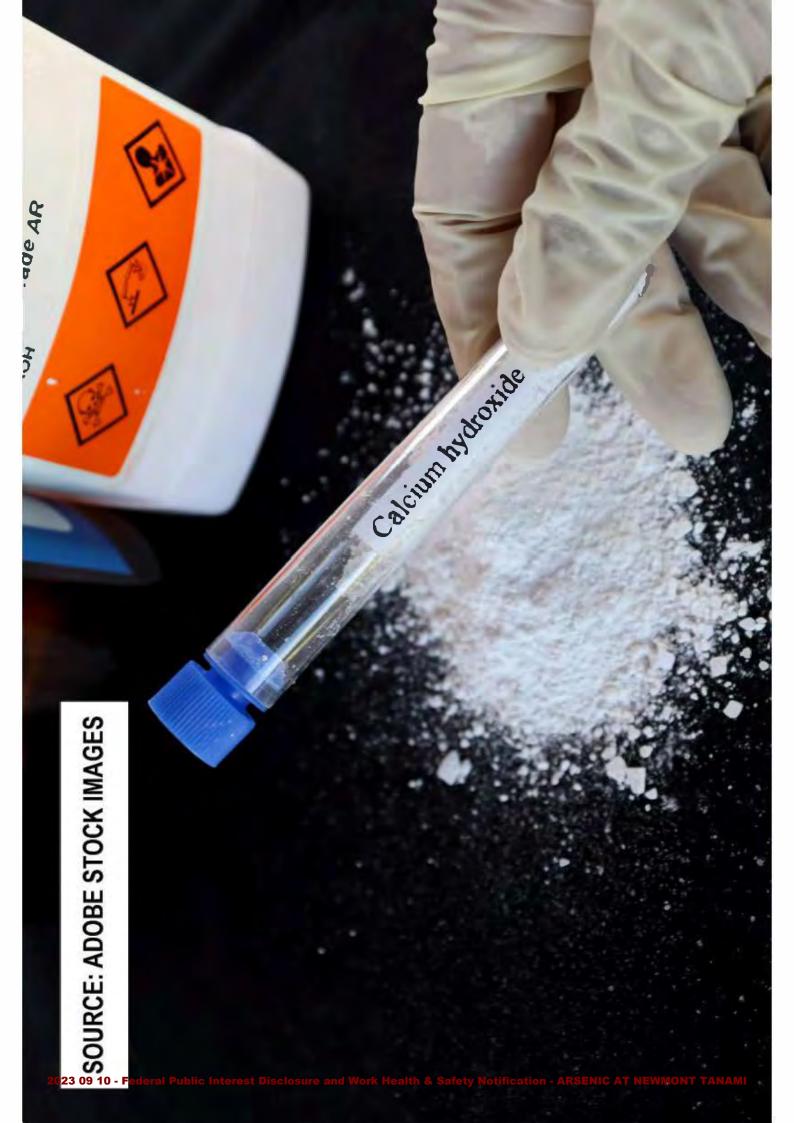
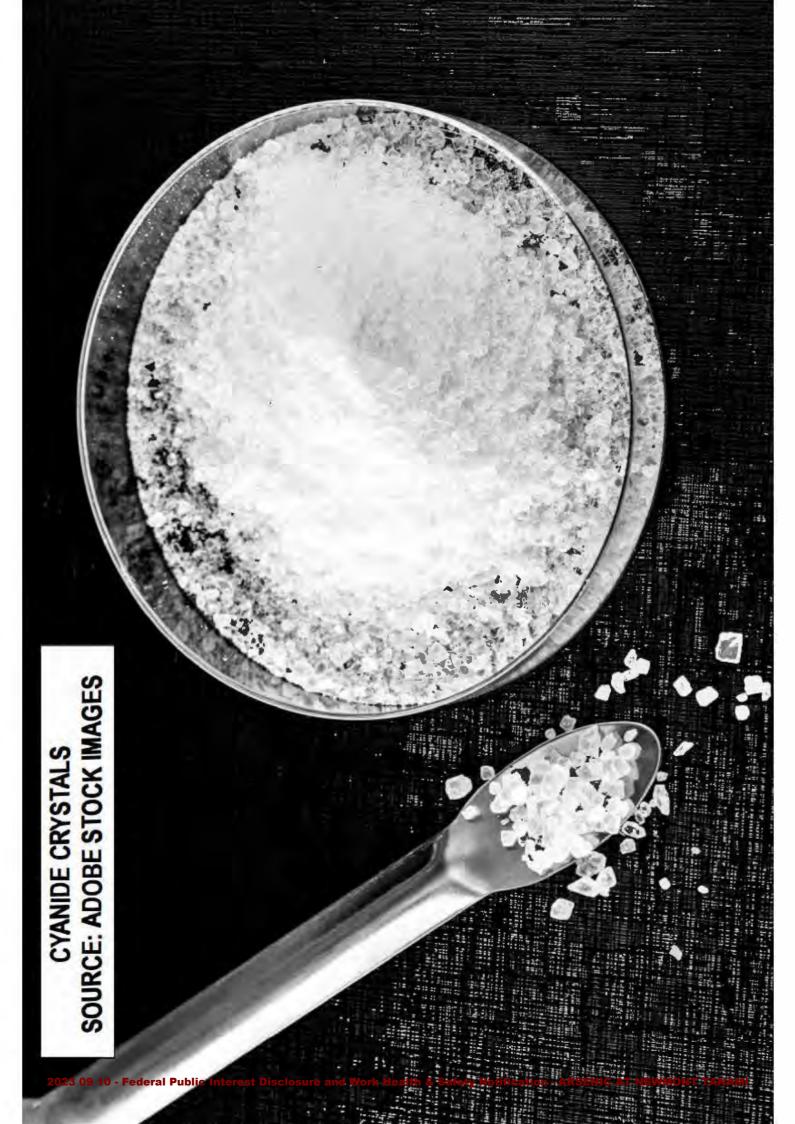
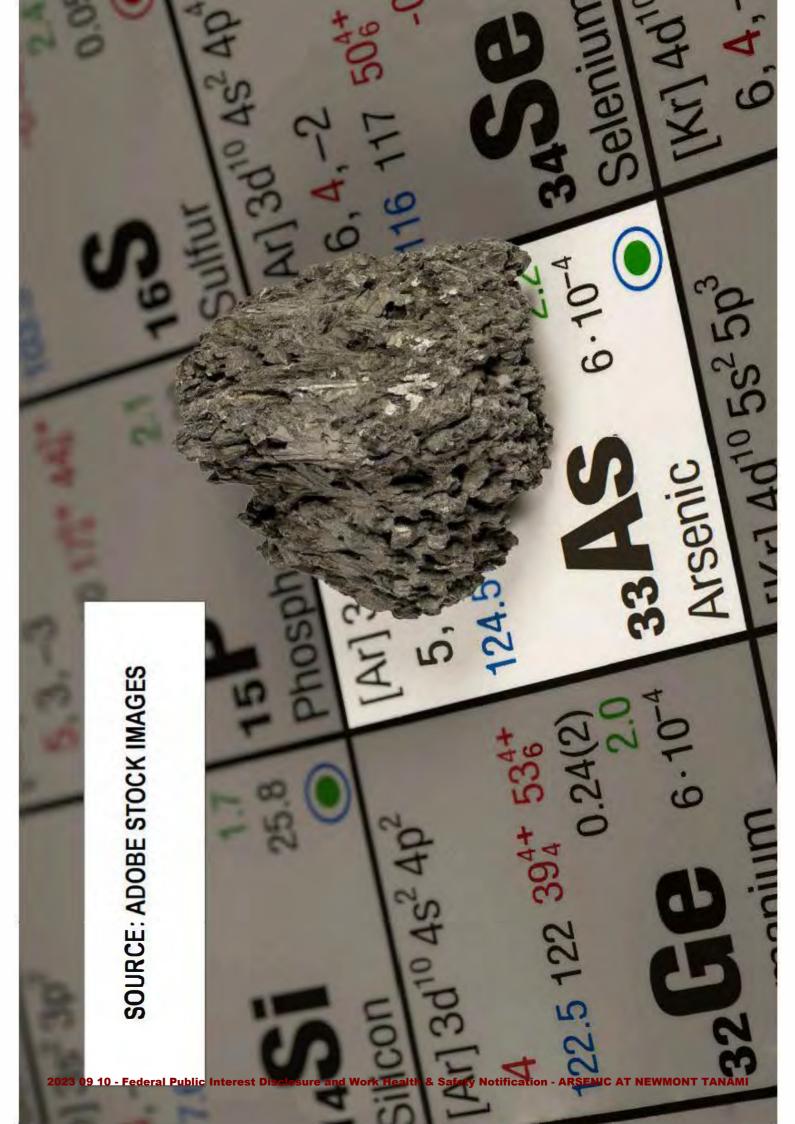
EXHIBIT B

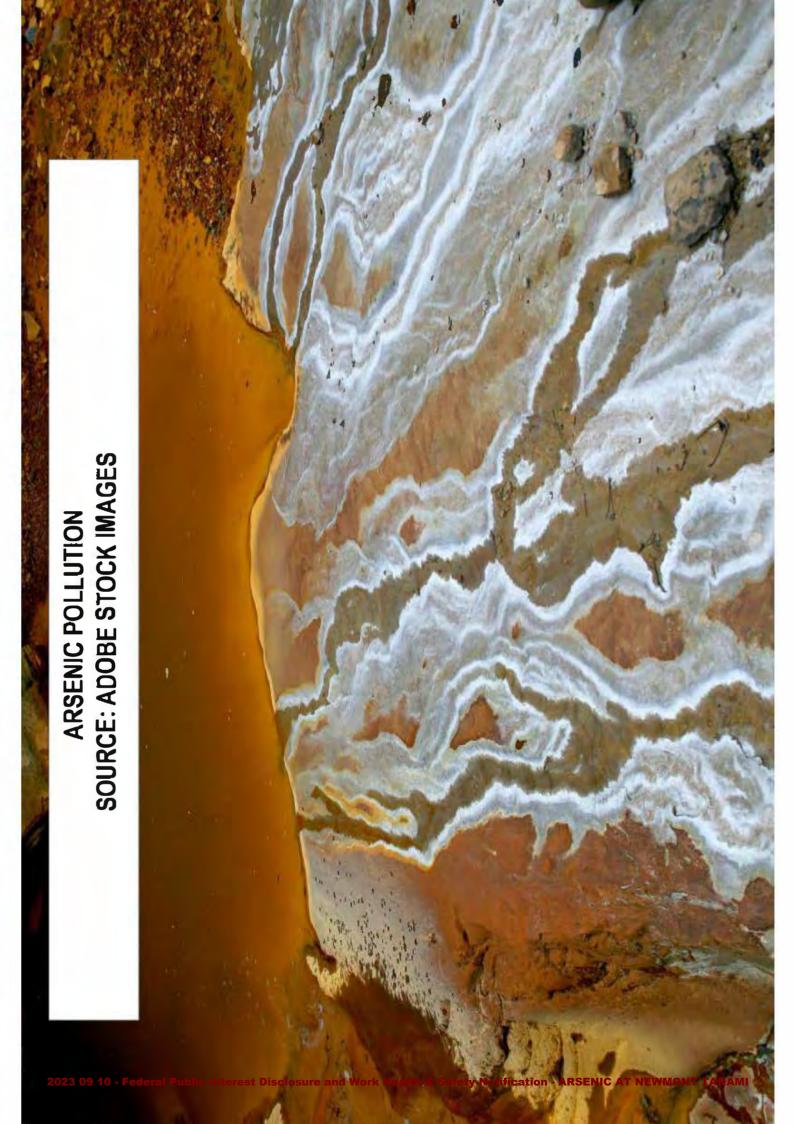
CONTROL IMAGES SOURCED

FROM ADOBE STOCK IMAGES









### **EXHIBIT C**

**IMAGES FROM SITE** 

NEWMONT TANAMI OPERATIONS: DEAD BOLLOCKS SOAK GRANITES



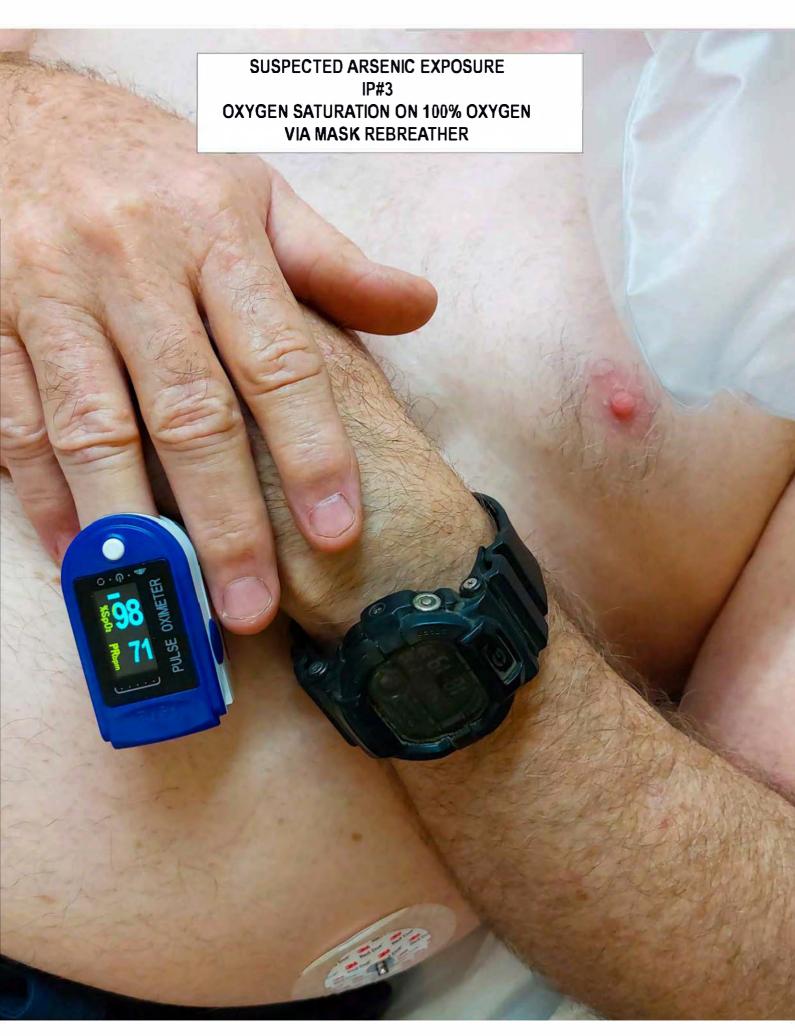








2023 09 10 - Federal Public Interest Disclosure and Work Health & Safety Notification - ARSENIC AT NEWMONT TANAMI



### **Exhibit D**

**Presentation - Critical Presentation Suspected Arsenic Exposure** 

Case Type		Q	Classification		Q
Incident Details					
Jurisdiction		Q	Occupational	4)	
Date Injured	yyyy/mm/dd		Time injured	1815MM (2.4h)	
			Cannot Determine Time of Event		
Injury			iliness	٥	
Illness Type	O Skin Disorder O Respirator	y Condition () Poisonir	ng () Hearing Loss ()	All Other Ninesses	
Lose Consciousness	0		Noorlestick		
First Day Out	уууу/mm/dd				
Reporting Information					
escri tion					
What was the employee doing just before the incident occurred?					
What happened?					
What was the injury or illness?					
Where the event occurred?					
What object or substance directly harmed the					
employee?					
Treatment Information					
SHA					
WC Clauru/Regart Information					
mpjovee Work Denio graphic					
Nature Of Injury					
Nature Of Injury	Part Of	Body	Side Of Body		Primary
Vital Date Vital Time	Practitioner Ht Wt BMI Tel	mp S8P DBP Arm	Cuff Size Position	HP PP COOR W	

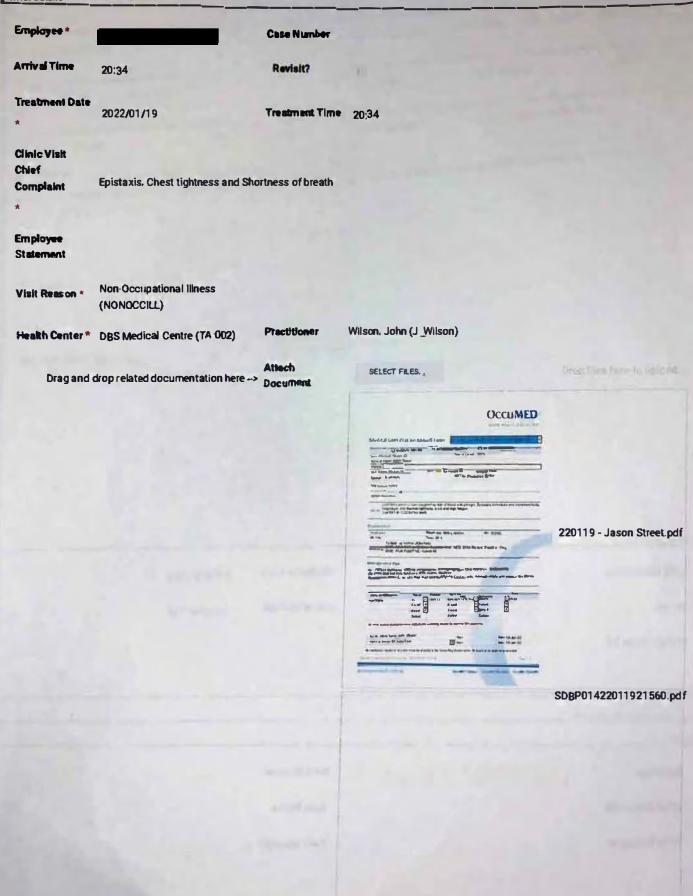
Care Type

Indicators

		Vital Signs	s										
	Đ	Height											
		Weight											
		ВМІ											
		Blood Pres	ssure (sys	tolic/disatoli	c)								
		Pulse											
		SP02											
		Waist Circ	umferenc	e									
	0	Hip Circum	nference										
		Pain scale	0-10										
		Fingerstick	k Blood G	lucose									
No	tes												
	Date	Time	Notes								Signed?	Practitioner N	lame
						-	undergro	ound complaini	ing c	of blood nose, coughing			
			0/a patie	ent C/o sob, t	ightness i	n chest rapid	d rise in te	mp and legs fe	eelin	g heavy.			
				-	ent to do	ctor Low for c	onsultati:	on - initial RFDS	S ret	rieval considered and			
			Body cod	oling and ora	l hydration	1							
	2022/01	/19 20:30	Troponin	test-negati	ve							Wilson, John	
			PCR - po	sitive Covid-1	19								
			Cardiac s	symptoms cl	eared and	ods stabilize	d over 3	hours with trea	atme	nt.			
			Covid syr	mptoms stre	ngthened -	- Header He, s	हर ग्रामाहि <b>अ</b>	ches and fever					
			Doctor Lo	ow and MRA	СС ћарру 1	with onsiक्ष	i i ment.						
			Pt require	es Cardiac ck	earance fo	or RTW.							
ller	gjes												
	Allergy	Da	ite	End Date	6	End Allergy F	Reason			Problem List Flag		Notes	
ledi	cations												
	Medication	on	Start Dat	e <b>E</b> n	d Date	End Me	edication	Reason		Practitioner	Signe	d? Note	es.
roc	edures	Melght											
D.C.I		e Code	P	rocedure Des	scription		Practi	tioner	Pro	ocedure Date	Cost	PrivateData	
000		otion			Doc	cument Type		Document Da	ate	To Be Reviewed/Appro	ved By Rec	eived From S	igned'
	Authori	ty to Releas	e Medica	IInformation		rkers Compe ierwork	nsation	2022/02/11					
	Visit Do	c - Non-Occ	cupational	Illness	Inju	ry Report		2022/01/22					
	Visit Do	c - Non-Occ	upational	Mness		ry Report		2022/01/22					
		c - Non-Occ				ry Report		2022/01/22					
					,51	,			_				

### Clinic Visit

### Arrival Details



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- confidential Interest	
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Brawierge Time HH:MM (24h)	
- M AA	
Follow Up Date yyyy/mm/dd	
	CHEER CT. Show like \$1.6.04  CHEER CT. Show l

Q

Q

Case Status

Case Manager

Discharge Details

Status

Notes

Details

Employee \*

Chief Complaint

Case Managed

**Duty Disposition** 

Status Notes [+]

Employee Work Demographic

Workers Comp Claim Forms Part A&B +  MCRF + additional information		Workers Compensation Paperwork 2022/02/10						
etters								
Letter Code		Created Date		Draft				
Referrais								
Refer To Referral Type	Appointment Date	Appointment Time	Nature Of Injury	Part Of Body	Side Of Body	Case Number		
estrictions								
Restriction	Start Date	End Date	Permanent	Occupatio	nal	Notes		
bsences								
Absence Status Code	Start Date	Lost Days	Restricted Days	Short Terr	n Disability (STD	)		
Ansence Status Code	Start Date	LUST Days	nestricted Days					

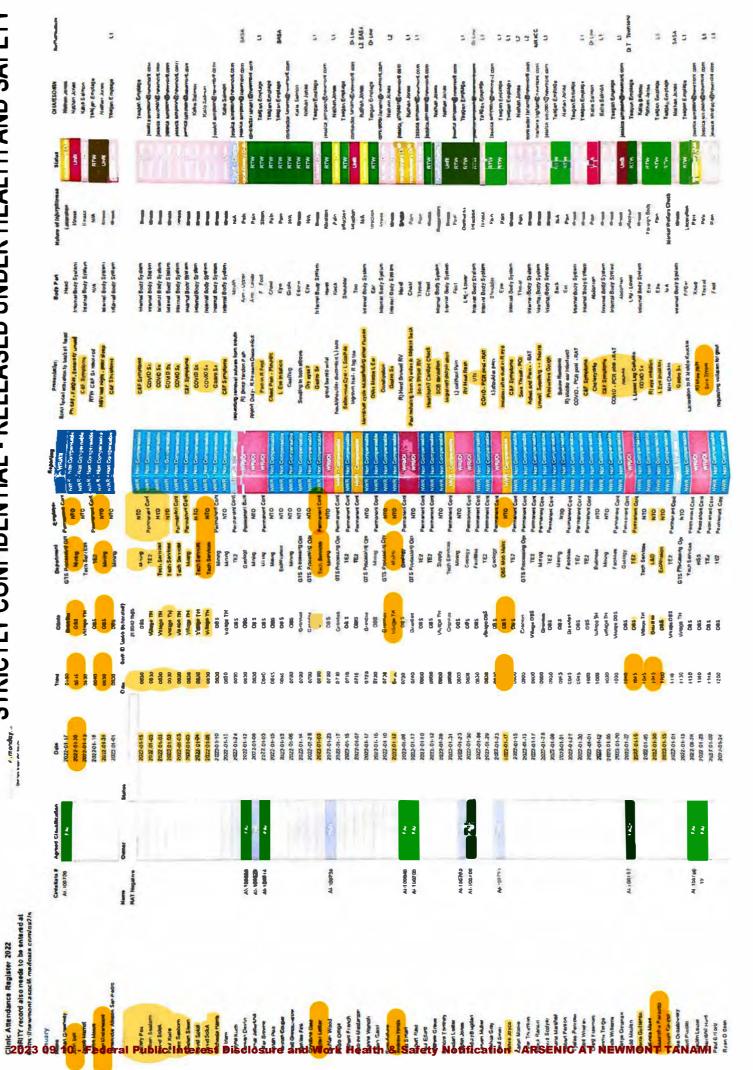
Case Number Medical Description Assessment Outcome code Assessment Outcome Number Assessment Outcome Date End Date Pre Existing 1

