Location	Job title	Sampling Results (mg/m ³)				
		Sevoflurane				
		LHD 3 (02/15/11)	LHA 5 (05/16/11)	LHA 5 (06/03/11)	LHA 4 (01/27/10)	CVN 77 (02/15/11)
Operating Room	CRNA	31	23	13	25	57
	Surgeon	37	19	13	21	40
	RN	37	15	11	30	
	Surgical Tech	31	15	9.5	27	
	Surgical Tech	28	18	13		
	General Area	27	20	24	32	ND*

What did we learn?

- 1) **There are concentrations of waste anesthetic gases (Sevoflurane) above the NAVOSH OEL in the ORs and in spaces that share the same air handler during surgical procedures – both PBZ and General Area**

Sevoflurane revisited

Sevoflurane Sample Summary

Location	Job title	Sampling Results (mg/m ³)				
		Sevoflurane				
		LHD 3 (02/15/11)	LHA 5 (05/16/11)	LHA 5 (06/03/11)	LHA 4 (01/27/10)	CVN 77 (02/15/11)
Operating Room	CRNA	31	23	13	25	57
	Surgeon	37	19	13	21	40
	RN	37	15	11	30	
	Surgical Tech	31	15	9.5	27	
	Surgical Tech	28	18	13		
	General Area	27	20	24	32	ND*
Room - post air handler	General Area	26	ND?	ND?	23	ND*

What did we learn?

- 2) In areas where waste anesthetic gases can be exhausted off the ship (CVN 77) - General Area concentrations are less than detectable both in the OR and in rooms on the same air handler

CVN 77 - Revisited

Location	Job Title	Sevoflurane results (mg/m ³)
		02/15/11
MOR #1	CRNA	57
	Surgeon	40
	General area	ND
Medical Common Space	General Area (Post Air Handler)	ND

ND = None Detected

What did we learn?

3) Isoflurane results were consistently lower than Sevoflurane

WHAT'S NEXT

**Turn data over to NAVSEA and BUMED
and let them figure it out**

QUESTIONS?