### **EXHIBIT E**

### NEWMONT TANAMI OPERATIONS DEAD BOLLOCKS SOAK GRANITES

HISTORICAL CLINIC PRESENTATION SUMMARIES

## STRICTLY CONFIDENTIAL - RELEASED UNDER HEALTH AND SAFETY



### SASA Or Townson 3 2 8 2 2 9 9 - sepanEmptage Tengan Englage Head, Infernal Body System Ear (ritemal Body System Heard Chair Internal Body Syden Ear Hard Internal Body System Internal Body System Heast Elbon Finger - Indox Hoast Body Hoast, Body Internal Body System Internal Body System Leg - Lower Chest. Back Shoulder Jegusal for Voltaron Gar-Plantar Fazculta aptever - Purmy Name, Mehvillage Eye STRICTLY CONFIDENTIAL - RELEASED UNDER HEALTH AND SAFETY R.T.V. - Givi ading path & larger Minuteshor RTNY - Gild eileg pain & lorgol Mediceliar vice on diferent cough symp miss Ingoing left arm numbrase 77TOS Sabacenus Cyd - L Scapule R) Ear Infection MINE PUB HEADECHE FOR benied R) ays. Hasslache, mid 1) Knod Swelling/Pain Others River Labbration behind R Ear operated Varioun Inhelet A Fauchos, PCR Negative Swoten glandware throat Habdarder, Beckeche L Ettow Burelle Spret Noted - Neg R.K. abor or ion L Indox Finger Medal bor Blocked L) ear Ripland Bulled Hostleche, Bacheche CLF Symptoms Sove Twost Insed Biller Nosting, Const pellor AND Chast P. W. COVID Se Tenne L. Knee RV COMD Se Gastro Sa Tines both feet Lecareton Pempengal Cont Personal Cod Personal Cod Personal Cod emened Cort Pemeren Con Gaslogy Permanent Con-luktory ATD 1E2 Permanent Con-Miking MTO 6 pt Presenting STW 1ech Services ATO 1ech Services ATO 1gc Presenting Conmanen Con smared Con Permanent Cort emanes Con NTO DBS MobMam D&S FP Mant TE2 CTS Processing Op DOS WILL PAR Vilege TH Valege TH Valege TH Genvies OBS 7022-01-16 7022-01-09 7022-01-02 3022-01-14 02-10-201 01-10-ZX 3022-01-19 7022-01-10 2022-01-23 7022-01-78 3022-01-10 15-10-200 202 -01-20 \$1.10-505 702-01-13 3057-01-06 7022-01-19 7022-01-21 (1-10-2202 01-10-200 2022-01-06 10-10-2202 2022-01-28 2022-01-02 7022-01.17 15-10-505 \$11.10 200 2022-01-25 2022-01-28 2022-01-08 21-10-220 2022-01-10 81-10-202 PG22-01-70 2022-01-19 2022-01-12 01-10-220 202-01-19 11-10-202 IVO ā ALTOCHS Al-1006Ae 2 100 43-10003 ALT DE/UF No Start Paul Smith Typina Payria Safe A Semp Farms AND Town Bear Adres uso Keen Frach Challenge No Merch Fraden Red ores hous MC CAN

### STRICTLY CONFIDENTIAL - RELEASED UNDER HEALTH AND SAFETY

Clinic Attendance Register 2022

Minor abrasions & lendemess to L chest Hand, Knee. Face, Chest Ila de attos a youth. Internal Body System Internal Body System Internet Body System ntamal Body System nternal Body System Plernal Body System Internal Body System Finger - Thumb Finger - Thumb Finger - Thumb Leg - Lower Arm - Lower lag-tower Lag - Lower Lag- Lower Shoulder Hand Mouth Mouth Shoulder Back Wrsl Kne Hand Ankte Head Hand Toe 70B Head Head Eye Š NWR-Non Compensable CIVID ve RAT, Headeche, Sinus & lethergy, (L) Eye Red Circular "Floater" in Vslon N. L. VIED Leithergy Post ? Expans Approx. 2 cm dlameter heat resh (R) Call Strain/Enar post Cramp Swelling and Pain-L Big Toe RFlank Pain - ? KidnayStona R Flank Pain . ? KidneyStone Offstle wound become infected Dressing Change post MVA review of R) thumb national chariga of drassing to R) be minor abrasion to R) hand Blood in uras, abdo pain review of R) thumb nall common cold symptoms Post brief d'azy spell Lower Back Pain Musculoskelelal Rash to lower lags R) thumb nellpain R) abow swelling Lower Back Pain R) shoulder pain Morning sickness **Feteheallhconsult** R) knee swelling L) lower leg rash Presentation R Eye Smitallon personal Issue L) shoulder palls Chemba Bum R) wrist pain COVID Sx MH Checkin WI Checkin L) hip strain? COVID SK **BPCheck** TMJ pain TMJ pain Migraine Mgraine NWR - Non Compensable WR. Non Compensable WR . Non ComPersable Permenteral Cont NWR - Non Compensable WWR - Non Compensable NWR - Non Compensat Permanent Cont NWR - Non Compens Joalin & Wellness WWR - Compensal NWR - Non Compe WRUOI WRWO. Permanent Cont ermanem Cort Permanent Cont Permanent Cont Permanent Cont Permanent Cort Permanent Cort Permaneni Cont Permaneni Cont Pennanery Cont Permanent Cont Permanent Cont STS Processing Ope Permanent Cort Permanent Cort Permanent Cont Permanent Cont Permanent Cont PermanentConf Permanent Cont Permanent Conl Perma nent Cont Permanent Corri Permanent Cont Permaneni Cont Permanent Conf Permanent Cont 37S PiocessingOp: \_\_armanen\_\_con OIN 2 0 STW 210 2 3TS Processing Ope STS Processing Opt STS Processing Ope OBS Mcb Maint UBS MOD Main OBS Mob Maint DBS Nob Maint OBS FP Waln Department OBS Mob Maril Exploration GTS FPM Geology GTS FPM Mining #Aning Frojects Facilities Geology TE2 HSS Geology Business Geology Geology Projects Gaology Similar WA TE2 Village CBS 700 VAINAGE DBS 1. C Granies Grantes Grantes 88 BB Grantles Ganiles Granles Geniles 088 3 į, 3 89 088 DBS 088 88 88 88 100 0630 2022-02-02 to 2022,02.11 2022-03-03 2022-02-02 2022-02-02 XX22-02-02 2022-02-02 2022-02-02 2022-02: 03 2 02202 2022-03 2022-02.03 202202 2022-02-04 2022-02-04 2023-02-05 2022-02-05 2022 02:05 2022-02 05 2022-0205 2022 02-02 022.02-02 2022-02-02 2022-02-05 2022 02:05 2022-02-05 2022-02-06 20220206 2022-02-06 202202-07 2022-0207 2022-02-08 2022-02-08 2022-02-07 2022-02-09 2022-02-09 20 22 02 08 2022.0 2.09 2022-02-09 2022.02.10 2022-02-10 2022-02-10 2022.02-11 2022-0211 2022-02-11 2022-02-11 2022-02-11 2022-02-11 Cintellate # Agreed Classification Pandrig FA AI-106836 OCORITY record also needs to be entered at Whites://newmontasoci6.medgate.com/ox2/se restopher Smilhers alien Burmesiler MAngelina ARKELL Jason ROBBINS alen Bumester aten Bunnester 66 February COLL STORMS Manga Phili ps AVIS. Thomas Bruiter ANGEL Wem Rudolph Paler Boorman Auslin Jointee amon Bannon Brian Ruxton Jack Donnally Robbie Scott Craly Bernett who make Iyan Cameron **Byan Cameron** anna Davies Da vid Baker Adam Street WOODB Tyris Kobi Scall **N**cola Tyris ane Buller WHITE AUTHOR Randee Flink Cicobi Scott Pobent Reid arc Roma Name 10

# STRICTLY CONFIDENTIAL INFORMATION - RELEASED UNDER HEALTH AND SAFETY

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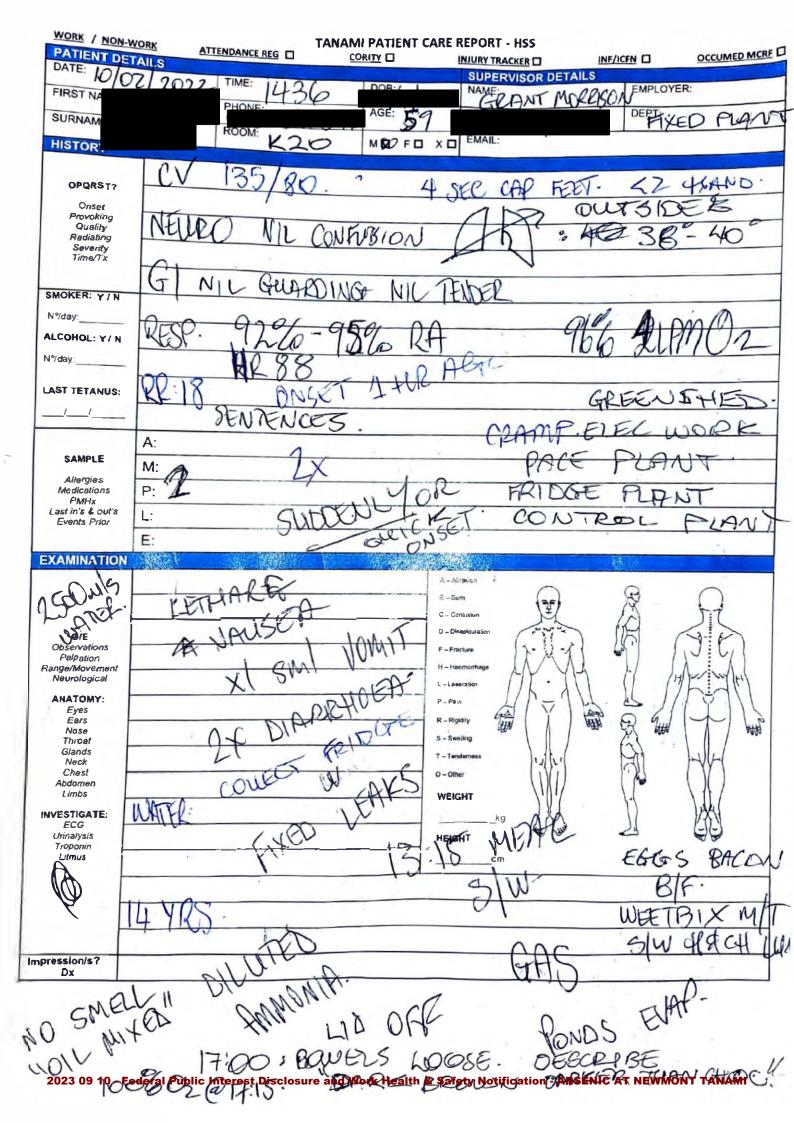
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### **Exhibit F**

### Patient Case File Suspected Arsenic Exposure



### **TANAMI PATIENT CARE REPORT - HSS**

MEDICAL	100	chii	VAIO	(A) []	Pa-1	TU	A-1191	PC17	100	'y <del>\</del>	7	NO	TI
CONSULT		July 1	4	-F.1	VC	1 1	TITE		7		ONT		
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							WAI	CF			00		WATE
TIME (24h)	S & OBSERVATI		PUPILS	PULSE				-	1	1			will
: Q	VERBAL MOTOR	TOTAL L	R +1-	rate/min	ВР	REFILL	Colour/Temper		RESP rate/min	8p02	PaO2 limin		BGL TEMP
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: MEDICATIO	W & EL LUD ADW	NO STATE OF SHIP					4-4						
TIME (24h)	N & FLUID ADMI	THE RESERVE OF THE PARTY OF THE	DONE   ROU	AUTH	IORISA XX	*HAUTING	A SIGNATURE	AMO	OUNT		WITNESS		SIGNATURE
TEAN	1b:35	1		V			1	e,	JA	2	500	OLE	R
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ATT 2022				
-1/6)//	TIME:	DOB:	SUPERVISOR D	ETAILS EMPLOYER:
- Cu	PHONE:	AGE:		DEPT:
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19:24 NIL	2: 9 71 12 COMPU	8% (W) +41R. +0/80 41NTS.	00%07	
BREC	Ţ			
M: P: L:				
JE:				
			A - Abrasion  B - Burn  C - Contusion  D - Discolouration  F - Fracture  N - Fracture	
	P:	19:20: 9 71 12 NIL COMPU  BRETT.  A: M: P: L:	19:20: 98% (2)   7H+1R.   140/80   NIL COMPUNITS.   A: M: P: L:	ROOM:  MO FOXO EMAIL:  19:20: 98% @ 100% @ 7HHR.  140/80  NIL COMPAINTS.  A:  M:  P:  L:  E:  A-Alradon  G-Containen  J-Da coloration  F-Fraction  F-Pan  R-Registry  S-Swelling  T-T-markens  G-Other  WEIGHT  kg  HEIGHT

Arrival Details					
Employee *			Case Number	8361	
Arrival Time	14:36		Revisit?		
Treatment Date *	2022/02/10		Treatment Time	14:45	
Clinic Visit Chlef Complaint	N&V&D, Lethargy and abdo pain				
Employee Statement	Took "Pods" to "repat area". Opened val allowed contents to drain. Returned to s Feeling Lethargic and advised co-works	shed and fo	elt quick onset nause	a, 1x sml vo <del>mit then 2x ep</del> isodes	of Diarrhoea
Visit Reason *	Occupational Injury (OCCINJ)				
Health Center *	Granites Medical Centre (TA-001)		Practitioner	Ferrara, Reece (R_Ferrara)	
	Drag and drop related documentation	on here>	Attach Document	SELECT FILES	
				Attachments Preview	
Discharge Details					
Duty Disposition			Discharge Time	HH:MM (24h)	
Status			Follow Up Date	yyyy/mm/dd	
Status Notes [+]					
Notes					
Employee Work Demogra	aphic				
Details Employee *			Case Number	8361	_
Chief Complaint	N&V&D Lethargy and mild abdo pain		Case Status	●pen (●PEN)	Q
Case Managed			Case Manager		Q
Case Type		Q	Classification		Q
Incident Details			To the second		
Jurisdiction	Northern Territory (NT)	Q	Occupational		
Date Injured	2022/02/10		Time injured	13.00	

Cannot Determine
Time of Event

Injury	<b>S</b>	Iline	ess	0		
Iliness Type	○ Skin Disorder ® Respiratory Co	ndition Poisoning	Hearing Loss C	All Other Illness	es	
Łose Consciousness	0	Nee	dlestick			
First Day Out	2022/02/11					
Reporting Information						
Description						
What was the employee doing just before the incident	Unscrewing lid on "Pod" to increase flo	w to empty conlents at "F	Repat area"			
occurred?						
What happened?	Approx 1 hour later c/o N8V&D letharg	y and abdo pain				
What was the injury or illness?	Hypoxaemia of unknown cause					
Where the event occurred?	Repat area or pond					
What object or substance directly harmed the employee?	? Liquid from Pod					
●SHA						
WC Claim/Report Informati	ion					
Employee Work Demograph	hic					
Nature •f Injury						
Nature Of Injury	Part Of Body				Side Of Body	Primary
Respiratory Diserc	ders Misc-Insufficier	t Info to Properly Iden	tify			E
		T 000 000	A 0.45 0'	Davidson ND	DD 0000 Weist	Hada Baia 5000
Vital Date Vital 2022/02/11 06:58		Temp SBP DBP				Neck Pain FSBG
2022/02/11 06.58					16 94 18 98	0
2022/02/10 17:49					18 98	0
2022/02/10 16:4:					18 98	
2022/02/10 15:45					20 95	
2022/02/10 15:15		37.1 125			18 94	0
2022/02/10 14:45					18 92	2

Indicators

Cardiovascular Patient experiences: Nil symptoms reported and no pHx Endocrine Nil pHx and no reports of symptoms. Eyes Patient experiences: NAD GI Patient experiences: Abdominal Pain Location: Central, Lower quadrant L/R Started: approx 1300 Timing: Sudden fast onset. Quality: Aching Severity: 2 Self resolved in Airconditioned Clinic. Context: Has multiple presentations for similar symptoms in past. Aggravating Factors: nil Alleviating Factors: Rest 2022/02/10 22:16 Associated Symptoms: Diarrhea, Nausea, Vomiting Ferrara, Reece D x 2, V x 1 Neurological Patient experiences: NAD Respiratory Patient experiences: Nil reported, Auscultation clear good air entry Skin/Hair/Nails Patient experiences: Nil rash or complaints reported Throat/Mouth Patient experiences: Throat normal nil signs of inflammation, incl nares. Social History Marital Status: Married Smoking History: Never Smoked ETOH: Nil excess reported Drug Use: Nil reported. Phys. Exam - Abdomen Patient Experiences: Mild tenderness on palpation to Upper region, nil Guarding, soft. Phys. Exam - Skin Normal nil complaints IP just phoned to advise: Received Pfizer Booster: Ferrara, Reece 9th Jan 2022 2022/02/10 16:00 Specific Gravity: 1.024 Ferrara, Reece

Vital Signs				- 177					
		2022/02/11 06:58	2022/02/10 17:45	2022/02/10 16:45	2022/02/10 16:15	2022/02/10 15:45	2022/02/10 15:15	2022/02/ 14:45	10 2021/02/12 07:41
☐ Height									
Weight									
BMI									
	re (systolic/disatolic)	135 / 80	140 / 80	130 / 85	125 /	125/	125 /	135 / 80	120 / 00
	re (systolic/disatolic)								138 / 90
□ Pulse		72	74	86	88	88	88	92	78
SP02		94	98	98	98	95	94	92	98
Waist Circum	ference								
Hip Circumfer	rence								
Pain scale 0-	10		0				0	2	
Fingerstick Bl	lood Glucose								5.1
tes									
Date	Time Notes							Signed?	Practitioner Nar
2022/02/10									Ferrara, Reece
	Follow up Cons	ult with Dr Tow	nsend				. 1 10		
	Follow up Cons	sult with Dr Tow stance Exposur					- F		
		stance Exposur y, Blood Patholo	e if any exists		start a basic w	orkup but diffi	cult when		
	Need to ID sub	stance Exposur y, Blood Patholo testing for	e if any exists		start a basic w	rorkup but diffi	cult when		
2022/02/10	Need to ID sub Req. Chest Xray unknown what Appropriate to	stance Exposur	e if any exists ogy, Lung Func ver night	ction Test to s		orkup but diffi	cult when	0	Ferrara, Reece
2022/02/10 2	Need to ID subs Req. Chest Xray unknown what Appropriate to	stance Exposur  y, Blood Patholo testing for  Stay in Clinic ov cally stable No	e if any exists ogy, Lung Fund ver night Emergency M	ction Test to s	sary				Ferrara, Reece
2022/02/10 2	Need to ID sub- Req. Chest Xray unknown what Appropriate to Appropriate to	stance Exposur  y, Blood Patholo testing for  Stay in Clinic ov cally stable No	e if any exists ogy, Lung Fund ver night Emergency M	ction Test to s	sary				Ferrara, Reece
2022/02/10	Need to ID sub- Req. Chest Xray unknown what Appropriate to Appropriate to	stance Exposur	e if any exists ogy, Lung Fund ver night Emergency Mo	ction Test to s	sary				Ferrara, Reece
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Ferrara, Reece

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From: <u>Contractor Tanami Clinic</u>

To: Brett Pascoe

Bcc: Reece.Storme@protonmail.com

**Subject:** \*Urgent\* IP Presenting? Unknown Chem Exposure \*Confidential\*

**Date:** Thursday, February 10, 2022 5:30:34 ₱M

### Evening Brett,

I have been treating and assessing the current IP here. On consultation with Dr Townsend it appears that the IP may have been exposed to a chemical in the form of a gas while draining storm water contaminated with Refridgerant oil from a "pod" out near the ? recovery pond ?. The advice provided was that it should be escalated in the context of several chem burns presentations over the past several weeks.

Please contact me asap.



Reece FERRARA
Registered PARAMEDIC (RESCUE)

**Site Contact:** 

E: contractor.tanamiclinic@newmont.com

M: 0400 690 987

From: Contractor Tanami, Clinic

To: mkeating@hoseafetyteining.com.au
Cc: rece.storme@protonmail.com
Subject: Update from Newmont

**Date:** Thursday, February 10, 2022 8:43:25 ₱M

Hey Matt,

Hope things are going well relations wise with Host and Newmont. They are different from the other more toxic places. I really respect them for how they operate.

A case has presented that requires overnight monitoring so I am staying in the clinic doing hourly obs. I still need to consult with the Dr if he wants him medevac'd but I feel RFDS wont Jet him out because he is stable.

At this stage from what I can gather, there's a substance that <u>may</u> have escaped controls and <u>could</u> be responsible for clusters of presentations to the clinics. To Newmonts credit, they have heard me out and backed by the On Call doctor they have escalated the matter and taken initial samples for testing and quarantined the area of possible exposure. I have agonised over the info for at least two hours before advising them and been as humble and respectful as I possibly could. That part is in their capable hands while I now focus on the patient only.

Let me know if you need anything further.



Reece FERRARA
Registered PARAMEDIC (RESCUE)
Site Contact:

E: contractor.tanamiclinic@newmont.com

M: 0400 690 987



Call Times: 15:47

20:44

✓ MEDICAL A	DAICE	☐ S4 AE	DMINISTRATION		S8 ADMINI	STRATI	ON
Date of Consult 10-Feb-22			Time of C	o∏sult:	1547		
Name of Patient							
Address:							
Date of Birth		Sex: Male [	✓ Female 🗌	1	Mergies: Nil		
Employer: Newmont			Job Title:	Electri	cian		
			rdiac issues), I in last 3 month			perience	ed.
Current Medication: Nil							
and experienced fas	st onset r	nausea follow	ved by x1 vomit	, lethar	gy, 2x diarrho	ea episo	odes and present
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From: Contractor Tanami Clinic < Contactor. Tanami Clinic @newmont.com>

Sent: Friday, 11 February 2022 7:13 AM

To: Grant Townsend <gtownsend@occumed.com.au>

Cc: tanamime@newmont.com

Subject: Tanami Phone Consult 2022 02 10 HILL, Michael

Morning Grant.

Attached is your consult form,

Thank you again, your input made this case significantly less stressful.

Thank you for your time,

## **Newmont**

**AUSTRALIA** 

Reece FERRARA Registered PARAMEDIC (RESCUE) Site Contact:

E: contractor.tanamiclinic@newmont.com

M: 0400 690 987

00:00:03:17 - 00:01:35:21

Reece Ferrara

[Dr Townsend] Hello Grant speaking.
Gday Grant how you going it's Reece.
[Dr Townsend] Oh Hi, Reece how are you going?.

Good, So just briefly, the patient still like at room air still sat'ing you know sort of Ninety three, Ninety two, Ninety four area. What I found interesting was on a hundred cos I pulled the worksafe Australia stuff, on cyanide and down towards the end, they said for more mild exposures 100% oxygen might umm is the recommended treatment and might be the only thing that he needs. So I chucked him on 100% via a umm like mask with a bag and he like the best sats we can get on a hundred percent is like 98 or 97 So I thought that was interesting given, you know putting him on a hundred percent umm so, from here I guess the question I would like to know is did you want him to be flown offsite and go into hospital? or umm

00:01:35:22 - 00:02:26:22

Dr Grant Townsend

Well at the moment you treat symtpoms, you don't just treat numbers.

[Reece] Well correct right?

He's not a smoker is he?

[Reece] No, no he's not.

I mean, at the end of the day, there could be other reasons for why he sats are that low, is that it's difficult to sort of know, because you can Transcription created by Adobe Premier Pro

Date: Thursday, 10th February 2021 Paramedics On-site: Reece Ferrara Jessica Simpson

see he presented with diarrhoea, didn't he that was the primary complaint? and unwell?
[Reece] Yeah and also lethargy so much so that he just wanted to go and lay down and go to sleep.

[Dr Townsend] cos. Really at the end of the day there's nothing that's an emergency with him, but its best that he gets flown off, because if he I don't know that he needs to go to hospital, but he needs blood tests, do you know what I mean, and more work problably a chest x-ray and a lung function. Those sort of basic workups those workups can see if theres anything else going wrong

00:02:26:23 - 00:03:18:05

Dr Grant Townsend

But again, from from our end we need to know what he's potentially exposed to otherwise we're just guessing, you see and and this there's how many different chemicals around could be what explaining the complication we need to know what he was exposed to and that will help narrow down because you even if we refer him off to Doc or hospital you know, they'll be like well what's he been exposed to. You can't just test him for everything.

[Reece] Yeah Yeah exactly.

If he was exposed to cyanide and it was present in the areas where he is working then it's worth while testing him for it you see but you your not going to test him for it, but you're not going to test him for it if we are going oh it might be this you see, so this again where that

Date: Thursday, 10th February 2021 Paramedics On-site: Reece Ferrara Jessica Simpson

Transcription created by Adobe Premier Pro

feedback from the investigation side of things will go oh well what's he been exposed to you see.

alone then it's just a, a provisional sort of hypothesis at this stage. You see, so how is he though symptoms wise, what what's he actually reporting?

[Reece] Yep... So umm.

[Reece] So since being in the clinic at rest and things like that, he he's umm not having any other complaints whatsoever.

Make sense? [Reece[ Yeah umm

00:04:40:20 - 00:05:13:06

00:03:18:06 - 00:03:59:24

Reece Ferrara

Reece Ferrara

So

So they have they've taken samples of the pod that he put away sort of thing or at least the pods, the pod that he is empty. But at least I taken samples of the the water that was taken from the drains and stuff like that. So they sent them off they're gonna fly them out tomorrow morning.

[Dr Townsend] Right ok

{Dr Townsend] Right.

I've auscultated his chest again that's still clear.

So umm and it's to their credit that umm I guess that they actually heard me out because particularly with trying to tell the manager that, [Dr Townsend] but this is what I mean

[Dr Townsend] Yeah, Yeah because we're not looking at a pneumonia here or something in there. This is we're looking sort of vascular sort of source do you know what I mean, that sort, again. The thing that's just concerning how peripheral shut down is he? and and that's impairing results to a degree but look If he's comfortable at the moment, I think it's reasonable to let him go back to his room. But getting him offsite probably tomorrow would be worthwhile.

00:03:59:24 - 00:04:40:11

Dr Grant Townsend

It's reasonable to at least ask the question and collect data.

[Reece] Yeah.

if the data doesn't support it then that that's sort of like being over the top do you know what I mean,

[Reece] Yeah

It's reasonable to ask questions rather than saying you know, if you make calls like that you have to be able to back it up with evidence

00:05:13:09 - 00:05:50:11

Dr Grant Townsend

Ideally, combined with that, information going these are the things he could have been exposed to and then the docs when they catch up with him then they can actually look at what's what sort of blood tests could be reasonable to consider doing to to exclude it as a cause because then if he's testing for those those

Date: Thursday, 10<sup>th</sup> February 2021 Paramedics On-site: Reece Ferrara Jessica Simpson

Transcription created by Adobe Premier Pro

different chemicals and they come up as negative then we rule that out as a work-related cause you see, the thing you're still looking at well you know could he have a lung condition we don't know about do you know what I mean, [Reece] Yeah

has he got -- lung disease that hasn't been diagnosed do you know what I mean he needs so he probably needs a chest x ray lung function to work out

00:05:51:01 - 00:06:45:06

Dr Grant Townsend

Is there an actual ventilation issue because either of ventilation or perfusion type problem going on if it's not chemical based do you know what I mean but as far as our side I think that's probably all you can do with him at the moment. Has the diarrhoea stopped?

[Reece] Yeah yeah. Oh he had one, one, one more episode. And he said like he said it was like very, very dark and like a very dark brown and I tried to sort of tease out was like malaena or you know?

[Dr Townsend] Well, that that's another thing to consider do you know what I mean because there is that potential vascular component. If he's middle aged is there something going on there look again if his obs are stable and he's otherwise well, do you know what I mean. I think you can let him go back to his room but obviously if his symptoms worsen or he has new issues then he comes back and sees you

00:06:46:17 - 00:07:36:19

Dr Grant Townsend

But at the moment we've got a rather complex presentation we don't really know what's going on with him. I mean as I said, the sats mikght be a red herring. His sats might have been like that for, years. And we're only now picking them up because he presents with another problem, you see. But again, we need to know what he could have been exposed to and then the Docs can at least investigate for that because then if he's negative for it and we know definitive that it wasn't work-related cause and then we'll leave it up to his own docs to

[Reece] to sort it out yeah? work it out whats going on.

Cos as I said it could be an issue, you know, that we're not aware of and he's just presented with simple gastro that we picked up reduced sats and potentially assuming that it's something else do you know what I mean, as I said. Unless the levels are above the occupational standard in the areas where he's been

00:07:36:19 - 00:08:24:18

Dr Grant Townsend

working. Highly unlikely that it's work-related, do you know what I mean. That's why they. Let them do their bit, we do our bit and then try and put the together.

[Reece] Yep

And if they marry, great. If they don't we defer to other sort of possible causes for each presentation.

[Reece[ Yeah.

All Right?

[Reece] So with. Cos what I. ahh. I guess what I suggested to them. And they said, yeah fine with that he stay in the clinic and like I stay here as well and maybe do, hourly. Two hourly obs or something like that. Are. Are you

Well. you do that more if you think they're a stroke or a head injury or things like that I mean, you know, it's reasonable to leave him at the clinic, you know what I mean but I woudnt do, suggest doing hourly obs on him, do you know what I mean.

[Reece] Yeah.

00:08:24:19 - 00:09:00:23

Dr Grant Townsend

If he deteriorates and he wakes up, do you know what I mean.

[Reece] Well, yeah

What are you going to wake him up every hour just to do obs on him?

[Reece] Oh, No, No, No.

I probly wouldn't do you know what I mean, mind you It's reasonable to let him stay at the clinic do you know what I mean. And then that way if he's got symptoms or issues then you can look at it

[Reece] Yeah.

But at the moment, do you know what I mean. Like. I wouldn't do that, he's not going to like you for it. Transcription created by Adobe Premier Pro

Date: Thursday, 10th February 2021 Paramedics On-site: Reece Ferrara Jessica Simpson

[Reece] Well no, I don't really wanna poke him, poke him, cos who knows he might be a grumpy, when he wakes up you know, if he. Well that's what I mean. That's what I mean. [Reece] Then I'm going back to boxing and dodging punches and stuff though. (Joke)

00:09:01:16 - 00:09:31:23

Reece Ferrara

[Dr Townsend] Yeeeah. All right.

So do I need to, should I take blood or should I take bloods and then send it off with him in the morning? Because, I mean,

[Dr Townsend] no, no, not at this stage because we don't know what we're dealing with, cos as I said you dont know what you're testing for, Do you know what I mean. Our job on site is just to stop people dying.

yeah.

[Dr Townsend] And just to start any early first aid that's sort of necessary, do you know what I mean. Whatever's going on with him is not life threatening, it's not acute but warrants further investigation, you see.

00:09:32:02 - 00:10:02:03

Dr Grant Townsend

So I would just do that, observe, get him out tomorrow morning but the information of what he was working with is what's important so then otherwise that the docs have access to blood tests and things like that, that if they don't know what they're looking for it's a needle in the haystack. Whereas your going the other way

Transcription created by Adobe Premier Pro

Date: Thursday, 10<sup>th</sup> February 2021 Paramedics On-site: Reece Ferrara Jessica Simpson

you gotta work out what he was exposed to. But you don't have testing facilities for those kind of issues. Alright.

[Reece] Alright cool thank you very much. Alright.

Ok. See you.

From: Contractor Tanami Cinic

To: AUS-TA-Tanami Medical; Brett Pascoe

Cc: Alan Tulloch; Tanya Modic; Andrea Kittel; Vince De Carolis; Leighton Surr; Paul Ford

Subject: Injury Notification & Update

 Date:
 Friday, February 11, 2022 7:55:32 AM

 Attachments:
 2022 02 10 - Fit to Fly.pdf

 2022 02 10 - Injury Notification.pdf

Good morning,

Attached is the Injury notification report for

His Vitals remained stable throughout the night although the Oxygen saturation remains unchanged. He is flying to Alice Springs on the **©**8:10. There is a work mate flying through with him to SA so he will have a support person going with him.

I am going to try and get him in to see a Doctor in Alice at a clinic Newmont has used before, although I understand medical resources there are scarce and if this is not possible will try and organise an appointment in SA, and liase with Jess to do so.

Kind Regards,



Reece FERRARA
Registered PARAMEDIC (RESCUE)
Site Contact:

E: contractor.tanamiclinic@newmont.com

M: 0400 690 987



Area:	DBS ☑	GTS 🗵	Cintellate No.							
Role:	ELECTRIC	IAN	Department:	DBS FIXED MAI	NTENANCE					
Injury Date:	2022 02 10		Injury Time:	1300 Approx.						
Treatment Date:	2022 02 10		Treatment Time:	1435						
Name:			Line Supervisor:	Grant Morrison						
Days into Roster:		completed of 14	Fatigue Assessment Conducted:	YES □ NO 🗷 N/A □						
Incident Description:	drain contents. F and experienced	Transported "Pods" filled with a liquid from Refridgeration Shed to "Repat" area. IP has opened valve to drain contents. Flow was minimal so IP has unscrewed lid on top of Pod. IP returned to Shed work area and experienced fast onset nausea followed by x1 vomit. lethargy, 2x diarrhoea episodes and presented with supervisor to clinic.								
Injury/Illness Details:	Unknown respira	ambient air.								
Treatment:	Monitoring and 100% Oxygen therapy									
Status:	No further treatment	Self Monitoring	Undergoing treatment	Precautionary Duties	Further medical assessment required					
Further Treatment or Follow Up:	In consultation with Dr Townsend, requires Chest X-Ray, Lung Function test and awaiting results fro samples collected from "Pods" to indicate any further testing that may be required. Organising Medi Review on return flight to Alice Springs today or home state of South Australia. Follow up required.									
Medic:	Relieferman									

### Alliance

### **Medical Clearance Form**

**PPM004** 

- 1. This form is required for passengers with a medical condition intending to travel on Alliance Airlines.
- 2. Prior to travel this form is to be completed and signed by a suitably qualified Medical Personnel to ensure the 3. The passenger is to sign the declaration in section 8 semi URGENT MEDICAL REQUEST passenger is fit to travel by air.
- 4. This form is to be forwarded to Alliance Airlines medicalclearance@allianceairlines.com.au\_prior to the

proposed date								
1. Passenger Details Co								
		Age: 59						
		Address		Post cod	e			
Email:								
2. Travel Information (C								
Flight Sector	Flight Number	Date of flight	Travelling from	n	Travelling to			
Sector 1								
Sector 2  3. Medical Information	Completed by Madical	Dansana						
		Personner)						
Medical Condition /Diag	gnosis: elated to unknown cause, (	Nipigally stable was	st 10 hours					
Date of Dia Snosis, onset				Onest sudden				
4. Travel History	. Of fillitess / e Msoule Of t	reatment or sur	get y. 2022 02 10-	Onset sudden.				
Has the passenger trave	elled overseas or been i	n a covid evnosi	ıra sita within th	a last 14 days	YES□ NOX			
If YES where:	inca overseas or been	ii a covia exposi	are site within th	e last 14 days	TESE NOW			
5. Oxygen Requirements	s (to be completed by I	Medical Personn	el)					
Is supplementary Oxyge		YES 🔀	9.1/		No 🗆			
If Yes what is the flow ra	·		rmittent/Continu	ious 🖺	NO D			
III TES WHAT IS THE HOW TO			continue Continu					
*Except for inflight eme	rgencies Alliance Airlir				or nassengers. Should a			
passenger require Perso	•		•					
6. Assistance Requireme				8				
	ired to the aircraft doo		oor□ or Seat		NOX			
or seat?								
b. Is an escort required	to assist with eating,	YES□			NOX			
medications and toi	leting during the flight?	?						
c. Is a medically traine	d escort required?	YES□			NOX			
		Name and	Qualification of e	scort				
d. Is the passenger tra	velling from hospital?	YES□			NOX			
e. Is an ambulance red	quired?	YES□			NOX			
			e necessary arran	gements				
NOTE: Clearance cannot	t be given until the	been made						
ambulance is booked		YES 🗆	NO 🗆					
f. Is any of the followi	ng equipment required	l? Humidicrib	☐ Stretcher ☐		Prior approval and			
		Other medi	ical equipment $\Box$	]	ambulance booking is			
		Specify:			REQ.			
g. Will the passenger b	be wearing a mask?	YESM Over	he Nasal Cannula		NO			
h. Additional Clinical Ir								
7. Medical Personnel De								
					nominated flights. I further			
certify that this passeng								
member at risk, or that	would contravene rele							
			Recepterram	The state of the s	mber,'0400 690 987			
Qualification: REGISTERED  8. Passe gers Declaration		Date: 2022 02	Date: 2022 02 10 Email: Contractor. Tanamiclinic@newmont.con					
A STATE OF THE PARTY OF THE PAR		is form is compl	ata and accurate	Lauthorico Al	liance Airlines to use this			
					e not medically trained and			
that the airlines cannot		_	_					
Alliance Airlines reserve								
Name:		2022 02 10	Signature					
9. Form Retention (office	e use only)							



OccuMED acknowledges the Traditional Custodians of Country throughout Australia.

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From: Contractor Tanami Clinic <Contactor.Tanami Clinic@newmont.com>

Sent: Friday, 11 February 2022 2:39 PM

To: Grant Townsend <gtownsend@occumed.com.au>

Cc: tanamime@newmont.com

Subject: Re: Tanami Phone Consult 2022 02 10 HILL, Michael

Thanks for this article, this is really interesting. I can only assume he is vaccinated as all staff are required to be, but he said that his experience of symptoms from COVID was quite mild and didn't report any ongoing issues or concerns.

I have left a message to get back to me to confirm.

## **Newmont.**

AUSTRALIA

Reece FERRARA

Registered PARAMEDIC (RESCUE)

**Site Contact:** 

E: contractor.tanamiclinic@newmont.com

M: 0400 690 987

From: Grant Townsend <gtownsend@occumed.com.au>

Sent: Friday, February 11, 2022 13:51

To: Contractor Tanami Clinic < Contactor. Tanami Clinic@newmont.com>

Cc: AUS-TA-Tanami Medical <tanamime@newmont.com>

Subject: [EXTERNAL] RE: Tanami Phone Consult 2022 02 10 HILL, Michael

Hello Reece, no issues. Didn't catch the history about prior CV-19 infection three months ago. Was this chap vaccinated at all before infection? If not could explain the lower than normal sats as CV-19 can cause peripheral issues and persistent low O2 sats as per article:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8062941/

Certainly possible explanation as the single one off exposure at work unlikely to be main driver given initial symptoms were more gastro...

Still best to get chemical breakdown report on what was in the pods but money would be on CV-19 causing hypoxia issue if he was not vaccinated prior to infection. Do we know vax status?

Dr Grant Townsend

MBBS (NDU) AMS (WorkCover WA) Grad Dip OHS (ECU) Masters of Musculoskeletal Studies (UWA) BSc Physiotherapy (Curtin) & Life Sciences (Curtin)

Occupational Physician Registrar

[mailto:%7BE-mail%7D]gtownsend@occumed.com.au

Re: Tanami Phone Consult 2022 02 10 HILL, Michael

Contractor Tanami Clinic <Contactor.TanamiClinic@newmont.com>

Fri 2022-02-11 18:21

To: Grant Townsend <gtownsend@occumed.com.au>

Cc: AUS-TA-Tanami Medical <tanamime@newmont.com>

received a call from and he has confirmed the following:

Received the 3<sup>rd</sup> Booster (Phizer) 2022 JAN 07

Received confirmation of being positive for COVID 2022 JAN 09

Ill enter this into Cority

## **Newmont..**

**AUSTRALIA** 

Reece FERRARA

Registered PARAMEDIC (RESCUE)

Site Contact:

E: contractor.tanamiclinic@newmont.com

M: 0400 690 987

From: Grant Townsend < gtownsend@occumed.com.au>

Sent: Friday, February 11, 2022 16:14

To: Contractor Tanami Clinic < Contactor. Tanami Clinic@newmont.com>

Cc: AUS-TA-Tanami Medical <tanamime@newmont.com>

Subject: [EXTERNAL] RE: Tanami Phone Consult 2022 02 10 HILL, Michael

Vaccinations were only mandatory for Mine workers from Dec onwards.

If he was infected three months ago this would be in Nov so again possible he was unvaccinated when infected so could explain his Sats.

#### Dr Grant Townsend

MBBS (NDU) AMS (WorkCover WA) Grad Dip OHS (ECU) Masters of Musculoskeletal Studies (UWA) BSc Physiotherapy (Curtin) & Life Sciences (Curtin)

#### **Occupational Physician Registrar**

[mailto:%7BE-mail%7D]qtownsend@occumed.com.au





Fitness for Work Assessments



**Independent Medical Assessments** 

OccuMED now has 6 specialist occupational physicians across Subiaco, Redcliffe and Murdoch.

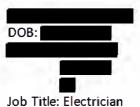


Tanami Operations

**Northern Territory** 

E: TanamiMe@newmont.com

P: 08 8993 8305



705 Title: Electrician

Saturday, February 12, 2022

**ATT: General Practitioner** 

RE: Respiratory Condition of unknown cause

Past Hx: Rheumatic Fever (Nil chronic issues)

Non Smoker

COVID-19 Positive 2021 Jan 09

Vaccination Status: 2x Pfizer Vaccination

Pfizer Booster 2021 Jan 07

#### **Presenting History:**

Transported "Pods" filled with a liquid from Refrigeration Shed to "Repat" area. IP has opened valve to drain contents. Flow was minimal so IP has unscrewed lid on top of Pod. IP returned to Shed work area and experienced fast onset nausea followed by x1 vomit, lethargy, 2x diarrhoea episodes and presented

#### **Chief Complaint:**

N&V&D, Lethargy and abdo pain

Reece FERRARA Registered PARAMEDIC (RESCUE)

E: Contractor.tanamiclinic@newmont.com

M: 0407 022 343



**AUSTRALIA** 

Tanami Operations Northern Territory

E: TanamiMe@newmont.com

P: 08 8993 8305

#### Examination:

Signs

Vital Date	Vital Time	Practitioner	Ht Wt BMI	Temp	SBP	DBP	Arm	Cuff Size	Position	HR	RR	SPO2	Waist N	leck	Pain FSBG
2022/02/11	06:58	Ferrara, Reece		37	135	80	Left		Sitting	72	16	94			
2022/02/10	17:45	Ferrara, Reece		37	140	80	Right		Supine	74	18	98		(	)
2022/02/10	16:45	Ferrara, Reece		37	130	85	Right		Supine	86	18	98			
2022/02/10	16:15	Ferrara, Reece		37.1	125		Right		Supine	88	18	<sup>98</sup> 100	0% O₂ 15]p	m via	Mask Rebrea
2022/02/10	15:45	Ferrara, Reece		37	125		Right		Supine	88	20				
2022/02/10	15:15	Ferrara, Reece		37.1	125				Supine	88	18	94	O₂ @ 4L	pm viá	nasal prong
2022/02/10	14:45	Ferrara, Reece		36.9	135	80	Right		Sitting	92	18	92		7	2

Procedure Date: 2022/02/10 Procedure Code: 000MED021

2022/02/10 22:35 Procedure Description: Exam - Complex

Oxygen Via Nasal Prong @ 2Lpm - 1450 Oxygen Via Nasal prong @ 4 Lpm - 1500 Oxygen Via Rebreather Mask @ 15 Lpm 1545

Ferrara, Reece

Cardiovascular

Patient experiences:

Nil symptoms reported and no pHx

**Endocrine** 

Nil pHx and no reports of symptoms.

Eyes

Patient experiences:

NAD

Reece FERRARA Registered PARAMEDIC (RESCUE)

E: Contractor.tanamiclinic@newmont.com

M: 0407 022 343

GI

Patient experiences:

**Abdominal Pain** 

Location: Central, Lower quadrant L/R Started: approx

1300

Timing: Sudden fast onset.

Quality: Aching Severity: 2

Self resolved in Airconditioned Clinic.

Context: Has multiple presentations for similar symptoms

in past.

Aggravating Factors:

nil

**Alleviating Factors:** 

Rest

Phys. Exam - Abdomen Patient Experiences:

Mild tenderness on palpation to Upper region, nil

Guarding, soft.



**AUSTRALIA** 

Tanami Operations Northern Territory

E: TanamiMe@newmont.com

P: 08 8993 8305

2022/02/10 22:16 Associated Symptoms: Diarrhea,

Nausea, Vomiting D x 2, V x 1

Neurological

Patient experiences:

NAD

Respiratory

Patient experiences:

Nil reported, Auscultation clear good air entry

Skin/Hair/Nails

Patient experiences:

Nil rash or complaints reported Throat/Mouth

Patient experiences:

Throat normal nil signs of inflammation, incl nares.

**Social History** 

Marital Status: Married

Smoking History: Never Smoked

ETOH: Nil excess reported

Drug Use: Nil reported.

Phys. Exam - Skin

Normal nil complaints

Ferrara, Reece

IP just phoned to advise:

Received Pfizer Booster:

2022/02/10 18:23 7th JAN 2022

Tested Positive for COVID-19:

IP Reports past Positive for COVID-19

2022/02/10 14:50 Minor symptoms Throughout and?

Full recovery Ferrara, Reece

9th Jan 2022

Ferrara, Reece

2022/02/10 16:00

Specific Gravity: 1.024

Absences

Case Number	Medical Description	Assessment Outcome code	Assessment Outcome Number	Assessment Outcome Date	End Date	Pre Exist	
8361	Dehydration	000MED029	(1)	2022/02/10	2022/02/12	d	
8361	Fatigue/Malaise	000MED039	2	2022/02/10	2022/02/12		

REPSIRATORY CONDITION OF UNKNOWN CAUSE OR ORIGIN Secondary to Mild Hypoxaemia

Reece FERRARA Registered PARAMEDIC (RESCUE)

E: Contractor.tanamiclinic@newmont.com

M: 0407 022 343



**Tanami Operations Northern Territory** 

E: TanamiMe@newmont.com

P: 08 8993 8305

Thank you for your time,

Any questions or concerns please feel free to call the site clinic.

Regards,

Reece S. FERRARA

Reece FERRARA Registered PARAMEDIC (RESCUE)

E: Contractor.tanamiclinic@newmont.com

M: 0407 022 343

#### **Exhibit G**

**Transcription of Phone Conversations with** 

**Senior Newmont Manager Brett Pascoe** 

Occumed Located in WA Dr Grant Townsend

#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

Victorian Civil and Administrative Tribunal Melbourne Registry.

Z362/2022

Applicant: Reece Storme FERRARA v National Paramedicine Board of Australia

RE: Notification to AHPRA Ref: 00492967

Transcription of Phone call With Newmont Senior Manager, Brett Pascoe at 18:33: February 10, 2022

\*\*Start Transcription

1. 00:00:03:17 - 00:00:09:00

Brett Pascoe - Newmont Senior Manager Hey Reece speaking.

2. 00:00:09:22 - 00:00:13:08

Reece Ferrara

G'day, ummm. Ahh. Reece here. Umm down in the clinic. Umm.

3. 00:00:13:08-00:00:14:01

Brett Pascoe - Newmont Senior Manager [indiscernible]

4. 00:00:14:01 - 00:00:34:14

Reece Ferrara

Are you. Oh well. I guess. Ahh. I'm just wondering. Are you aware, with umm. Ahh. The IP we've got here at the moment. Umm.

5. 00:00:34:14 - 00:00:40:20

Brett Pascoe - Newmont Senior Manager

Yes, I am aware of that.

Initial Deponen

Initial Witness:

Page 1 of 17

## VCAT Z362/2022 Ferrara v National Paramedicine Board of Australia Commonwealth of Australia STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959 Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

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6. 00:00:40:20 - 00:02:06:09

Reece Ferrara

Yeah, Yeah. So. Umm. I've. I've spent. Like. I've spent about 2 hours. Umm. Going through a very detailed assessment and umm, history and all that sort of stuff. Umm. I spoke to Dr Townsend for about 20 minutes, umm. About it. And based on. Umm. His. Ahh. His oxygen saturation and. Umm. His respiratory rate. And the history and all available information and. And. You know, Input from Dr Townsend. The only thing can explain the his symptoms. Is. A. Chemical exposure. And, umm. Of the chemicals that are here. The chemical that. Is most likely to produce, like, low oxygen saturation. Umm, Oxygen saturation is the amount of oxygen that's in the blood. Right. Is likely to be cyanide. Now. Umm. the reason for that. Is that. Umm. His symptoms are. Pretty much. Umm. Now. Isolated to. At rest. And on room air. His saturat. His oxygen saturation are anywhere from Ninety Two, to.

7. 00:02:06:09 - 00:02:06:18

Brett Pascoe - Newmont Senior Manager Right.

8. 00:02:06:18 - 00:02:28:04

Reece Ferrara

At best Ninety Five percent. So. Umm. That's abnormal. 'Cos I auscultated his chest, he has good air entry and all that sort of stuff so there's no reason why the oxygen shouldn't be getting to where it should. And umm. Like, I've had him on a hundred percent. Oxygen And umm. On a. On a mask. On. Umm.

9. 00:02:28:04 - 00:02:30:00

Brett Pascoe - Newmont Senior Manager Yep

10. 00:02:35:14 - 00:02:36:03

Reece Ferrara Based on

Initial Deponent:

Page 2 of 17

#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

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11. 00:02: 36:03- 00:02:38:02

Brett Pascoe - Newmont Senior Manager But, but.

12.00:02:38:02 - 00:02:38:06

Reece Ferrara

Sorry, Yeah.

13. 00:02:38:06 - 00:02:38:11

Brett Pascoe - Newmont Senior Manager So he's got that down at DBS, right.

14. 00:02: 38:11 - 00:02:41:24

Reece Ferrara

Well. Ahh. From the story that I got. Is umm. Over at the. The Compressor shed. Umm,

15. 00:02:41:24 - 00:02:42:01

Brett Pascoe - Newmont Senior Manager Yep.

16. 00:02:42:01-00:02:53:06

#### Reece Ferrara

Where, Ammonia compressor. And what's happened is. Umm. An oil seal "let go" and then. oil got. [indiscernible]. Yeah, so oil got into the drain. And then some.

17. 00:02:53: 06- 00:03:02: 09

Brett Pascoe - Newmont Senior Manager

Leco. Yeah Lam awara of the discurstances abounces access by the question live got is the discussion down at DBS.

Initial Deponent:

**Initial Witness:** 

Page 3 of 17

Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959 Declaration of Mr. Reece Storme FERRARA

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18. 00:03:04:07 - 00:03:10:21

#### Reece Ferrara

Well, Umm. Like, I, I, I. I've run why. Look. So. I've come. I'm only new to site. And then I'm not.

19. 00:03:10:21 - 00:03:10:21

**Brett Pascoe - Newmont Senior Manager** Yeah.

20. 00:03:11:16 - 00:03:26:07

#### Reece Ferrara

You know. And, And, I don't. I don't. Say these things lightly. Umm, like I said is I agonised over this for, like two hours.

21, 00:03:26:07 - 00:03:26:08

Brett Pascoe - Newmont Senior Manager Yeah.

22. 00:03:26:08 - 00:03:54:02

#### Reece Ferrara

And, So, umm. Y. You know. I. I don't know. The fact is, there's a question mark somewhere. Because the evidence. The strongest evidence for cyanide. If he's on a hundred percent oxygen and he's still only satur, saturating at around ninety eight. If you put any human being on a hundred percent oxygen come up at a hundred.

23. 00:03:55:03-00:04:02:13

Brett Pascoe - Newmont Senior Manager

Hmm. Yeah well it's umm. The, the thing that I'm struggling with is where is the exposure come from, right.

24. 00:04:02:13 - 00:04:03:14

Reece Ferrara

So

Initial Deponent:

Page 4 of 17

#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

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Set out matter declared to in numbered paragraphs,

25. 00:04:03:14 - 00:04:13:02

Brett Pascoe - Newmont Senior Manager

Wh, where's the exposure come from? Now the RO plant place I would expect to see, chlorine there. I would expect to see ammonia. I'm not gonna see. I'm not gonna see the ahh, cyanide. At all.

26.00:04:13:02 - 00:04:13:03

Reece Ferrara

Yep.

27. 00:04:13:03 - 00:04:26:18

Brett Pascoe - Newmont Senior Manager

[indiscemable] Ahh. Potentially, [indiscemible] there is grounds exposure. Look we.

We do get arsenic. But, not cyanide. So this is what I'm. This is what I'm struggling with mate. Umm, Cyanide is [indiscernable] to site. And it's 50 kilometres away.

From, from that area. So.

28. 00:04:26:18 - 00:04:26:19

Reece Ferrara

Yeah.

29.00:04:41:14 - 00:04:41:23

Brett Pascoe - Newmont Senior Manager Where did the cyanide come from?

30. 00:04:41:23 - 00:05:33:14

LIECTE . atta. L

out collection was, was put into pods. dight. Some got, He was asked with, units, getting this pod onto a forklift and taking it over where the pods are at the Ahh.

Umm, th, the recovery, you know, pond or whatever. And so what he's done is open up the tap. Now, when you open up the tap, you get low flow because there's no air coming in from the top to force the fluid out. So he unscrewed the lid. Right. And then

Initial Deponent:

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### VCAT Z362/2022 Ferrara v National Paramedicine Board of Australia Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

been in close proximity within arm's length, right, of that unscrewed lid. Now whatever is in there, is a liquid, but in the heat, gas is going to accumulate in the

31. 00:05:33:14 - 00:05:33:22

Brett Pascoe - Newmont Senior Manager Mmmm.

32.00:05:33:22 - 00:05:50:09

Brett Pascoe - Newmont Senior Manager

I've got no idea what the gas is, or what's in there, but the li. Th, where the exposure has taken place is at this pod. So umm.

33.00:05:50:09 - 00:05:50:11

Brett Pascoe - Newmont Senior Manager Yeah.

34. 00:05:50:11 - 00:06:05:06

Reece Ferrara

I got, like I got him to speak to his supervisor. And then. To say, well maybe we should quarantine the pods, 'cos I didn't want to make that decision, 'cos. You know, I'm an outsider.

35. 00:06:06:03 - 00:06:17:14

Brett Pascoe- Newmont Senior Manager

That's happening now, right so what we're doing is. We're quarantining the area.

And, umm, we've asked the guys to kit up. Umm, on. In respiratory equipment and take some samples, which we'll fly off site [indiscernible]

36. 00:06:17:14 - 00:07:09:05

Reece Ferrara

where the exposure took place. Now. Umm. The other thing is as well, what I wonder

Initial Deponent:

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# VCAT Z362/2022 Ferrara v National Paramedicine Board of Australia Commonwealth of Australia STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959 Declaration of Mr. Reece Storme FERRARA

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Set out matter declared to in numbered paragraphs,

is that. Like. I can't remember her name but she works in the lab. And, umm. She was saying something like, the, the mine's been operating for like thirty or forty years and. Umm. She's like, you know. You know. We're, we're really good, like, we're really good umm. At capturing, the, the cyanide and stuff like that. But over 40 years. Umm. Y, you know. Like, I, ahh, look I don't know, and, an, and, you, you guys know your site, you, you guys are the experts, but i'm just. Like throwing it out there is.

37. 00:07:09:05 - 00:07:09:05

Brett Pascoe - Newmont Senior Manager Mmmm.

38. 00:07:09:05 - 00:07:25:16

Reece Ferrara

With the rain in the last month or two, it was excessive, or is more than normal. Umm, could it be in the, in the soil? Like, you know. I, I, I don't know but umm.

39. 00:07:26:12 - 00:07:37:07

Brett Pascoe - Newmont Senior Manager
I don't prescribe to that theory either because umm. It rains here every year. There's a wet season every year. What we've had is not excessive and it's not abnormal.

40. 00:07:37:07 - 00:07:52:01

Reece Ferrara

Yeah, k. So, so and look umm, what, what he's presenting with here is. Is interesting when you take it in the context of, of the five cases with the chemical burns.

41. 00:07:52:01 - 00:07:52:13

Brett Pascoe - Newmont Senior Manager Yeah.

42. 00:07:52:13 - 00:07:52:20

Reece Ferrara

Up at the, Up at the mill. Whatever, whatever, umm. You know, that white residue is

Initial Deponent:

Initial Witness:

Page 7 of 17

#### Commonwealth of Australia

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Set out matter declared to in numbered paragraphs,

43. 00:07:52:20 - 00:08:09:06

Brett Pascoe - Newmont Senior Manager

Look, umm, at, at, at the end of the day, umm. At the end of the day we don't know what we're dealing with, I just don't want, anyone jumping to conclusions.

44.00:08:09:06 - 00:08:11:22

Reece Ferrara

Yeah, yeah, right. Yeah. Correct right? Yeah.

45.00:08:11:22 - 00:08:23:05

Brett Pascoe - Newmont Senior Manager

We'll take the samples, we'll get them sent off to the lab. We'll get the exposures that he's had, umm, tested. In the mean time, umm we just need to make sure he is, ahh.

46. 00:08:23:05 - 00:08:23:08

Reece Ferrara

Looked after.

47. 00:08:23:08 - 00:08:34:11

Brett Pascoe - Newmont Senior Manager

Looked after. Umm. To the best of our ability, right. And certainly, if he has to go off site, then we'll arrange. Although I doubt that, ahh. MRAC will take it.

48. 00:08:34:11 - 00:08:34:16

Reece Ferrara

Yeah

49. 00:08:35:06 - 00:08:53:14

Brett Pascoe - Newmont Senior Manager

So, umm. But we, we can do that. Umm. Worst case scenario if he doesn't pick up overnight. We can throw him, ahh. But he's still well, a flight. We could put him on a plane tomorrow morning.

**Initial Deponent:** 

Initial Witness:

Page 8 of 17

#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

50. 00:08:53:14 - 00:10:31:01

#### Reece Ferrara

Well, Yeah, so like what I did was, ahh, ahh, the, worksafe Australia site has, umm. You know, like a document on cyanide and the treatment. What it seems like if he is presenting with treatment and what it seems like if he's presenting with a what could be either the result of chronic exposure or a singular minor exposure, and umm, it says that like a hundred percent oxygen might just be all that they need. They categorically need to be monitored for like the next 48 hours.

51. Umm. And so if his symptoms stay stable, 'cos like this is, this is. Umm. Cyanide doesn't build up in body. Right, which is fantastic. So it's literally a matter of time and so umm, what what I'm thinking at the moment. I'll ring Dr. Townsend and run it past him and that sort of, get that tick of approval there. 'Cos it's literally just umm. Like, at intervals, taking him off the oxygen. And see what he sats at. His oxygen sats are at room air, umm. At intervals and when it goes back to normal, then then what you know, we are essentially in the clear but ideally I think it would be. I think it would be best if he get flown out and gets seen by a doctor. Umm, now. He, probably, he wouldn't be able to go, umm. On a flight on his own. He's probly gonna need a medical escort.

52. 00:10:31:01 - 00:10:31:09

Brett Pascoe - Newmont Senior Manager Yep.

53.00:10:31:09 - 00:10:35:11

Reece Ferrara

Yeah. So. He'll need oxygen on the plane.

54. 00:10:36:02 - 00:10:53:03

Brett Pascoe - Newmont Senior Manager

And that's what the flying doctors are for, right? If doctor Townsend agrees that he should be flown off. We'll get him flown off. Right. And I don't want you jumping to conclusions about it being cyanide because I don't see where the exposure is.

Initial Deponent:

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in num bered paragraphs,

55. 00:10:53:11 - 00:10:53:23

Reece Ferrara

Yeah, so Like.

56. 00:10:53:23 - 00:10:58:13

Brett Pascoe - Newmont Senior Manager

So unless it's naturally occurring which I believe it's not.

57. 00:10:58:13 - 00:11:00:04

Reece Ferrara

Yeah.

58. 00:11:00:04 - 00:11:11:00

Reece Ferrara

Umm, Then there is no cyanide exposure down there. Now if he's got cyanide exposure from elsewhere and in another life or you know, he's been on site now for at least a week.

59. 00:11:11:00 - 00:11:11:22

Reece Ferrara

Yep.

60. 00:11:11:22 - 00:11:15:03

Brett Pascoe - Newmont Senior Manager

So how does he present after a week.

61. 00:11:15:15 - 00:11:17:19

Reece Ferrara

Yeah. Chronic Chronic exposure you can.

Initial Deponent:

Initial Witness:

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## VCAT Z362/2022 Ferrara v National Paramedicine Board of Australia Commonwealth of Australia STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959 Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

62.00:11:18:19-00:11:27:15

Brett Pascoe - Newmont Senior Manager
So, so maybe he had it off-site, but. Ahh don't wanna be someone jumping to conclusions there.

63. 00:11:27:15 - 00:12:52:02

#### Reece Ferrara

Well, no, yeah. look, when I, when I spoke to Justin, I said to him, look. Oh. This is. This is. It's not. I don't. I don't say these things lightly and I'm not like. Like I said is. I've been agonising over this, like. Quite. Quite. Like, intense. So I, I, I agree with you. Right. Because when you jump to conclusions, it can create panic, hysteria, all that sort of stuff. Right, and we don't wan't that. Hundred percent. But, Umm.

64. The, the. Like, every time. Like, I. I just go back to the numbers, right. The numbers, the numbers, the vital sign numbers, they never lie. It is literally a, like a snapshot of the body in that place in time. And. It's impossible for a human being to be, have. A hundred percent oxygen. Breathing a hundred percent oxygen, and only be satting at ninety eight. That's impossible. The only chemical here that could explain a displacement of oxygen in the body. And when you're breathing in 100% oxygen, is cyanide. And then, that's how death occurs, it, it's death by asphixiation, because the, the oxygen doesn't get into the cell.

65. 00:12:52:23 - 00:12:56:00

Brett Pascoe - Newmont Senior Manager
Yep, Yeah Look, I'm well aware of how cyanide goes, it's a part of our business,

right.

66. 00:12:57:17 - 00:13:14:05

#### Reece Ferrara

y, y, yeah. A, and I'm trying I'm trying to do this as humbly as I can. You guys are the experts, hundred percent. And I know that. And I want to do this with the utmost respect. And, and, I'm trying. I don't want to offend anyone.

Initial Deponent: \_

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

67. 00:13:14:24 - 00:13:31:13

Reece Ferrara

Because at the end of the day, Reece. What we need to do. Is. We need to, Let's say. We're doing what we need to do for them. If we cant treat them on-site and especially (indiscernible) then Dr Townsend will make that determination.

68. 00:13:32:00 - 00:13:32:23

Reece Ferrara

Yeah. For sure, yep.

69. 00:13:33:13 - 00:13:39:19

**Brett Pascoe - Newmont Senior Manager** 

Then and then we get them off-site. We just go down the investigation path which me and my team will handle.

70. 00:13:39:19 - 00:13:39:24

Reece Ferrara

Yeah.

71. 00:13:39:24 - 00:13:41:03

Brett Pascoe - Newmont Senior Manager

And we'll take it from there.

72.00:13:41:03 - 00:13:41:08

Reece Ferrara

Yeah.

73.00:13:41:08 - 00:13:46:10

Reece Ferrara

At the moment the area is isolated.

**Initial Deponent:** 

Initial Witness:

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

74. 00:13:46:10 - 00:13:46:16

Brett Pascoe - Newmont Senior Manager Yep.

75. 00:13:46:16 - 00:13:50:03

Brett Pascoe - Newmont Senior Manager
Umm, It is barricaded off, a, and we're retrieving samples.

76. 00:13:50:03 - 00:13:51:00

Reece Ferrara

Yep.

77. 00:13:51:00 - 00:13:53:13

Reece Ferrara

To see if there's anything in there that's untowards.

78. 00:13:53:13 - 00:13:54:03

Reece Ferrara

Yep.

79. 00:13:54:03 - 00:14:19:07

Brett Pascoe - Newmont Senior Manager

Yep, but I'm as I say, I'm not going to jump to conclusions about it being cyanide or any other chemical until I've got proof that it is. And, umm currently what I'm seeing is, and what I understand is that. There is no cyanide down there, from a. From a, ahh, process point of view. So where did it come from. And if it.

80. 00:14:20:05 - 00:14:20:10

Reece Ferrara

Well, ahh, look it.

Initial Deponent:

Initial Witness:

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: 1, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

81, 00:14:22:20 - 00:14:27:09

Brett Pascoe - Newmont Senior Manager

And if it is down there in those samples, then. If [indiscernible] is in there, we've got a bigger problem than this.

82. 00:14:27:09 - 00:14:39:12

#### Reece Ferrara

Yeah, a, are the samples coming from the water that are in those pods that they got out of the drains? Or is it. Yeah, on yeah ok, cool.

83. 00:14:39:16 - 00:14:48:13

Brett Pascoe - Newmont Senior Manager
We're taking soil samples and we're taking water samples.

84. 00:14:50:20 - 00:14:50:23

#### Reece Ferrara

Yeah, cool, ok. Umm. Yeah, look Umm. I just.

85. 00:14:50:23 - 00:14:54:07

Brett Pascoe - Newmont Senior Manager I just don't know what else to do.

86. 00:14:54:07 - 00:15:17:16

#### Reece Ferrara

I can't say I've ever been in this situation before either. And. You know, I'm not it's not. A pleasurable position to be in. Umm, but. I, I, Look umm. I, I give my job and, I give everything a hundred percent. And, I, I'm here. And i'll work in with you. You just let me know what you would like to do and I'll help you out. I'll do whatever I can.

87. 00: 15: 19:08 - 00: 15: 22: 02

Brett Pascoe - Newmont Senior Manager
All I want you to do is look after the patient.

Initial Deponent:

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

88. 00:15:22:20 - 00:15:28:06

Reece Ferrara

Yeah, and you guys are the experts so you got to do what you do best and then I'll just look after him. Yeah?

89. 00:15:29:01 - 00:15:36:04

Brett Pascoe - Newmont Senior Manager

And umm, and take direction from Dr Townsend.

90. 00:15:36:04 - 00:15:36:18

Reece Ferrara

Correct, yep

91.00:15:37:20 - 00:15:45:20

Brett Pascoe - Newmont Senior Manager
And if we need to fly him off-site, umm.

92. 00:15:46:22 - 00:15:47:00

Reece Ferrara

Then we'll take it from there.

93. 00:15:47:00 - 00:15:47:01

Brett Pascoe - Newmont Senior Manager We go from there, right? Yep.

94. 00:15:47:01 - 00:15:47:01

Reece Ferrara

Yeah ok cool. Yep. [sigh] ok.

95. 00:15:47:01 - 00:15:50:18

Brett Pascoe - Newmont Senior Manager
I don't want you to worry about anything other than just the patient and [indiscernible]. Right?

Initial Deponent:

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

96. 00:15:51:01 - 00:16:00:17

Reece Ferrara

Yeah. Okay. Umm. Thank you for your time and, and. we'll just let you do your thing.

97. 00:16:01:10 - 00:16:03:11

Brett Pascoe - Newmont Senior Manager

Yep, no worries, thanks mate.

#### \*\*End transcription

I, Reece Ferrara, examined the original audio from which this transcription was created. I understand that a person who intentionally makes a false statement in a statutory declaration is guilty of an offence under section 11 of the Statutory Declarations Act 1959, and I believe that the statements in this declaration are true in every particular.

Signature of deponent

Full name of the deponent

Date: 25 17 12022\_

CE STORME

Initial Deponent:

Initial Witness:

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Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraphs,

Signature of witness

EHERYL DUFF
C/O HONDRARY JUSTICE OFFICE
18/121 EXHIBITION STREET
MELBOURNE 3001
JUSTICE OF THE PEACE FOR VICTORIA
REG. NO 11947

Full name of the authorised witness

Qualification of witness

Date: 25 17 12022

Note 1 A person who intentionally makes a false statement in a statutory declaration is guilty of an offence, the punishment for which is imprisonment for a term of 4 years – see section 11 of the Statutory Declarations Act 1959.

Note 2 Chapter 2 of the Criminal Code applies to all offences against the Statutory Declarations Act 1959 - see section 5A of the Statutory Declarations Act 1959.

Initial Deponent:

Initial Witness:

Page 17 of 17

## Commonwealth of Australia STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959 Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

Victorian Civil and Administrative Tribunal

Melbourne Registry

Z362/2022

Applicant: Reece Storme FERRARA v National Paramedicine Board of Australia

RE: Notification to AHPRA Ref: 00492967

Transcription of Phone consult with Occumed Doctor, Dr Grant Townsend at 20:44: February 10, 2022

#### \*\*Start Transcription

1. 00:00:03:17 - 00:01:35:21

Dr Grant Townsend Hello Grant speaking.

2. Reece Ferrara

Gday Grant how you going it's Reece.

3. Dr Grant Townsend

Oh Hi, Reece how are you going?.

#### 4. Reece Ferrara

Good, So just briefly, the patient still like at room air still satting you know sort of Ninety three, Ninety two, Ninety four area. What I found interesting was on a hundred cos I pulled the worksafe Australia stuff, on cyanide and down towards the end, they said for more mild exposures 100% oxygen might umm is the recommended treatment and might be the only thing that he needs.

5. So I chucked him on 100% via a umm like mask with a bag and he like the best sats we can get on a hundred percent is like 98 or 97 So I thought that was interesting given, you know putting him on a hundred percent umm so, from here I guess the question I would like to know is did you want him to be flown offsite and go into hospital? or umm

Initial Deponent:

Initial Witness:

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Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

6. 00:01:35:22 - 00:02:26:22

Dr Grant Townsend

Well at the moment you treat symtpoms, you don't just treat numbers.

7. Reece Ferrara

Well correct right?

8. Dr Grant Townsend

He's not a smoker is he?

Reece Ferrara

No, no he's not.

10 Dr Grant Townsend

I mean, at the end of the day, there could be other reasons for why he sats are that low, is that it's difficult to sort of know, because you can see he presented with diarrhoea, didn't he that was the primary complaint? and unwell?

#### 11. Reece Ferrara

Yeah and also lethargy so much so that he just wanted to go and lay down and go to

#### 12. Dr Grant Townsend

cos. Really at the end of the day there's nothing that's an emergency with him, but its best that he gets flown off, because if he I don't know that he needs to go to hospital, but he needs blood tests, do you know what I mean, and more work problably a chest x-ray and a lung function. Those sort of basic workups those workups can see if theres anything else going wrong

13. 00:02:26:23 - 00:03:18:05

Dr Grant Townsend

But again, from from our end we need to know what he's potentially exposed to otherwise we're just guessing, you see and and this there's how many different

Initial Deponent:

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

chemicals around could be what explaining the complication we need to know what he was exposed to and that will help narrow down because you even if we refer him off to Doc or hospital you know, they'll be like well what's he been exposed to. You can't just test him for everything.

#### 14. Reece Ferrara

Yeah Yeah exactly.

#### 15. Dr Grant Townsend

If he was exposed to cyanide and it was present in the areas where he is working then it's worth while testing him for it you see but you your not going to test him for it, but you're not going to test him for it if we are going on it might be this you see, so this again where that feedback from the investigation side of things will go on well what's he been exposed to you see.

16. Reece Ferrara

Yep... So umm.

17. Dr Grant Townsend

Make sense?

18. Reece Ferrara

Yeah umm

19. 00:03:18:06 - 00:03:59:24

Reece Ferrara

So they have they've taken samples of the pod that he put away sort of thing or at least the pods, the pod that he is empty. But at least I taken samples of the the the water that was taken from the drains and stuff like that. So they sent them off they're gonna fly them out tomorrow morning.

20. Dr Grant Townsend

Right.

Initial Deponent:

**Initial Witness:** 

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

#### 21. Reece Ferrara

So umm and it's to their credit that umm I guess that they actually heard me out because particularly with trying to tell the manager that,

#### 22. Dr Grant Townsend

but this is what I mean

#### 23. 00:03:59:24 - 00:04:40:11

**Dr Grant Townsend** 

it's reasonable to at least ask the question and collect data,

#### 24. Reece Ferrara



#### 25. Dr Grant Townsend

if the data doesn't support it then that that's sort of like being over the top do you know what I mean,

#### 26. Reece Ferrara



#### 27. Dr Grant Townsend

It's reasonable to ask questions rather than saying you know, if you make calls like that you have to be able to back it up with evidence alone then it's just a, a provisional sort of hypothesis at this stage. You see, so how is he though symptoms wise, what what's he actually reporting?

#### 28. Reece Ferrara

So since being in the clinic at rest and things like that, he he's umm not having any other complaints whatsoever.

Initial Deponent:

**Initial Witness:** 

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Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

29. 00:04:40:20 - 00:05:13:06

Reece Ferrara

So

30. Dr Townsend

Right ok

31. Reece Ferrara

I've auscultated his chest again that's still clear.

32. Dr Grant Townsend

Yeah, Yeah because we're not looking at a pneumonia here or something in there. This is we're looking sort of vascular sort of source do you know what I mean, that sort, again. The thing that's just concerning how peripheral shut down is he? and and that's impairing results to a degree but look If he's comfortable at the moment, I think it's reasonable to let him go back to his room. But getting him offsite probably tomorrow would be worthwhile.

#### 33. 00:05:13:09-00:05:50:11

#### **Dr Grant Townsend**

Ideally, combined with that, information going these are the things he could have been exposed to and then the docs when they catch up with him then they can actually look at what's what sort of blood tests could be reasonable to consider doing to to exclude it as a cause because then if he's testing for those those different chemicals and they come up as negative then we rule that out as a work-related cause you see, the thing you're still looking at well you know could he have a lung condition we don't know about do you know what I mean,

#### 34. Reece Ferrara

mean he needs so he probably needs a chest x-ray lung function to work out

Initial Deponent:

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Initial Witness:

# VCAT Z362/2022 Ferrara v National Paramedicine Board of Australia Commonwealth of Australia STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959 Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

#### 35. 00:05:51:01 - 00:06:45:06

#### Dr Grant Townsend

Is there an actual ventilation issue because either of ventilation or perfusion type problem going on if it's not chemical based do you know what I mean but as far as our side I think that's probably all you can do with him at the moment. Has the diarrhoea stopped?

#### 36. Reece Ferrara

Yeah yeah. Oh he had one, one, one more episode. And he said like he said it was like very, very dark and like a very dark brown and I tried to sort of tease out was like malaena or you know?

#### 37. Dr Grant Townsend

Well, that that's another thing to consider do you know what I mean because there is that potential vascular component. If he's middle aged is there something going on there look again if his obs are stable and he's otherwise well, do you know what I mean. I think you can let him go back to his room but obviously if his symptoms worsen or he has new issues then he comes back and sees you

#### 38. 00:06:46:17 - 00:07:36:19

#### Dr Grant Townsend

But at the moment we've got a rather complex presentation we don't really know what's going on with him. I mean as I said, the sats mikght be a red herring. His sats might have been like that for, years. And we're only now picking them up because he presents with another problem, you see. But again, we need to know what he could have been exposed to and then the Docs can at least investigate for that because then if he's negative for it and we know definitive that it wasn't work-related cause and then we'll leave it up to his own docs to

#### 39. Reece Ferrara

To sort it out yeah?

Initial Deponent:

Initial Witness: 🕢

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

#### 40. Dr Townsend

Work it out whats going on. Cos as I said it could be an issue, you know, that we're not aware of and he's just presented with simple gastro that we picked up reduced sats and potentially assuming that it's something else do you know what I mean, as I said. Unless the levels are above the occupational standard in the areas where he's



#### 41. 00:07:36:19 - 00:08:24:18

#### **Dr Grant Townsend**

working. Highly unlikely that it's work-related, do you know what I mean. That's why they. Let them do their bit, we do our bit and then try and put the together.

#### 42. Reece Ferrara

Yep

#### 43. Dr Grant Townsend

And if they marry, great. If they don't we defer to other sort of possible causes for each presentation.

#### 44. Reece Ferrara

Yeah.

#### 45. Dr Grant Townsend

All Right?

#### 46. Reece Ferrara

So with. Cos what I. ahh. I guess what I suggested to them. And they said, yeah fine with that he stay in the clinic and like I stay here as well and maybe do, hourly. Two hourly obs or something like that. Are. Are you

Initial Deponent:

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#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

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Set out matter declared to in numbered paragraph

#### 47. Dr Grant Townsend

Well. you do that more if you think they're a stroke or a head injury or things like that I mean, you know, it's reasonable to leave him at the clinic, you know what I mean but I woudnt do, suggest doing hourly obs on him, do you know what I mean.

#### 48. Reece Ferrara

Yeah.

#### 49. 00:08:24:19 - 00:09:00:23

**Dr Grant Townsend** 

If he deteriorates and he wakes up, do you know what I mean.

#### 50. Reece Ferrara

Well, yeah

#### 51. Dr Grant Townsend

What are you going to wake him up every hour just to do obs on him?

#### 52. Reece Ferrara

Oh, No, No, No.

#### 53. Dr Grant Townsend

I probly wouldn't do you know what I mean, mind you It's reasonable to let him stay at the clinic do you know what I mean. And then that way if he's got symptoms or issues then you can look at it

#### 54. Reece Ferrara

Yeah.

#### 55. Dr Grant Townsend

But at the moment, do you know what I mean. Like. I wouldn't do that, he's not going to like you for it.

Initial Deponent:

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Initial Witness:

#### Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

#### 56. Reece Ferrara

Well no, I don't really wanna poke him, poke him, cos who knows he might be a grumpy, when he wakes up you know, if he.

#### 57. Dr Grant Townsend

Well that's what I mean. That's what I mean.

#### 58. Reece Ferrara

Then I'm going back to boxing and dodging punches and stuff though.

59. 00:09:01:16 - 00:09:31:23

Dr Grant Townsend

Yeeeah. All right.

#### 60. Reece Ferrara

So do I need to, should I take blood or should I take bloods and then send it off with him in the morning? Because, I mean,

#### 61. Dr Grant Townsend

No, no, not at this stage because we don't know what we're dealing with, cos as I said you dont know what you're testing for, Do you know what I mean. Our job on site is just to stop people dying.

#### 62. Reece Ferrara

veah.

#### 63. Dr Townsend

And just to start any early first aid that's sort of necessary, do you know what I mean.

Whatever's going on with him is not life threatening, it's not acute but warrants further investigation, you see.

Initial Deponent:

**Initial Witness:** 

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Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

64. 00:09:32:02 - 00:10:02:03

**Dr Grant Townsend** 

So I would just do that, observe, get him out tomorrow morning but the information of what he was working with is what's important so then otherwise that the docs have access to blood tests and things like that, that if they don't know what they're looking for it's a needle in the haystack. Whereas your going the other way you gotta work out what he was exposed to. But you don't have testing facilities for those kind of issues. Alright.

65. Reece Ferrara

Alright cool thank you very much. Alright.

66. Dr Grant Townsend

Ok. See you.

\*\*End transcription

I, Reece Ferrara, examined the original audio from which this transcription was created. I understand that a person who intentionally makes a false statement in a statutory declaration is guilty of an offence under section 11 of the Statutory Declarations Act 1959, and I believe that the statements in this declaration are true in every particular.

Signature of deponent

REECE STORME FERRARA

Full name of the deponent

Date: 25 1 7 1 2022

Initial Deponent:

Page 10of11

Initial Witness:

Commonwealth of Australia

STATUTORY DECLARATION pursuant to the Statutory Declarations Act 1959

Declaration of Mr. Reece Storme FERRARA

Name: I, Reece Storme FERRARA currently unemployed, suspended ex-paramedic of Greensborough make the following declaration under the Statutory Declarations Act 1959:

Set out matter declared to in numbered paragraph

Signature of witness

CHERYL DUFF
C/O HONORARY JUSTICE OFFICE
18/121 EXHIBITION STREET
MELGUIRNE 3001
JUSTICE OF THE PEACE FOR VICTORIA
REG NO 11947

Full name of the authorised witness

Qualification of witness

Date: 25 1 7 12022

Note 1 A person who intentionally makes a false statement in a statutory declaration is guilty of an offence, the punishment for which is imprisonment for a term of 4 years – see section 11 of the Statutory Declarations Act 1959.

Note 2 Chapter 2 of the Criminal Code applies to all offences against the Statutory Declarations Act 1959 -

see section 5A of the Statutory Declarations Act 1959.

**Initial Deponent:** 

**Initial Witness:** 

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# **Exhibit H**

Text Messages with Newmont Supervisor Justin Bryce





**Newmont Justin** 

Hey mate. Michael had COVID a few weeks ago. could explain the low oxygen or make whatever he was exposed to have worse symptoms.

Yeah he told me that.

I'm going to call Dr Townsend after a new set of Vitals.

And get his directions.

It's a factor, it would need a chest x ray to see if there is any lung scarring to account for the Oxygen % or even a biopsy.

NJ

**Newmont Justin** 

He could have even had Delta wich can have long covid symptoms after recovery

I really do hope there is a benign explanation for the presentation. I'll will keep researching your suggestions throughout the night and keep you posted



**Newmont Justin** 

Don't do too much research mate. Our controls here on site are solid. While I never say never it's highly unlikely it's anything other than an exacerbated reaction to a contaminate due to covid recovery.

You're a solid medic and a great fella you've already proven that to us all. I just need you to chill a bit. And I know that is hard for you to do mate but if you want to keep working mining jobs, that's the key.... Knowing that the company has already jumped through a million hoops just to be able to prove a safe mining method to regulators.

That's me as a mate giving you that advice bro.

Thanks mate. I really appreciate the effort to tell me this it's something that no one has ever done before.

I was sweating bullets just before calling Brett and throughout the conversation. In my nerves I tried to get across that I was trying as best I could to be respectful and not step out of my lane and reiterate just that I provide medical info and Newmont does what it is expert at and in the unlikely event of finding anything they will act accordingly and showcase that expertise and I'm on standby for whatever he would like me to do.

Thanks again Justin.

Your a solid dude.



Cheers buddy, I wouldn't have said anything if I didn't think so highly of you mate.

Straight back at cha



February 11, 2022

I just booked my flight home from Brisbane to Melb.

I was wondering just quietly if there were any plans on having me come back after Tuesday?

My roster ends on Tuesday hence the question. Any outcome is out of my control so will have to roll with what will be I guess it might be helpful for planning what I'm going to do next if this door has closed.

February 13, 2022



**Newmont Justin** 

ok mate. let me get it sorted.

## **Exhibit I**

Independent Medicolegal Consultant Psychiatrist Dr Nicholoas Ingram

Psychiatric Assessment Reece Ferrara

# DR NICHOLAS INGRAM M.B., BS., F.R.A.N.Z.C.P.

Church Street Consulting Suites Suite 5,140 Church Street Richmond 3121 Telephone: 9420 1421 Facsimile: 9421 0077

Provider number: 259 082 H

1st June 2022

Australian Health Practitioner Regulation Agency Attention: Ms Victoria Bennet GPO Box 9958 Melbourne Vic 3001

Dear Ms Bennet,

Claim number: H

PARA0001200706

Claimant's name:

Mr Reece Ferrara (Storme)

Date of birth:

21st July 1983

Mr Ferrara was seen on Wednesday 1<sup>st</sup> June 2022 for the purpose of making a psychiatric assessment. He had previously been seen by me on the 24<sup>th</sup> August 2021, at which time I had felt that he had been suffering from:

- a) Recurrent episodes of depression, at that time well controlled with Pristiq.
- b) Post-traumatic stress disorder, seemingly resolved.
- c) Attention deficit hyperactivity disorder, currently being treated with Dexamphetamine and controlled.

He had also previously been diagnosed with borderline personality, though I found no evidence of this at my assessment then.

Recent Background, as related in referral from AHPRA:

A record of various notices received by AHPRA was detailed in the referral letter from AHPRA:

On the 6<sup>th</sup> and 14<sup>th</sup> January 2002, two confidential notifications had been received in regard to an incident alleged to have occurred on the 5<sup>th</sup> January 2022 where it was alleged that:

a) When an ambulance was called to attend a 36-year-old female patient who had twisted her ankle Mr Ferrara had been present at the scene, as a member of the public, not a paramedic and had provided unwarranted health services to a patient when he was no longer working for Ambulance Victoria and an ambulance was on the way.

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b) Mr Ferrara had unnecessarily and invasively performed intravenous cannulation on the patient's hand with his own equipment without acceptable hygiene standards and without the ability to give pain relief and Mr Ferrara had misdiagnosed the patient with a deformity of the ankle when there was no deformity and it appeared to be a low-mechanism soft tissue injury and that he unnecessarily made a makeshift traction splint with two crutches and compression bandages, causing more pain.

c) Mr Ferrara unnecessarily cut the patient's clothing and underwear to facilitate the splint causing distress and embarrassment.

The third confidential notification had been received on the 17<sup>th</sup> January, which raised the following concerns:

- a) Mr Ferrara had been engaged as a paramedic on a short-term contract by Newmont Tamani Mine in the Northern Territory and he remained onsite from about the 1<sup>st</sup> to the 15<sup>th</sup> February 2022.
- b) Following the commencement of his role that Mr Ferrara allegedly became fixated and obsessive about what he believed to be a live chemical exposure toxic event to such an extent that it compromised the treatment of patients and caused them distress.
- c) A local doctor, Dr Townsend concluded that Mr Ferrara was operating in an unsafe manner and took steps to have him stood down and recommended that Mr Ferrara undergo a formal psychiatric assessment before he returned to duty.
- d) When Mr Ferrara left the meeting site he made allegations about toxic poisoning to the regulator and e-mailed the Minister for Health about alleged lime poisoning and made a notification to AHPRA.
- e) A formal independent third-party investigator was implemented by Newmont to investigate the allegations raised by Mr Ferrara and this investigation concluded that there was no evidence to support the allegations raised by Mr Ferrara.

On 4<sup>th</sup> March 2022 Mr Ferrara advised by e-mail that he was taking a voluntary leave of absence to attend to personal matters that had arisen from consequences of adverse action, defamation, discrimination and other inhuman and invalidating action outside his control.

On the 30<sup>th</sup> March Mr Ferrara provided an uninvited response to Notification 492967, which focused significantly on the role of a whistle-blower. This response suggested that he still believed himself to be a whistle-blower in relation to chemical exposure at Newmont and on 7th April 2022 Mr Ferrara provided an uninvited response to notifications 489774 and 490403, in which he stated that:

a) He was present at the incident on the 5<sup>th</sup> January 2022 and rendered assistance as a good Samaritan.

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b) He performed IVC on the patient's hand, though he denied this was done unsafiely or in contravention of hygiene standards

- c) He denied having misdiagnosed the patient's ankle in jury.
- d) He denied that he unnecessarily made a traction splint, though he immobilised the ankle for transport to the toilets and denies that he was responsible for suggesting that the patient's clothing be cut and that he was the one who cut them and that he says he was not present when this occurred and submits that the Ambulance Victoria crew were dismissive of him and have been unreasonable in assessment of his actions.

A brief report from Dr Hokin on the 13<sup>th</sup> April 2022, as part of Mr Ferrara's current monitoring condition stated that:

- a) Mr Ferrara is fit to practice and apart from a period between 17<sup>th</sup> August 2021 and 11<sup>th</sup> January 2022 he had been otherwise attending monthly appointments.
- b) He had been diagnosed as suffering from PTSD with depressed mood currently in remission in a setting of a vulnerable personality of possible narcissistic nature.
- c) He had not been displaying any symptoms of affective or psychotic mental disorder, however, there had been a few months of reactive depressive symptoms with specific personality related sensitivity, persecution by various governments and an organisation, where he was temporarily unemployed.

In his report it is unclear whether Dr Hokin was aware of the more recent notifications.

On the 24<sup>th</sup> April 2022, Mr Ferrara sent an email to AHPRA Complaints Manager, stating that the Board's decision was nil and void due to their failure to declare a conflict of interest with the Director and Paramedic of Medical Rescue Pty Ltd. He also submitted that AHPRA was engaged in vicarious enactment of victimisation and discrimination.

He also stated that he had refused three offers of work in the resources sector in line with his commitment to public safety and insight into the self-management of his health and provided a substantial list of academic references in support of his e-mail. He also provided a document that in summary alleged that the report on chemical exposure at the Tamani Mine had been biased, had failed to address conflicts of interest and information was omitted in this document. Mr Ferrara submitted fourteen pages of references.

On the 27<sup>th</sup> April Mr Ferrara provided a written submission attaching a copy of the Senate Inquiry into AHPRA where he made various statements, one of which had been AHPRA's decision to pursue regulatory action against him had been founded on fabricated allegations and that their concerns were raised on hearsay and that AHPRA's unlawfulness had led to a destabilisation of his state of mind, which had been compounded by adverse actions in the resources industry, involving mining, oil and gas amongst many other statements and allegations.

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As a result of these various issues the Board took action and suspended Mr Ferrara's registration on the 28<sup>th</sup> April 2022 and requested Mr Ferrara have another independent health assessment.

#### Presenting Complaint:

At the time I had last seen Mr Ferrara, on the 24<sup>th</sup> August 2021, he had had a licence to practice as an Ambulance Officer, on the proviso that he informed prospective employers of certain details of his last history. At my assessment I had found him fit and safe to practice with conditions on his registration to continue to attend his treating practitioner and therefore the same conditions remained in place.

Subsequently, in October 2021, Mr Ferrara's treating psychiatrist, Dr Hokin, alerted AHPRA that he had received e-mails from Mr Ferrara that gave him concerns for his health including that Mr Ferrara advised him that he was involved in an altercation with Police and had expressed suicidal thoughts.

There had also been three prior notifications raising concerns of health impairment as well as a failure to comply with conditions on his registration.

Subsequently, in April of 2022, AHPRA had decided to restrict his right to practice altogether.

Mr Ferrara said that there had been several reasons for this, related to the further notifications received by AHPRA.

- The first notification had occurred in the middle of 2021, when he had been having a dispute with the Ambulance Service in New South Wales where he felt they manufactured a complaint that a female had accused him of offering to obtain an abortion for her. He said that this had been completely untrue and when it had been investigated it had been found that he had no case to offer, though this had been another factor used to justify suspending his licence by AHPRA.
- The second of these had been in regard to his attendance at an accident site, where a young woman had injured her ankle and which he treated in a way that he had felt had been quite appropriate, not as an Ambulance Officer, but as a good Samaritan with appropriate skills. However, when the Ambulance Officers had arrived they had felt that Mr Ferrara's treatment had been inappropriate and this issues had been raised with AHPRA, who he felt had automatically taken the Ambulance Officers side.
- The third notification had been concerned to his working as a Paramedic for Newmont Mine. While he had been working there he had noticed a number of the workers presenting with dermatitis and after some particularly heavy rains he had noticed a white powder falling on the surface of the pools that had collected when the water had dried out. He thought this might have been caused by the effect of lime, which could cause dermatitis, and he had sent a hypothesis suggesting this to mine management. He had also come across two causes of hypoxia, which can sometimes be caused by cyanide poisoning and he had again raised his concern that this might be the case at the mine. Following his writing to high office he found that the attitude towards him had changed and shortly after that he had been

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stood down, the grounds being that the consultant to the mine site, Dr Townsend, had felt that he was mentally ill and needed psychiatric evaluation.

• The fourth notification to AHPRA had been from him, letting them know that he had suicidal thoughts. This had come about because the person who had employed him to take on the work at Newmont Mine had not paid him and when he had left the mine and had come to Melbourne he had had no money and had been quite isolated and he had been facing eviction and he had become very stressed and distressed and had started getting suicidal thoughts.

At this time he had gone to the emergency department at St Vincent's Hospital hoping to be admitted, which they had not done, though they had referred him to North-western Health and he had also contacted his own psychiatrist. It had been on the basis of these four incidents, some of which Mr Ferrara felt were evidence of people in authority using their power against him, that his licence had been suspended and he had now wanted to challenge that.

To this end, in the last couple of months he had been spending up to fifteen hours a day obsessively reading the literature and writing reports to justify his position, marshalling all his energies into his defence.

When talking about this, he was able to see that this possibly had helped him deal with underlying depressive symptoms, as when he had been engaged in his research he had been less depressed. He had also wondered if in some ways he was recreating the situation of his childhood, where he felt abused by a powerful father, and he was now trying to seek justice for what happened in his childhood by mounting these cases against other authoritative figures.

#### Current Level of Activity:

Mr Ferrara had now been living back in Melbourne on his own, though he had had custody of his 9-year-old son three or four days a week, which had been the most important thing in his life and he said that when his son had been with him his mood had been better and he had been able to engage normally with his son and they had had good conversations.

Outside this, his main occupation had been spending up to fifteen hours a day doing his research into mounting a case that he was being unfairly treated and he said that he was being heard by VCAT on the 22<sup>nd</sup> June, 2022. Apart from this, however, he said that he had few interests and nothing else to do, except that he had still done basic cleaning and had had a shower every day, though he had no longer had any friends and apart from when he had been with his son he had been fairly isolated.

#### Present Psychiatric History:

Since I had last seen Mr Ferrara he felt he had become depressed. This had come on in the last few months and these depressive symptoms had been with him most of the time, especially when he had first woken up in the morning, when he had felt particularly low, though he had then taken the Dexamphetamine that he had been given for his ADHD and this had lifted his mood until it had started to wear off in the evenings. He had related his depression to his sense that he had been unfairly treated

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by both AHPRA and Newmont Mining and the Ambulance Officers who had accused him of treating the woman who had injured her leg inappropriately. He said that he had been pursuing these issues as he had wanted to make sense of what had been going on and said that if VCAT had found that the other organisations had had no case to answer, then he would accept this and try and get on with his life.

He had already come to terms with the idea that he might not be able to continue as an Ambulance Officer and he was thinking about what else he might like to do and one thing that would interest him, as he had wanted to help people, would be studying to become a kindergarten teacher.

Associated with his depression had been a loss of motivation, except after when he had taken the amphetamines and had been driven to do his research about his case, and he had still been able to get interested in doing things with his son, though he had become more withdrawn than in the past. Although he had still sometimes had suicidal thoughts, he had not felt he would act on these because of his son, though if they had not improved he had been thinking he would talk to his psychiatrist about going into hospital.

He had usually slept reasonably with Melatonin, though his appetite had been reduced when he had been down and he thought there had been some loss of weight. His energy levels had been variable and he had not done any exercise. His memory and concentration had been reasonable and he said his libido had been low when he had felt particularly down. He said that he had mostly felt angry at himself, rather than the other organisations that he felt had treated him unfairly.

He was currently seeing Dr Zimmerman who treated his ADHD with Dexamphetamine and psychiatrist, Dr Hokin, who was giving him antidepressants. He had also been seeing a psychologist, Emma, who had been helping him to see that some of his pursuits of justice probably were related to his childhood.

#### Personal History:

Mr Ferrara stated that he had had episodes of depression since the age of nineteen, which had often seemed to be related to external circumstances and he had had antidepressants in the past and had also had some counselling. He had also been diagnosed with a borderline personality disorder in about 2016, although he had not been sure if this was really what had been wrong with him and he thought the diagnosis of ADHD most closely fitted problems he had had when he had been younger. There was also a strong family history of psychiatric disorder and since he had had been diagnosed with ADHD his son had also been diagnosed with ADHD and he thought his mother had also suffered from ADHD. One brother had also suffered from agoraphobia and depression and anxiety and his other two brothers had both seemed quite depressed.

He said that he had had an unhappy childhood, as his father had been very angry and aggressive and he had felt suffocated as a child and the whole atmosphere in the household growing up had been that of an unhappy family. He had been quite distractible and irritable as a child and he had had problems at school if he had not been interested in a subject, though if the subject had interested him he had been able to focus and he had finished Year 12. He said that he had decided in his early teens

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that he had not wanted to be negative and angry like his father and he had thereafter always tried to be positive.

He had been in several relationships in his twenties lasting up to a few years and his longest relationship had been with the mother of his son. They had had a lot of problems when they had been matried, which he felt had been the source of his PTSD, but he said they had a much better relationship now and were able to look after their son on a very amicable basis.

He had not smoked or drunk alcohol or taken drugs. He said that he had always been a rather excitable and over-talkative person with a tendency to be over-active and he thought he had been a little more stable since he had been on the dexamphetamine.

Looking back he could see that his father had been a tyrant when he had been a child and he wondered now if he were looking to put himself into situations where he had experienced the same feelings, so he could resolve them in the present.

#### Mental State Examination:

At assessment Mr Ferrara presented as a thin middle-aged who was casually dressed. His behaviour was appropriate and there was no evidence of any psychomotor retardation. He spoke clearly and answered questions fully and gave a good history.

His affect was depressed at times, though he engaged well with normal reactivity. There was a preoccupation with his sense of having been unfairly treated by the Newmont Mine and by Ambulance Officers and by AHPRA, but these thoughts were not held with delusional intensity and he had been able to say that possibly his interpretation of these had been somewhat distorted by his childhood experiences. There was no evidence of any hallucinations and his memory, concentration and intelligence seemed normal and he had reasonable insight.

#### Summary:

Mr Storme is a 39-year-old man who presented to me initially six years after the diagnosis of post-traumatic stress disorder, which seems to have developed in the setting on an unsatisfactory marriage, where he felt physically and psychologically abused by his partner. At that stage he started coping with his feelings of depression and anxiety by taking Fentanyl, which he illegally took home from his work as a Paramedic.

In November of 2015 he admitted to Ambulance Victoria what he was doing, as a result of which his position was terminated and he faced criminal charges. Since then, however, he has been diagnosed with PTSD and he has been treated with antidepressant medication and in the last 18 months he has also been diagnosed with ADHD and treated with Dexamphetamine, which he feel shas made a huge difference to his ability to concentrate and apply himself.

He came from what seems to have been an unhappy childhood with an angry and negative father and several other members of the family had depression and he had not had a close relationship with either of his parents. Psychologically, there was a history of episodes of depression since the age of 19 and looking back he thinks he

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has had ADHD since his childhood and he was diagnosed with a borderline personality disorder in 2016.

In regard to work, he had trained as a Paramedic and had wanted to work as a Paramedic and at the time of my first assessment he had been given a general registration as a Paramedic, though conditions were imposed, that he should continue to see a psychiatrist.

Since I last saw him he had found work at Newmont mines as a paramedic, where he seems to have become convinced that their were toxic chemicals leading to dermatitis among the workers. His crusade against this led to his being sacked, following which he developed significant financial problems and became depressed.

At the same time there were several notifications made to AHPRA about his performance and as a result at the end of April his registration was suspended.

This led to a worsening of his depression and he became obsessed with proving that he was being discriminated against, to the extent that he was spending up to 15 hours a day in his pursuit for justice, though it also seems that this pre-occupation with his rights was a way of coping with his underlying depressive symptoms.

#### Assessment:

Mr Ferrara's is currently suffering from a depressive illness.

He has also had PTSD, which seem largely resolved and attention deficit hyperactivity disorder, which is now controlled by Dexamphetamine.

It is also likely that he has some personality problems, which have manifested in the last few months with his obsessional need to justify his position and these probably relate to unresolved problems from his childhood, though I think are also likely to have been amplified by his depression.

#### Discussion:

This is a very complex case, complicated not only be MR Ferrara's psychiatric conditions, but also his underlying personality, which has led to his pursuing obsessive quest for justice for what he has perceived as discrimination against him and it is he clear that he has a very different interpretation of events from that of other people.

Since I last saw Mr Ferrara, AHPRA have been notified of several new issues to do with his behaviour, one involving his treatment of a woman with a sprained ankle when he had been off duty, the second when he made claims of workers at a mining site being exposed to toxicity, when that had proved not to be the case, and finally when he had made a self-notification because of suicidal thinking. As result of this AHPRA suspended Mr Ferrara's registration, which he was now challenging.

In regard to these issues, Mr Ferrara felt the first was because the Ambulance Officers had been biased against him because he had not been an Ambulance Officer on duty

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and on the second occasion he felt that the mine covered up what he had exposed and therefore dismissed him.

He feels that he has been unfairly treated and he has spent many hours in the first few months, he said up to fifteen hours a day, researching what he perceives to be injustice with hundreds of references to back up his claims. This determination to prove justice at all costs does in part seem to suggest some kind of personality disorder, with obsessional and possibly paranoid aspects, though there was no evidence of any clear-cut delusional thinking or perceptual abnormality.

Whatever the truth behind these various matters, however, from a purely psychiatric perspective and from the history that Mr Storme gave me today and from my assessment, I feel that he has become depressed since I last saw him and that this is contributing to some of his obsessional behaviour.

One of the reasons for the development of this depression is because of his changed circumstances since he left his last job, since when he has been under significant financial stress, as well as his sense of having been unfairly treated. It seems to me his obsessional research has been a way of keeping his depressive feelings at bay and when he stops working he becomes more aware of his depression and this is associated with suicidal thinking.

At this stage I therefore think it is important that he continue to see his psychiatrist and it may be that there needs to be change in his dose of antidepressants.

I also think it is important that he continue to see his psychologist and hopefully she would be able to help him understand that in some ways his pursuit of justice against what he perceives as a bullying authority is possibly related to the situation he had as a child, when he had an overbearing father whom he described as a bully and a tyrant.

Now that he is on Dexamphetamine and his ADHD is better controlled, he clearly is able to focus and pursue a cause and if he could be persuaded to do this in pursuit of a new job rather than in pursuit of the righting of a perceived injustice, he may be more productive in developing a new career, given that, in his discussion with me today, he was saying that realistically he had not felt that he could go back to work with as an ambulance officer.

In regard to the specific questions asked by AHPRA:

- 1) Mr Ferrara had several psychiatric conditions, mainly recurrent depressive disorder, attention deficit disorder and a past history of PTSD.
  - At the current time I feel there has been a recurrence of one of his depressive episodes.
- 2a) When I last assessed him I felt that these would not interfere with his ability to practice as an Ambulance Officer, though at the current time I think there has been a worsening of his depression and I think this is sufficient that I would now say that this would have a detrimental effect on his ability to practice his profession.

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2b) Mr Ferrara's mood varies during the day and he is quite depressed in the mornings when he becomes less motivated and has suicidal thoughts and I think this would put him at risk as working as an Ambulance Officer at the current time.

3) Mr Ferrara seems to be compliant with treatment and has some insight into his current condition.

I would recommend Mr Ferrara continue seeing his psychiatrist and review his antidepressant medication and also continue working with his psychologist. It may be that he decides that he does not want to pursue a career as an Ambulance Officer.

- 4) Mr Ferraro should be able to receive a copy of my report.
- 5) At the present time I do not feel that Mr Ferraro is fit for work and feel he needs treatment from his psychiatrist of his depression.
- I think it would be incumbent on his treating psychiatrist to then advise the Board when Mr Ferraro's depression had been treated and whether his psychiatrist then thought he was fit to resume practice as an Ambulance Officer.

However, I do have some concerns about whether this would be the best profession for Mr Ferrara to pursue, given all that has happened in the last few years and Mr Ferrara's sense that the Board is against him. It may be that the best course for his mental health would be that he pursue a different career and this is something that he may be able to work through with his psychologist.

Yours sincerely,

Dr Nicholas Ingram Consultant Psychiatrist

# **Exhibit J**

Chronological Events of time on site Including
Critical Patient presenting suspected Arsenic Exposure February 13 2022

Senior Manager Brett Pascoe Removes Senior Paramedic while patient still critically ill



Monday, 14 February 2022

Newmont Tanami Operations Tanami Clinics Brett Pascoe Superintendent

Position Held: Rescue Paramedic Arrival: Tuesday 1<sup>st</sup> Feb 2022

#### **OUTLINE OF EVENTS:**

Sunday 30<sup>th</sup> Jan 2022: Contacted by Matt Keating inquiring if I was interested in work.

Assignment Newmont Tanami in Northern Territory Rescue Paramedic

"Commencement Date: Tuesday 1st Feb 2022

Roster: 14 days on, 7 off

Access Type: Short Term Worker"

Confirmed I was willing to accept assignment

Monday 31<sup>st</sup> Jan 2022: Completed paper work, General Induction, submitted Statutory Declaration in lieu of a police check certificate.

- Advised of ADHD and Entries on Police check.
- Advised I was accepted for entry to site and received itinerary from Newmont (attached).

#### **Travel Itinerary for Newmont:**

Chartered Flight QQ371 Tue, 01-Feb-2022, Flights booked until end of May 2022.

- Booked Flight to Brisbane, departing 20:30. PCR Completed.
- "You are booked on QQ371 from BNE to GTS. Your booking reference is:

  AOQUXA..." Text message @ 19:35

Tuesday 1<sup>st</sup> Feb 2022: - PCR test negative

- -ve RATTest at BNE Airport



 Arrived to site and picked up by "Brycey" drove to site and drove the vehicle as well. Good conversation and I didn't know at the time it was Justin my reporting supervisor.

#### Thursday 3rd Feb 2022:

- Acute Muscle strain/tear presentation
- Andrea quickly visited the Granites clinic to advise that the feedback has all been positive. She is flying out for R&R Tomorrow morning.

#### Friday 4th Feb 2022: - Test msg from Matt:

"Morning mate. Quick email to say the feedback on you is continuing to be extremely positive. I'm very happy with how you are being received up there mate. Credit to you, thanks again!" 08:16

Txt to Matt:

"Thank you for looking at the person present and not the past. It is actually pretty rare so I am just so lucky to have crossed paths with you at the right time.

This place is also rare with how down to earth they are and am really enjoying it here. Andrea the HSS Manager came in to let me know the positive feedback before she left so I am just so lucky to be here. Here's to never judging a book by its cover." 10:34

#### Saturday 5th Feb 2022:

Justin visited clinic to advise everything is going well. Asked "how flexible are you?" I said that I can do whatever they needed up to 2 weeks straight as my son doesn't cope very well longer than that. Justin advised I would stay an extra week and go over to "Dead Bollocks Soak" (DBS) Clinic to go on rotation there. Justin "We're going to need you."

- Justin Asked to provide training session to ERT on a medical topic
- Completed Session on DRSABC but more in depth and with real life examples. Feedback was extremely positive for the session.



#### Sunday 6th Feb 2022: Completed More induction Modules

- Sodium Cyanide Awareness
- Fatality Risk
- Processing (Mill)

#### Monday 7<sup>th</sup> Feb 2022:

One presentation of ? Heat Rash L Wrist of Processing Mill Fitter and Turner One presentation of ? Contact Dermatitis with two large blisters.

When Supervisor returned, stated

"that's the same thing we had two weeks ago. They were working knee deep in water."

Review Clinic presentation list and noted multiple presentations some clusters on same day for heat rash/dermatitis/Cellulitis

Review chemicals in area of particular note, Calcium Oxide or Calcium Hydroxide.

Presentations consistent with chemical burns and noted white crystals remained from evaporated rain or flood water. Worker noting area was wet hence gumboots.

#### Text msg to Matt:

- 'Hey matt. It looks like I may have discovered what could be a major incident here at site as there have been medical presentations that have links to each other consistent with an exposure to a hazardous chemical. It appears to be either Calcium Hydroxide, Sodium Hydroxide or an acid/base that has caused burns to several personnel over the past two months." 21:06
- "I have explained to Justin and a supervisor here verbally and the
  evidence continues to point to lime. Typically my experience in
  resources if you do anything that anyone in management doesn't like
  the sound of you're blocked from site. So far they have been awesome

-



- but I thought I would give yourself and the other guys coming a heads up." 21:11
- Verbal conversation with Justin about presentations, rationale and comparison photos. A lot to take in and apologised for the nature of the information. Expressed desire to work with and help company as much as I could.
- Still had documentation to do and finish notification email to Management team about Possible clusters of chemical burns.
   Completed and sent approx. 0200.

From: Centractor Tanami Clinic

To: Brett Pascoe; Andrea Kittel; Alan Tulloch; Tanya Modic; AUS-TA-Tanami

Medical; Justin Bryce; "Matthew Turner"

Subject: Urgent Notification \*\*Confidential\*\*

Date: Tuesday, February 8, 2022 1:56:00 AM

Attachments: image@01.pnq

2022 02 08 - Checmical Exposure medical case Clusters.pdf

Importance: High

Tuesday 8<sup>th</sup> Feb 2022: - Start at DBS Clinic today. Drive over with Jess.

- Throughout day noticed significant shift in demeanour and report with management staff.
- Feels familiar to previous work sites, same cold and "ghosting" behaviour... still to early to tell for sure.

#### Thursday 10th Feb 2022:

IP: Transported "Pods" filled with a liquid from Refrigeration Shed to "Repat" area. IP has opened valve to drain contents. Flow was minimal so IP has unscrewed lid on top of Pod. IP returned to Shed work area and experienced fast onset nausea followed by x1 vomit, lethargy, 2x diarrhoea episodes and presented. Hypoxia secondary to unknown respiratory condition or exposure.



From: Contractor Tanami Clinic To: Brett Pascoe Bcc:

Reece.Storme@protonmail.com Subject: \*Urgent\* IP Presenting? Unkown Chem Exposure \*Confidential\*

Date: Thursday, February 10, 2022 5:30:34 PM

Evening Brett, I have been treating and assessing the current IP here. On consultation with Dr Townsend it appears that the IP may have been exposed to a chemical in the form of a gas while draining storm water contaminated with Refridgerant oil from a "pod" out near the ? recovery pond ?. The advice provided was that it should be escalated in the context of several chem burns presentations over the past several weeks.

#### Conversation with Brett Pascoe:

Frustrated and dismissive. Essentially requesting to stay out of our business and just treat the patients. "Im trying my best to be respectful... This is not pleasant for me, I have been agonising over this for two hours to make this as accurate as possible..."

#### Friday 11th Feb 2022:

Checked INX Flight Itinerary – ALL flights gone.

Roster finishes Tuesday 15<sup>th</sup> Feb 2022

No other shifts scheduled.

#### Text message to Justin:

"I booked my flight home from Bristo Melb. I was wondering if there are plans on having me come back after Tuesday? My roster ends on Tuesday hence the question."

- No reply
- Upsetting as I had sacrificed my place in the Masters Program for Paramedic Practitioner at Deakin to continue with Newmont in this position.



Sunday 13<sup>th</sup> Feb 2022: - Another presentation of similar symptoms to Thursday's presentation,
hypoxia 88% oxygen on room air, decreased conscious state, abnormal ecg,
moderate dehydration, unwell.

- 20 mins later second presentation headache, nausea, dizziness, light headed, metallic taste, Oxygen 93% Shot Creter, -ve RAT. Teagen discharged from clinic without assessment.
- Concerns continue about ? chemical gas exposure, chronic cyanide ultimately a larger question mark was emerging.
- Admitted "Im stressed" to Dr Townsend. Dismissed chemical exposure and asked to speak to supervisor. Short time later while patient still unstable.
- Matt Pascoe presented to clinic to advise I was relieved of duty on Dr
   Townsends recommendation. Complied with request.

#### Reece:

"I hope I'm wrong but If Im not would you call me and apologise?"

Matt Pascoe

"Yeah I have been wrong before... But it wont change the decision."

#### Please provide in writing:

- Confirmation it was Newmont management that unilaterally made the decision to remove me from medical duties at Newmont Tanami operations on the 13<sup>th</sup> Feb 2022.
- 2. If Dr Townsend made the recommendation, provide written confirmation for his decision to recommend I be removed from medical duty.
- 3. If you disagree with any of the facts listed above.

Please respond as soon as practicable.

enara

Regards,

Reece Ferrara

## **EXHIBIT A**

## **SELECTED PAGES FROM**

Agency for Toxic Substances and Disease Registry: Toxicological Profile For Arsenic. Atlanta, United States. U.S. Department of Health and Human Services. (2007).

# TOXICOLOGICAL PROFILE FOR ARSENIC

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry

August 2007

ARSENIC

#### 1. PUBLIC HEALTH STATEMENT

This public health statement tells you about arsenic and the effects of exposure to it.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites are then placed on the National Priorities List (NPL) and are targeted for long-term federal clean-up activities. Arsenic has been found in at least 1,149 of the 1,684 current or former NPL sites. Although the total number of NPL sites evaluated for this substance is not known, the possibility exists that the number of sites at which arsenic is found may increase in the future as more sites are evaluated. This information is important because these sites may be sources of exposure and exposure to this substance may harm you.

When a substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure. You can be exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to arsenic, many factors will determine whether you will be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider any other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

#### 1.1 WHAT IS ARSENIC?

Arsenic is a naturally occurring element that is widely distributed in the Earth's crust. Arsenic is classified chemically as a metalloid, having both properties of a metal and a nonmetal; however, it is frequently referred to as a metal. Elemental arsenic (sometimes referred to as metallic arsenic) is a steel grey solid material. However, arsenic is usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur. Arsenic combined with

these elements is called inorganic arsenic. Arsenic combined with carbon and hydrogen is referred to as organic arsenic.

Most inorganic and organic arsenic compounds are white or colorless powders that do not evaporate. They have no smell, and most have no special taste. Thus, you usually cannot tell if arsenic is present in your food, water, or air.

Inorganic arsenic occurs naturally in soil and in many kinds of rock, especially in minerals and ores that contain copper or lead. When these ores are heated in smelters, most of the arsenic goes up the stack and enters the air as a fine dust. Smelters may collect this dust and take out the arsenic as a compound called arsenic trioxide (As<sub>2</sub>O<sub>3</sub>). However, arsenic is no longer produced in the United States; all of the arsenic used in the United States is imported.

Presently, about 90% of all arsenic produced is used as a preservative for wood to make it resistant to rotting and decay. The preservative is copper chromated arsenate (CCA) and the treated wood is referred to as "pressure-treated." In 2003, U.S. manufacturers of wood preservatives containing arsenic began a voluntary transition from CCA to other wood preservatives that do not contain arsenic in wood products for certain residential uses, such as play structures, picnic tables, decks, fencing, and boardwalks. This phase out was completed on December 31, 2003; however, wood treated prior to this date could still be used and existing structures made with CCA-treated wood would not be affected. CCA-treated wood products continue to be used in industrial applications. It is not known whether, or to what extent, CCA-treated wood products may contribute to exposure of people to arsenic.

In the past, inorganic arsenic compounds were predominantly used as pesticides, primarily on cotton fields and in orchards. Inorganic arsenic compounds can no longer be used in agriculture. However, organic arsenic compounds, namely cacodylic acid, disodium methylarsenate (DSMA), and monosodium methylarsenate (MSMA), are still used as pesticides, principally on cotton. Some organic arsenic compounds are used as additives in animal feed. Small quantities of elemental arsenic are added to other metals to form metal mixtures or alloys with improved

properties. The greatest use of arsenic in alloys is in lead-acid batteries for automobiles.

Another important use of arsenic compounds is in semiconductors and light-emitting diodes.

To learn more about the properties and uses of arsenic, see Chapters 4 and 5.

#### 1.2 WHAT HAPPENS TO ARSENIC WHEN IT ENTERS THE ENVIRONMENT?

Arsenic occurs naturally in soil and minerals and it therefore may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching. Volcanic eruptions are another source of arsenic. Arsenic is associated with ores containing metals, such as copper and lead. Arsenic may enter the environment during the mining and smelting of these ores. Small amounts of arsenic also may be released into the atmosphere from coal-fired power plants and incinerators because coal and waste products often contain some arsenic.

Arsenic cannot be destroyed in the environment. It can only change its form, or become attached to or separated from particles. It may change its form by reacting with oxygen or other molecules present in air, water, or soil, or by the action of bacteria that live in soil or sediment. Arsenic released from power plants and other combustion processes is usually attached to very small particles. Arsenic contained in wind-borne soil is generally found in larger particles. These particles settle to the ground or are washed out of the air by rain. Arsenic that is attached to very small particles may stay in the air for many days and travel long distances. Many common arsenic compounds can dissolve in water. Thus, arsenic can get into lakes, rivers, or underground water by dissolving in rain or snow or through the discharge of industrial wastes. Some of the arsenic will stick to particles in the water or sediment on the bottom of lakes or rivers, and some will be carried along by the water. Ultimately, most arsenic ends up in the soil or sediment. Although some fish and shellfish take in arsenic, which may build up in tissues, most of this arsenic is in an organic form called arsenobetaine (commonly called "fish arsenic") that is much less harmful.

For more information on how arsenic behaves in the environment, see Chapter 6.

#### 1.3 HOW MIGHT I BE EXPOSED TO ARSENIC?

Since arsenic is found naturally in the environment, you will be exposed to some arsenic by eating food, drinking water, or breathing air. Children may also be exposed to arsenic by eating soil. Analytical methods used by scientists to determine the levels of arsenic in the environment generally do not determine the specific form of arsenic present. Therefore, we do not always know the form of arsenic a person may be exposed to. Similarly, we often do not know what forms of arsenic are present at hazardous waste sites. Some forms of arsenic may be so tightly attached to particles or embedded in minerals that they are not taken up by plants and animals.

The concentration of arsenic in soil varies widely, generally ranging from about 1 to 40 parts of arsenic to a million parts of soil (ppm) with an average level of 3–4 ppm. However, soils in the vicinity of arsenic-rich geological deposits, some mining and smelting sites, or agricultural areas where arsenic pesticides had been applied in the past may contain much higher levels of arsenic. The concentration of arsenic in natural surface and groundwater is generally about 1 part in a billion parts of water (1 ppb), but may exceed 1,000 ppb in contaminated areas or where arsenic levels in soil are high. Groundwater is far more likely to contain high levels of arsenic than surface water. Surveys of U.S. drinking water indicate that about 80% of water supplies have less than 2 ppb of arsenic, but 2% of supplies exceed 20 ppb of arsenic. Levels of arsenic in food range from about 20 to 140 ppb. However, levels of inorganic arsenic, the form of most concern, are far lower. Levels of arsenic in the air generally range from less than 1 to about 2,000 nanograms (1 nanogram equals a billionth of a grain) of arsenic per cubic meter of air (less than 1–2,000 ng/m³), depending on location, weather conditions, and the level of industrial activity in the area. However, urban areas generally have mean arsenic levels in air ranging from 20 to 30 ng/m³.

You normally take in small amounts of arsenic in the air you breathe, the water you drink, and the food you eat. Of these, food is usually the largest source of arsenic. The predominant dietary source of arsenic is seafood, followed by rice/rice cereal, mushrooms, and poultry. While seafood contains the greatest amounts of arsenic, for fish and shellfish, this is mostly in an organic form of arsenic called arsenobetaine that is much less harmful. Some seaweeds may

contain arsenic in inorganic forms that may be more harmful. Children are likely to eat small amounts of dust or soil each day, so this is another way they may be exposed to arsenic. The total amount of arsenic you take in from these sources is generally about 50 micrograms (1 microgram equals one-millionth of a gram) each day. The level of inorganic arsenic (the form of most concern) you take in from these sources is generally about 3.5 microgram/day. Children may be exposed to small amounts of arsenic from hand-to-mouth activities from playing on play structures or decks constructed out of CCA-treated wood. The potential exposure that children may receive from playing in play structures constructed from CCA-treated wood is generally smaller than that they would receive from food and water. Hand washing can reduce the potential exposure of children to arsenic after playing on play structures constructed with CCA-treated wood, since most of the arsenic on the children's hands was removed with water.

In addition to the normal levels of arsenic in air, water, soil, and food, you could be exposed to higher levels in several ways, such as the following:

- Some areas of the United States contain unusually high natural levels of arsenic in rock, and this can lead to unusually high levels of arsenic in soil or water. If you live in an area like this, you could take in elevated amounts of arsenic in drinking water. Children may be taking in higher amounts of arsenic because of hand-to-mouth contact or eating soil in areas with higher than usual arsenic concentrations.
- Some hazardous waste sites contain large quantities of arsenic. If the material is not properly disposed of, it can get into surrounding water, air, or soil. If you live near such a site, you could be exposed to elevated levels of arsenic from these media.
- If you work in an occupation that involves arsenic production or use (for example, copper or lead smelting, wood treating, or pesticide application), you could be exposed to elevated levels of arsenic during your work.
- If you saw or sand arsenic-treated wood, you could inhale some of the sawdust into your nose or throat. Similarly, if you burn arsenic-treated wood, you could inhale arsenic in the smoke.
- If you live in a former agricultural area where arsenic was used on crops, the soil could contain high levels of arsenic.

• In the past, several kinds of products used in the home (rat poison, ant poison, weed killer, some types of medicines) had arsenic in them. However, most of these uses of arsenic have ended, so you are not likely to be exposed from home products any longer.

You can find more information on how you may be exposed to arsenic in Chapter 6.

## 1.4 HOW CAN ARSENIC ENTER AND LEAVE MY BODY?

If you swallow arsenic in water, soil, or food, most of the arsenic may quickly enter into your

The amount that enters your body will depend on how much you swallow and the kind of arsenic that you swallow. This is the most likely way for you to be exposed near a waste site. If you breathe air that contains arsenic dusts, many of the dust particles settle onto the lining of the lungs. Most of the arsenic in these particles is then taken up from the lungs into the body. You might be exposed in this way near waste sites where arsenic-contaminated soils are allowed to blow into the air, or if you work with arsenic-containing soil or products. If you get arsenic-contaminated soil or water on your skin, only a small amount will go through your skin into your so this is usually not of concern.

Both inorganic and organic forms leave your body in your urine. Most of the inorganic arsenic will be gone within several days, although some will remain in your body for several months or even longer. If you are exposed to organic arsenic, most of it will leave your body within several

You can find more information on how arsenic enters and leaves your body in Chapter 3.

### 1.5 HOW CAN ARSENIC AFFECT MY HEALTH?

Scientists use many tests to protect the public from harmful effects of toxic chemicals and to find ways for treating persons who have been harmed.

One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. For some chemicals, animal testing may be necessary. Animal testing may also help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals.

Inorganic arsenic has been recognized as a human poison since ancient times, and large oral doses (above 60,000 ppb in water which is 10,000 times higher than 80% of U.S. drinking water arsenic levels) can result in death. If you swallow lower levels of inorganic arsenic (ranging from about 300 to 30,000 ppb in water; 100–10,000 times higher than most U.S. drinking water levels), you may experience irritation of your stomach and intestines, with symptoms such as stomachache, nausea, vomiting, and diarrhea. Other effects you might experience from swallowing inorganic arsenic include decreased production of red and white blood cells, which may cause fatigue, abnormal heart rhythm, blood-vessel damage resulting in bruising, and impaired nerve function causing a "pins and needles" sensation in your hands and feet.

Perhaps the single-most characteristic effect of long-term oral exposure to inorganic arsenic is a pattern of skin changes. These include patches of darkened skin and the appearance of small "corns" or "warts" on the palms, soles, and torso, and are often associated with changes in the blood vessels of the skin. Skin cancer may also develop. Swallowing arsenic has also been reported to increase the risk of cancer in the liver, bladder, and lungs. The Department of Health and Human Services (DHHS) has determined that inorganic arsenic is known to be a human carcinogen (a chemical that causes cancer). The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans. EPA also has classified inorganic arsenic as a known human carcinogen.

If you breathe high levels of inorganic arsenic, then you are likely to experience a sore throat and irritated lungs. You may also develop some of the skin effects mentioned above. The exposure level that produces these effects is uncertain, but it is probably above 100 micrograms of arsenic

per cubic meter (µg/m³) for a brief exposure. Longer exposure at lower concentrations can lead to skin effects, and also to circulatory and peripheral nervous disorders. There are some data suggesting that inhalation of inorganic arsenic may also interfere with normal fetal development, although this is not certain. An important concern is the ability of inhaled inorganic arsenic to increase the risk of lung cancer. This has been seen mostly in workers exposed to arsenic at smelters, mines, and chemical factories, but also in residents living near smelters and arsenical chemical factories. People who live near waste sites with arsenic may have an increased risk of lung cancer as well.

If you have direct skin contact with high concentrations of inorganic arsenic compounds, your skin may become irritated, with some redness and swelling. However, it does not appear that skin contact is likely to lead to any serious internal effects.

Almost no information is available on the effects of organic arsenic compounds in humans. Studies in animals show that most simple organic arsenic compounds (such as methyl and dimethyl compounds) are less toxic than the inorganic forms. In animals, ingestion of methyl compounds can result in diarrhea, and lifetime exposure can damage the kidneys. Lifetime exposure to dimethyl compounds can damage the urinary bladder and the kidneys.

You can find more information on the health effects of inorganic and organic arsenic in Chapters 2 and 3.

### 1.6 HOW CAN ARSENIC AFFECT CHILDREN?

This section discusses potential health effects in humans from exposures during the period from conception to maturity at 18 years of age.

Children are exposed to arsenic in many of the same ways that adults are. Since arsenic is found in the soil, water, food, and air, children may take in arsenic in the air they breathe, the water they drink, and the food they eat. Since children tend to eat or drink less of a variety of foods and beverages than do adults, ingestion of contaminated food or juice or infant formula made

OSHA will listen to your formal complaints about workplace health hazards and inspect your workplace when necessary. Employees have a right to seek safety and health on the job without fear of punishment.

You can find more information about how arsenic can affect children in Sections 3.7 and 6.6.

# 1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO ARSENIC?

Several sensitive and specific tests can measure arsenic in your blood, urine, hair, or fingernails, and these tests are often helpful in determining if you have been exposed to above-average levels of arsenic in the past. These tests are not usually performed in a doctor's office. They require sending the sample to a testing laboratory.

Measurement of arsenic in your urine is the most reliable means of detecting arsenic exposures that you experienced within the last several days. Most tests measure the total amount of arsenic present in your urine. This can sometimes be misleading, because the nonharmful forms of arsenic in fish and shellfish can give a high reading even if you have not been exposed to a toxic form of arsenic. For this reason, laboratories sometimes use a more complicated test to separate "fish arsenic" from other forms. Because most arsenic leaves your body within a few days, analysis of your urine cannot detect if you were exposed to arsenic in the past. Tests of your hair or fingernails can tell if you were exposed to high levels over the past 6–12 months, but these tests are not very useful in detecting low-level exposures. If high levels of arsenic are detected, this shows that you have been exposed, but unless more is known about when you were exposed and for how long, it is usually not possible to predict whether you will have any harmful health

You can find more information on how arsenic can be measured in your hair, urine, nails, and other tissues in Chapters 3 and 7.

ARSENIC 15

### 2. RELEVANCE TO PUBLIC HEALTH

# 2.1 BACKGROUND AND ENVIRONMENTAL EXPOSURES TO ARSENIC IN THE UNITED STATES

Arsenic is widely distributed in the Earth's crust, which contains ~3.4 ppm arsenic. In name, arsenic is mostly found in minerals and only to a small extent in its elemental form. Arsenic is mainly obtained as a byproduct of the smelling of copper, lead, cobalt, and gold ores. Arsenic trioxide is the primary form in which arsenic is marketed and consumed. There has been no domestic production of arsenic since 1985. In 2003, the world's largest producer of arsenic compounds was China, followed by Chile and Peru.

In 2003, the United States was the world's largest consumer of arsenic. Production of wood preservatives, primarily copper chromated arsenate (CCA), CrO<sub>3</sub>•CuO•As<sub>2</sub>O<sub>5</sub>, accounted for >90% of domestic consumption of arsenic trioxide. In response to consumer concerns, U.S. manufacturers of arsenical wood preservative began a voluntary transition from CCA to other wood preservatives for certain residential wood products. This phase-out was completed on December 31, 2003; wood treated prior to this date could still be used and CCA-treated wood products continue to be used in industrial applications.

Other uses for arsenic compounds include the production of agricultural chemicals, as an alloying element in ammunition and solders, as an anti-friction additive to metals used for bearings, and to strengthen lead-acid storage battery grids. High-purity arsenic (99.9999%) is used by the electronics industry for gallium-arsenide semiconductors for telecommunications, solar cells, and space research. Various organic arsenicals are still used in the United States as herbicides and as antimicrobial additives for animal and poultry feed. However, the use of inorganic arsenic compounds in agriculture has virtually disappeared beginning around the 1960s. Arsenic trioxide and arsenic acid were used as a decolorizer and fining agent in the production of bottle glass and other glassware. Arsenic compounds also have a long history of use in medicine, and have shown a re-emergence of late with the recent introduction of arsenic trioxide treatment for acute promyelocytic leukemia.

The principal route of exposure to arsenic for the general population is likely to be the oral route, primarily in the food and in the drinking water. Dietary exposures to total arsenic were highly variable, with a mean of  $50.6 \,\mu\text{g/day}$  (range of  $1.01-1,081 \,\mu\text{g/day}$ ) for females and  $58.5 \,\mu\text{g/day}$  (range of  $0.21-1,276 \,\mu\text{g/day}$ ) for males. U.S. dietary intake of inorganic arsenic has been estimated to range from 1 to  $20 \,\mu\text{g/day}$ , with grains and produce expected to be significant contributors to dietary inorganic arsenic

intake. Drinking water generally contains an average of 2 µg/L of arsenic, although 12% of water supplies from surface water sources in the North Central region of the country and 12% of supplies from groundwater sources in the Western region have levels exceeding 20 µg/L. Arsenic is also widely distributed in surface water, groundwater, and finished drinking water in the United States. Surveys of arsenic concentrations in rivers and lakes indicate that most values are below 10 µg/L, although individual samples may range up to 3,400 µg/L. Arsenic released to the land at hazardous waste sites is likely to be relatively immobile due to a high capacity for soil binding, particularly to iron and manganese oxides. Exposure to arsenic from other pathways is generally small, but may be significant for areas with high levels of arsenic contamination or in occupational settings. For a more complete discussion of possible exposures to arsenic, see Chapter 6 of the profile.

#### 2.2 SUMMARY OF HEALTH EFFECTS

Arsenic is a potent toxicant that may exist in several oxidation states and in a number of inorganic and organic forms. Most cases of arsenic-induced toxicity in humans are due to exposure to inorganic arsenic, and there is an extensive database on the human health effects of the common arsenic oxides and

Although there may be some differences in the potency of different chemical forms (e.g., arsenites tend to be somewhat more toxic than arsenates), these differences are usually minor. An exception would be arsine, which is highly toxic. However, because arsine and its methyl derivatives are gases or volatile liquids and are unlikely to be present at levels of concern at hazardous waste sites, health effect data for these compounds are not discussed in this document. Humans may be exposed to organic arsenicals (mainly methyl and phenyl derivatives of arsenic acid) that are used in agriculture and to organic arsenicals found in fish and shellfish (arsenobetaine and arsenocholine). Although the toxicity of organic arsenicals has not been as extensively investigated as inorganic arsenicals, there are sufficient animal data to evaluate the toxicity of methyl arsenates (e.g., monomethylarsonic acid [MMA] and dimethylarsinic acid [DMA]) and roxarsone. The so-called "fish arsenic" compounds (e.g., arsenobetaine) are not thought to be toxic and health effects data are not discussed in this document.

It is generally accepted that the arsenic-carbon bond is quite strong and most mammalian species do not have the capacity to break this bond; thus, inorganic arsenic is not formed during the metabolism of organic arsenicals. In most species, including humans, ingested (or exogenous) MMA(V) and DMA(V) undergo limited metabolism, do not readily enter the cell, and are primarily excreted unchanged in the urine. This is in contrast to inorganic arsenic, which undergoes sequential reduction and methylation reactions leading to the formation of MMA and DMA. Inorganic As(V) is readily reduced to inorganic

As(III), which is taken up by the cell. Within the cell (primarily in the liver), As(III) is methylated to form MMA(V), which is reduced to MMA(III); MMA(III) subsequently undergoes oxidative methylations to form DMA(V). DMA(V) is the primary excretion product in humans. Because inorganic and organic arsenicals exhibit distinct toxicolainetic characteristics, the health effects and MRLs are considered separately.

Inorganic Arsenicals. Exposures of humans near hazardous waste sites could involve inhalation of arsenic dusts in air, ingestion of arsenic in water, food, or soil, or dermal contact with contaminated soil or water. Increased risk of lung cancer, respiratory initation, nausea, skin effects, and neurological effects have been reported following inhalation exposure. There are only a few quantitative data on noncancer effects in humans exposed to inorganic arsenic by the inhalation route. Animal data similarly identify effects on the respiratory system as the primary noncancer effect of inhaled inorganic arsenic compounds, although only a few studies are available. Only limited data on the effects of inhaled organic arsenic compounds in humans or animals are available; these studies are generally limited to high-dose, short-term exposures, which result in frank effects.

Relatively little information is available on effects due to direct dermal contact with inorganic arsenicals, but several studies indicate that the chief effect is local irritation and dermatitis, with little risk of other adverse effects.

The database for the oral toxicity of inorganic arsenic is extensive, containing a large number of studies of orally-exposed human populations. These studies have identified effects on virtually every organ or tissue evaluated, although some end points appear to be more sensitive than others. The available data from humans identify the skin as the most sensitive noncancer target following long-term oral arsenic exposure. Typical dermal effects include hyperkeratinization of the skin (especially on the palms and soles), formation of multiple hyperkeratinized corns or warts, and hyperpigmentation of the skin with interspersed spots of hypopigmentation. Oral exposure data from studies in humans indicate that these lesions typically begin to manifest at exposure levels of about 0.002-4.02 mg As/kg/day, but one study suggests that lesions may appear at even lower levels. At these exposure levels, peripheral vascular effects are also commonly noted, including cyanosis, gangrene, and, in Taiwanese populations, the condition known as "Blackfoot Disease." Other reported cardiovascular effects of oral exposure to inorganic arsenic include increased incidences of high blood pressure and circulatory problems. The use of intravenous arsenic trioxide as therapy for acute promyelocytic leukemia has raised further concerns about the cardiovascular effects of arsenic, including alterations in cardiac OT interval and the

development of torsades de pointes. Decrements in lung function, assessed by spirometry, have been reported in subjects exposed to approximately 0.008-0.04 mg As/kg/day in the drinking water who exhibited skin lesions.

In addition to dermal, cardiovascular, and respiratory effects, oral exposure to inorganic arsenic may result in effects on other organ systems. Nausea, vomiting, and diarrhea are very common symptoms in humans following oral exposure to inorganic arsenicals, both after acute high-dose exposure and after repeated exposure to lower doses; these effects are likely due to a direct irritation of the gastrointestinal mucosa. Acute, high-dose exposure can lead to encephalopathy, with clinical signs such as confusion, hallucinations, impaired memory, and emotional lability, while long-term exposure to lower levels can lead to the development of peripheral neuropathy characterized by a mumbness in the hands and feet that may progress to a painful "pins and needles" sensation. Recent studies also have reported neurobehavioral alterations in arsenic-exposed children.

Chronic exposure of humans to inorganic arsenic in the drinking water has been associated with excess incidence of miscarriages, stillbirths, preterm births, and infants with low birth weights. Animal data suggest that arsenic may cause changes to reproductive organs of both sexes, including decreased organ weight and increased inflammation of reproductive tissues, although these changes may be secondary effects. However, these changes do not result in a significant impact on reproductive ability. Animal studies of oral inorganic arsenic exposure have reported developmental effects, but generally only at concentrations that also resulted in maternal toxicity.

Arsenic is a known human carcinogen by both the inhalation and oral exposure routes. By the inhalation route, the primary tumor types are respiratory system cancers, although a few reports have noted increased incidence of tumors at other sites, including the liver, skin, and digestive tract. In humans exposed chronically by the oral route, skin tumors are the most common type of cancer. In addition to skin cancer, there are a number of case reports and epidemiological studies that indicate that ingestion of arsenic also increases the risk of internal tumors (mainly of bladder and hung, and to a lesser extent, liver, kidney, and prostate).

The Department of Health and Human Services (DHHS) has concluded that inorganic arsenic is known to be a human carcinogen. The International Agency for Research on Cancer (IARC) cites sufficient evidence of a relationship between exposure to arsenic and human cancer. The IARC classification of arsenic is Group 1. The EPA has determined that inorganic arsenic is a human carcinogen by the

inhalation and oral routes, and has assigned it the cancer classification, Group A. EPA has calculated an oral cancer slope factor of 1.5  $(mg/kg/day)^{-1}$  and a drinking water unit risk of  $5 \times 10^{-5}$   $(\mu g/L)^{-1}$  for inorganic arsenic based on human dose-response data. The inhalation unit risk for cancer is calculated to be  $0.0043 \ (\mu g/m^3)^{-1}$ . The unit risk is the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of  $1 \ \mu g/L$  in water or  $1 \ \mu g/m^3$  in air. EPA is currently revising the assessment for inorganic arsenic; a more detailed discussion of the uncertainties associated with human cancer risk levels for arsenic is presented in Section 3.2.2.7.

The following sections discuss significant effects resulting from exposure to inorganic arsenic in greater detail: dermal, cardiovascular, respiratory, gastrointestinal, neurological, and cancer. Additional information on these effects and on other effects is discussed in Section 3.2.

Dermal Effects. The most characteristic effect of long-term oral exposure to inorganic arsenic compounds is the development of skin lesions; these lesions are often used as diagnostic criteria for arsenicosis. The three lesions most often associated with chronic arsenicosis are hyperkeratinization of the skin (especially on the palms and soles), formation of multiple hyperkeratinized corns or warts, and hyperpigmentation of the skin with interspersed spots of hypopigmentation. Numerous studies of long-term, low-level exposure to inorganic arsenic in humans have reported the presence of these lesions. In general, they begin to manifest at chronic exposure levels >0.02 mg As/kg/day. Chronic oral studies of lower exposure levels, ranging from 0.0004 to 0.01 mg As/kg/day, have generally not reported dermal effects. However, in a study with detailed exposure assessment, all confirmed cases of skin lesions ingested water containing >100 μg/L arsenic (approximately 0.0037 mg As/kg/day) and the lowest known peak arsenic concentration ingested by a case was 0.115 μg/L (approximately 0.0043 mg As/kg/day). Another large study reported increased incidence of skin lesions associated with estimated doses of 0.0012 mg As/kg/day (0.023 mg As/L drinking water). The mechanism(s) by which inorganic arsenic causes dermal effects is not well-understood. Elucidating the mechanism of dermal effects has been particularly difficult because the dermal effects common in humans have not been seen in studies in

Dermal effects have also been reported following inhalation exposures to inorganic arsenic, although they are not as diagnostic as for oral exposure. Several studies of arsenic-exposed workers have reported the development of dermatitis; exposure levels required to produce this condition are not well-established. Altered dermal pigmentation and hyperkeratosis have also been reported in studies of humans exposed to inorganic arsenic by inhalation, although exposure levels have varied considerably. Direct dermal contact

with inorganic arsenicals may cause irritation and contact dermatitis. Usually, the effects are mild (erythema and swelling), but may progress to papules, vesicles, or necrotic lesions in extreme cases; these conditions tend to heal without treatment if exposure ceases.

Cardiovascular Effects. A large number of studies in humans have reported cardiovascular effects following oral exposure to inorganic arsenic compounds. The cardiac effects of arsenic exposure are numerous, and include altered myocardial depolarization (prolonged QT interval, nonspecific ST segment changes), cardiac arrhythmias, and ischemic heart disease. These effects have been seen after acute and long-term exposure to inorganic arsenic in the environment, as well as side effects from intravenous therapy with arsenic trioxide for acute promyelocytic leukemia. Exposure levels for environmental exposures have not been well characterized, but intravenous doses for arsenic trioxide therapy are generally on the order of 0.15 mg As/kg/day.

Chronic exposure to inorganic arsenic has also been shown to lead to effects on the vascular system. The most dramatic of these effects is "Blackfoot Disease," a disease characterized by a progressive loss of circulation in the hands and feet, leading ultimately to necrosis and gangrene. Blackfoot Disease is endemic in an area of Taiwan where average drinking water levels of arsenic range from 0.17 to 0.80 ppm, corresponding to doses of about 0.014-0.65 mg As/kg/day. The results of a another study suggested that individuals with a lower capacity to methylate inorganic arsenic to DMA have a higher risk of developing peripheral vascular disease in the Blackfoot Disease-hyperendemic area in Taiwan.

Arsenic exposure in Taiwan has also been associated with an increased incidence of cerebrovascular and microvascular diseases and ischemic heart disease. While Blackfoot Disease itself has not been reported outside of Taiwan, other vascular effects are common in areas with high arsenic exposures, and include such severe effects as increases in the incidences of Raynaud's disease and of cyanosis of fingers and toes as well as hypertension, thickening and vascular occlusion of blood vessels, and other unspecified cardiovascular conditions. However, while the majority of human studies have reported cardiovascular effects following exposure to inorganic arsenic, some have found no such effects.

Changes in cardiac rhythm and in some vascular end points have also been reported in animal studies of inorganic arsenicals, but generally only at higher exposure levels and not to the degree of severity seen in

**Respiratory Effects.** While case reports and small cohort studies have routinely reported an increase in respiratory symptoms of humans exposed occupationally to inorganic arsenic, dose-response data for

these symptoms are generally lacking. The only study that evaluated respiratory effects (changes in chest x-ray or respiratory performance) and reported an exposure estimate did not report significant changes at an exposure level of 0.613 mg As/m<sup>3</sup>. Exposed workers often report irritation of the mucous membranes of the nose and throat, which may lead to laryngitis, bronchitis, or rhinitis. Increased mortality due to respiratory disease has been reported in some cohort mortality studies of arsenic-exposed workers, but no conclusive evidence of an association of these diseases with arsenic exposure has been presented. It is not known whether respiratory effects following inhaled inorganic arsenic compounds are due to a direct effect of arsenic on respiratory tissues, general effects of foreign material in the lungs, or an effect of arsenic on the pulmonary vasculature. Similar responses, including rales, labored breathing, and respiratory hyperplasia, have been noted in animal studies of inhaled or instilled inorganic arsenic

Respiratory effects have also been reported following oral exposure of humans to inorganic arsenic. Acute oral exposure to ≥8 mg As/kg may result in serious respiratory effects, including respiratory distress, hemorrhagic bronchitis, and pulmonary edema; however, it is not clear whether these are primary effects or are the result of damage to the pulmonary vascular system. In general, respiratory effects have not been widely associated with long-term oral exposure to low arsenic doses. However, some studies have reported minor respiratory symptoms, such as cough, sputum, rhinorrhea, and sore throat, in people with repeated oral exposure to 0.03–0.05 mg As/kg/day. More serious respiratory effects, such as bronchitis and sequelae (bronchiectasis, bronchopneumonia) have been observed in patients chronically exposed to arsenic and at autopsy in some chronic poisoning cases. There are few animal data reporting respiratory effects of oral exposure to inorganic arsenic, and those studies generally found effects only at very high dose levels.

Gastrointestinal Effects. Both short-term and chronic oral exposures to inorganic arsenicals have been reported to result in irritant effects on gastrointestinal tissues. Numerous studies of acute, high-dose exposure to inorganic arsenicals have reported nausea, vomiting, diarrhea, and abdominal pain, although specific dose levels associated with the onset of these symptoms have not been identified. Chronic oral exposure to 0.01 mg As/kg/day generally results in similar reported symptoms. For both acute and chronic exposures, the gastrointestinal effects generally diminish or resolve with cessation of exposure. Similar gastrointestinal effects have been reported after occupational exposures to inorganic arsenicals, although it is not known if these effects were due to absorption of arsenic from the respiratory tract or from mucociliary clearance resulting in eventual oral exposure.

Neurological Effects. A common effect following both oral and inhalation exposure to inorganic is the development of peripheral neuropathy. Following occupational exposure to inorganic arsenic in pesticide plants or smelters, exposed workers have shown increased incidence of neurological changes, including altered nerve conduction velocities. One study reported that these effects were seen after 28 years of exposure to 0.31 mg As/m³. In another study, signs and symptoms of sensory and motor polyneuropathy on both upper and lower extremities were reported in workers at a power station in Slovakia. The average length of exposure was 22.3 years (standard deviation [SD] ±8.4 years) and the average arsenic exposure in inhaled air ranged from 4.6 to 142.7 μg/m³.

Following high-dose (>2 mg As/kg/day) acute oral exposures to inorganic arsenicals in humans, reported effects include headache, lethargy, mental confusion, hallucination, seizures, and coma. Following longer-term exposure to 0.03-4.1 mg As/kg/day, peripheral neuropathy, characterized initially by numbness of the hands and feet and a "pins and needles" sensation and progressing to muscle weakness, wrist-drop and/or ankle-drop, diminished sensitivity, and altered reflex action. Histological features of the neuropathy include a dying-back axonopathy and demyelination. Following removal from exposure, the neuropathy is only partially reversible and what recovery does occur is generally slow. Reports of neurological effects at lower arsenic levels (0.004-4.006 mg As/kg/day) have been inconsistent, with some human studies reporting fatigue, headache, depression, dizziness, insomnia, nightmare, and numbness while others reported no neurological effects. Some studies also have reported that exposure to arsenic may be associated with intellectual deficits in children. Neurological effects have also been reported in oral studies of arsenic toxicity in animals, although these were generally performed at higher doses (0.4–26.6 mg As/kg/day) than has been reported in exposed human populations. The mechanism(s) of arsenic-induced neurological changes has not been determined.

**Cancer.** There is clear evidence from studies in humans that exposure to inorganic arsenic by either the inhalation or oral routes increases the risk of cancer. Numerous studies of copper smelters or miners exposed to arsenic trioxide have reported an increased risk of lung cancer. Increased incidence of lung cancer has also been observed at chemical plants where exposure was primarily to arsenate. Other studies suggest that residents living near smelters or arsenical chemical plants may have increased risk of lung cancer, although the reported increases are small and are not clearly detectable in all cases. In general, studies reporting long-term exposure to 0.07 mg As/m³ or greater have shown an increased incidence of lung cancer, while at lower exposure levels, the association has been less clear or not present.

There is convincing evidence from a large number of epidemiological studies and case reports that ingestion of inorganic arsenic increases the risk of developing skin cancer. The most common tumors seen are squamous cell carcinomas, which may develop from the hyperkeratotic warts or coms commonly seen as a dermal effect of oral inorganic arsenic exposure. Early studies of populations within the United States did not suggest an increased risk of cancer from oral inorganic arsenic exposure. Later studies have found suggestive evidence that the possibility of arsenic-induced skin cancers cannot be discounted based on an association between toenail arsenic levels and incidence of skin cancer.

There is increasing evidence that long-term exposure to arsenic can result in the development of bladder cancer, with transitional cell cancers being the most prevalent. While studies have noted statistical dose-response trends in arsenic-induced bladder cancers, reliable quantitative assessments of dose-response relationships have not been presented. Several studies have also shown that chronic oral exposure to arsenic results in the development of respiratory tumors, making lung cancer an established cause of death from exposure to arsenic in drinking water. Exposure levels in studies evaluating respiratory and bladder cancers have been comparable to those in studies evaluating skin tumors. Studies of U.S. populations have not identified an increased risk of bladder or respiratory tumors following oral exposure to inorganic

Animal studies of both inhalation and oral exposure to inorganic arsenicals have not resulted in increased incidence of cancer formation in adult animals. However, a series of studies have shown that inorganic arsenic can induce cancer in the offspring from mice exposed to arsenic during gestation (transplacental carcinogen) and acts as a co-carcinogen with UV light and polycyclic aromatic hydrocarbons (PAHs).

Organic Arsenicals. Humans may be exposed to organic arsenicals via inhalation of dusts, ingestion of organic arsenic in water, food, soil, or dermal contact with contaminated soil, water or plants following pesticide application. There are limited data on the toxicity of organic arsenicals following inhalation exposure in humans and animals and these data do not allow for identification of critical effects.

Keratosis was observed in workers exposed to 0.065 mg/m³ arsanilic acid (i.e., 4-aminophenyl arsenic acid); no alterations in gastrointestinal symptoms or hematological alterations were observed. In animals, very high concentrations (>3,000 mg/m³) of DMA results in respiratory distress, diarrhea, and erythematous lesions on the feet and ears. No adverse effects were observed in rats exposed to DMA concentrations as high as 100 mg DMA/m³ for 95 days.

Similarly, the available dermal toxicity data do not allow for identification of critical effects. Contact dermatitis was observed in workers applying DMA (and its sodium salt) and mild dermal irritation was observed in a Draize test in rabbits (adverse effect level not reported). Intermediate duration (21 days) exposure studies in rabbits did not result in systemic toxicity or skin irritation following 5 day/week exposure to 1,000 mg/kg/day MMA or DMA.

The preponderance of toxicity data for organic arsenicals involves oral exposure. Human data are limited to three case reports of individuals intentionally ingesting pesticides containing organic arsenicals. Gastrointestinal irritation (vomiting, nausea, and diamhea) were consistently reported in these cases. Animal data has primarily focused on the toxicity of MMA, DMA, and roxarsone; these data suggest that the targets of toxicity may differ between the compounds.

MMA. The gastrointestinal tract appears to be the most sensitive target of toxicity for MMA. Diarrhea and tissue damage in the large intestine have been reported in several animal species following dietary, gavage, and capsule exposure. For diarrhea, both the time of onset and incidence appear to be doserelated. In rats, diarrhea was observed in 100% of females exposed to 98.5 mg MMA/kg/day, 55% of females exposed to 33.9 mg MMA/kg/day, and 5.1% of females exposed to 3.9 mg MMA/kg/day. The increased incidence of diarrhea was observed after 3 weeks of exposure to 98.5 mg MMA/kg/day, 4 weeks at 33.9 mg MMA/kg/day, and 18 months at 3.9 mg MMA/kg/day. Histological damage consisting of squamous metaplasia of the epithelial columnar absorptive cells in the cecum, colon, and rectum was observed in rats and mice chronically exposed to 72.4 or 67.1 mg MMA/kg/day, respectively. Hemorrhagic, necrotic, ulcerated, or perforated mucosa were also observed in the large intestine of rats exposed to 67.1 mg MMA/kg/day for 2 years. In rats, the damage to the large intestine resulted in intestinal contents leaking into the abdominal cavity and the development of peritonitis. The available data provide suggestive evidence that there may be some species differences in the sensitivity to gastrointestinal damage; however, some of these differences may be due to the route of administration. The lowest adverse effect levels, regardless of duration of exposure, for gastrointestinal effects in rats, mice, rabbits, and dogs are 25.7, 67.1, 12, and 2 mg MMA/kg/day, respectively; the no adverse effect levels in rats and mice (NOAELs were not identified in rabbits and dogs) were 3.0 and 24.9 mg MMA/kg/day. However, the rabbit and dog studies involved bolus administration (gavage and capsule administration), which may have increased sensitivity; the rat and mouse studies involved dietary exposure.

The kidney also appears to be a sensitive target in rats and mice chronically exposed to MMA. An increase in the severity of progressive glomemlonephropathy was observed in female rats exposed to 33.9 mg MMA/kg/day for 2 years and an increase in the incidence of progressive glomemlonephropathy was observed in male mice exposed to 6.0 mg MMA/kg/day for 2 years. Other adverse effects that have been observed in animals exposed to MMA include hypertrophy of the thyroid follicular cells in rats exposed to 33.9 mg MMA/kg/day in the diet for 2 years, reproductive toxicity, and developmental toxicity. Decreases in pregnancy rate and male fertility index were observed in F<sub>0</sub> and F<sub>1</sub> rats exposed to 76 mg MMA/kg/day for 14 weeks prior to mating and during the mating period; the findings were not significantly different than control values but were considered treatment-related because they were outside the range found in historical controls. This study also reported a decrease in pup survival in the F<sub>1</sub> and F<sub>2</sub> offspring of rats exposed to 76 mg MMA/kg/day; as with the reproductive effects, the incidence was not statistically different from controls but was considered biologically significant because survival in the MMA pups was outside the range found in historical controls. Another study reported impaired fetal growth (decreases in fetal weights and incomplete ossification) and minor skeletal defects (an increase in the number of fetuses with supernumerary thoracic ribs and eight lumbar vertebrae) in rat and rabbit fetuses exposed to 500 or 12mg MMA/kg/day, respectively; maternal toxicity was also observed at these dose levels and the effects may be secondary to maternal stress rather than a direct effect on the developing organisms. A 2-year bioassay did not result in significant increases in the incidence of neoplastic lesions in rats and mice exposed to doses as high as 72.4 and 67.1 mg MMA/kg/day, respectively.

DMA. The most sensitive targets of DMA toxicity in rats are the urinary bladder and kidneys. In the bladder, the effects progress from cytotoxicity to cellular necrosis to regenerative proliferation and hyperplasia. At dietary doses of 11 mg DMA/kg/day, cytotoxicity is observed as early as 6 hours after exposure initiation and cellular proliferation (as evident by increased BrdU labeling) was observed after 2 weeks of exposure. After 10 weeks of exposure, necrosis and hyperplasia were also observed. The lowest adverse effect levels for urinary bladder effects following intermediate or chronic duration exposure were 5 mg DMA/kg/day for evidence of regenerative proliferation and 3.1 mg DMA/kg/day for vacuolar degeneration of urothelium and hyperplasia. Vacuolization of the superficial cells of the urothelium was observed in mice exposed to 7.8 mg DMA/kg/day and higher for 2 years. However, unlike the vacuolar degeneration observed in rats, the vacuolization observed in mice was not associated with cytotoxicity, necrosis, inflammation, or hyperplasia.

Kidney damage characterized by increased urinary calcium levels, calcification, nephrocalcinosis, and necrosis of the renal papillae have been observed in rats following intermediate- or chronic-duration exposure. Increases in urine calcium levels and corticomedullary junction calcification were observed in rats exposed to 5 or 10 mg DMA/kg/day for 10 weeks and cortical degeneration and necrosis were observed in rats exposed to 57 mg DMA/kg/day for 4 weeks. Chronic-duration exposure to 3.1 mg DMA/kg/day resulted in an increased incidence of nephrocalcinosis and necrosis of the renal papillae in rats; these lesions are typical in aged rats, although DMA exposure appeared to exacerbate them. An exacerbation of age-related kidney lesion (progressive glomerulonephropathy and nephrocalcinosis) has also been observed in male inice exposed to 37 or 94 mg DMA/kg/day, respectively, for 2 years. A consistent finding in intermediate and chronic rat studies is an increase in mine volume, which corresponds to an increase in water consumption; the toxicological significance of this finding is not known. The observed decreases in electrolyte levels and specific gravity are likely due to the higher urine volume.

Although gastrointestinal effects have been observed in animals exposed to DMA, it does not appear to be as sensitive a target compared to MMA. Diarrhea has been observed in rats exposed to a lethal dose of 190 mg DMA/kg/day for 4 weeks and in dogs administered via 16 mg DMA/kg/day. No gastrointestinal effects were observed in rats or mice chronically exposed to 7.8 or 94 mg DMA/kg/day.

Other adverse effects that have been observed in animals exposed to organic arsenicals include hypertrophy of thyroid follicular cells in rats exposed to 4.0 mg DMA/kg/day in the diet for 13 weeks and 7.8 mg DMA/kg/day in the diet for 2 years and developmental effects in rats and mice. Decreases in fetal growth and delays in ossification have been observed in rat fetuses exposed to ≥36 mg DMA/kg/day; these alterations typically occur at doses associated with decreases in maternal weight gain. Other developmental effects that have been reported include an increase in the incidences of irregular palatine rugae in rats exposed to 30 mg DMA/kg/day, diaphragmatic hernia in rats exposed to 36 mg DMA/kg/day, and cleft palate in mice exposed to 40€ mg DMA/kg/day. No developmental effects were observed in rabbits exposed to 12 mg DMA/kg/day.

The available data provide strong evidence that DMA is carcinogenic in rats. A 2-year exposure to DMA resulted in significant increases in the incidence of neoplastic urinary bladder tumors in rats exposed to 7.8 mg DMA/kg/day in the diet or 3.4 mg DMA/kg/day in drinking water. No increases in neoplastic tumors were observed in mice exposed to doses as high as 94 mg DMA/kg/day for 2 years; however, a

## Respiratory Effects.

Inorganic Arsenicals. Workers exposed to arsenic dusts in air often experience irritation to the mucous membranes of the nose and throat. This may lead to laryngitis, bronchitis, or rhinitis (Dunlap 1921; Morton and Caron 1989; Pinto and McGill 1953), and very high exposures (characteristic of workplace exposures in the past) can cause perforation of the nasal septum (Dunlap 1921; Pinto and McGill 1953; Sandstrom et al. 1989). Despite the known respiratory irritant effects of arsenic, there have been few systematic investigations of respiratory effects in humans exposed to arsenic. Perry et al. (1948) found no difference in chest x-rays or respiratory performance (vital capacity and exercise-tolerance tests) between unexposed and exposed workers in a cross-sectional study at a factory where sodium arsenite was prepared. The NOAEL of 0.613 mg As/m<sup>3</sup> for respiratory effects in this study is shown in Table 3-1 and plotted in Figure 3-1.

Increased mortality due to respiratory disease has been reported in some cohort mortality studies of arsenic-exposed workers, but no conclusive evidence of an association with arsenic has been produced. In studies of workers exposed to arsenic trioxide at the Anaconda copper smelter in Montana, mortality due to noncancer respiratory disease (e.g., emphysema) was significantly increased compared to the general population (Lee-Feldstein 1983; Lubin et al. 2000; Welch et al. 1982). However, the data were not adjusted for smoking (a well-known confounder for respiratory disease), and analysis of the data with respect to arsenic exposure level did not show a clear dose-response. Similarly, Enterline et al. (1995) found a significant excess of nonmalignant respiratory disease mortality in workers at the ASARCO copper smelter in Tacoma, Washington, but only a slight negative relation to cumulative arsenic exposure. Xuan et al. (1993) found an increase in the relative risk of mortality from pneumoconiosis associated with arsenic exposure in a cohort of tin miners in China. However, this finding was based on a small number of observations (n=32), a clear exposure-response relationship with arsenic was not established, and the miners experienced confounding exposures to dust (a known risk factor for pneumoconiosis) and to radon. These studies were all considered to be inconclusive as to the relationship between inhaled inorganic arsenic and respiratory disease.

Respiratory symptoms were observed in a study of developmental effects in rats. Pregnant female rats exposed to arsenic trioxide dust starting 14 days prior to making and continuing through mating and gestation exhibited rales at 8 mg As/m³ and labored breathing and gasping at 20 mg As/m³, with no symptoms at 2 mg As/m³ (Holson et al. 1999). The lungs were examined by gross necropsy and no lesions were found. Intratracheal instillation of arsenic trioxide (13 mg As/kg) or gallium arsenide (1.5–

52 mg As/kg) can cause marked irritation and hyperplasia in the lungs of rats and hamsters (Goering et al. 1988; Ohyama et al. 1988; Webb et al. 1986, 1987). Since this sort of response is produced by a number of respirable particulate materials, it is likely that the inflammatory response is not specifically due to the arsenic.

Organic Arsenicals. No studies were located regarding respiratory effects in humans exposed to organic arsenicals. Short-term exposure of rats and mice to high concentrations (≥4,000 mg/m³) of DMA caused respiratory distress, and necropsy of animals that died revealed bright red lungs with dark spots (Stevens et al. 1979). Respiratory distress was also observed in rats and mice exposed to high levels (≥6,100 mg/m³) of the disodium salt of MMA (Stevens et al. 1979), although none of the MMA-exposed animals died. Respiratory distress appears to be associated with inhalation of very high concentrations of organic arsenicals. In 5-minute whole-body plethysmography trials, DMA and the disodium salt of MMA had RD₅0 (concentration calculated to produce a 50% decrease in respiration rate) values of 3,150 and 1,540 mg/m³, respectively (Stevens et al. 1979). Based on these RD₅0 values, neither DMA nor MMA is considered to be a potent respiratory irritant. At low concentrations of DMA (34 or 100 mg DMA/m³), an increase in intracytoplasmic eosinophilic globules were found in the nasal turbinates of rats exposed to DMA 6 hours/day, 5 days/week for 67-68 exposures (Whitman 1994).

## Cardiovascular Effects.

Inorganic Arsenicals. There is some evidence from epidemiological studies that inhaled inorganic arsenic can produce effects on the cardiovascular system. Cardiovascular effects following oral exposure to arsenic are well known (see Section 3.2.2.2). A cross-sectional study of workers exposed to an estimated time-weighted average of 0.36 mg As/m³ (as arsenic trioxide) at the Ronnskar copper smelter in Sweden for an average of 23 years showed that smelter workers had significantly increased incidences of Raynaud's phenomenon (a peripheral vascular disease characterized by spasm of the digital arteries and numbness of the fingers) and showed increased vasospasticity (constriction of blood vessels) in response to cold when tested in the fingers (Lagerkvist et al. 1986). A follow-up study conducted 2–3 years later found that vasospasticity measurements in exposed workers had improved concurrent with a reduction in arsenic exposure levels, although symptoms of peripheral vascular effects (cold hands or feet, white fingers, numbness in fingers or feet) were still common (Lagerkvist et al. 1988). A cross-sectional study including 46 workers in Denmark with varying, unquantified occupational exposure to arsenic in different occupations found that systolic blood pressure was significantly increased in the arsenic workers (median=125 mmHg) compared with controls (median=117 mmHg) (Jensen and Hansen 1998). Diastolic

pressure was also increased in this study (77.9 vs. 74.7 mmHg), although the difference from controls was not statistically significant.

Cohort mortality studies of arsenic-exposed workers at the ASARCO copper smelter in Tacoma, Washington (Enterline et al. 1995), Anaconda copper smelter in Montana (Lee-Feldstein 1983; Welch et al. 1982), Ronnskar copper smelter in Sweden (Wall 1980), orchard workers in Washington state (Tollestrup et al. 1995), and tin miners in China (Qiao et al. 1997; Xuan et al. 1993) have all reported increased risk of mortality from cardiovascular disease, specifically ischemic heart disease and cerebrovascular disease, in the cohorts studied. However, none of these studies provided conclusive evidence that the observed increase in risk was due to arsenic exposure. The studies in the ASARCO and Anaconda copper smelter workers failed to find a clear dose-response relationship with arsenic (Enterline et al. 1995; Welch et al. 1982), while a follow-up study of the Ronnskar smelter workers not only found lack of a dose-response, but also that the risk of cardiovascular disease was no longer elevated in the cohort (Järup et al. 1989). The studies in orchard workers and tin miners were limited by confounding exposures to copper, lead, and radon, respectively (Qiao et al. 1997; Tollestrup et al. 1995). The risk of cardiovascular disease mortality in the tin miners not only showed no dose-response relationship with arsenic exposure, but was positively associated with radon exposure, suggesting that radon may have been responsible for the increased cardiovascular risk in this cohort (Xuan et al. 1993).

The LOAEL for Raynaud's phenomenon and vasospasticity identified by Lagerkvist et al. (1986) is shown in Table 3-1 and Figure 3-1. No studies were located regarding cardiovascular effects in animals after inhalation exposure to inorganic arsenic.

*Organic Arsenicals*. No studies were located regarding cardiovascular effects in humans after inhalation exposure to organic arsenicals. No histological alterations were observed in the hearts of rats exposed to 100 mg DMA/m<sup>3</sup> for 67–68 exposures (Whitman 1994).

# Gastrointestinal Effects.

Inorganic Arsenicals. Several case studies have reported nausea, vomiting, and diarrhea in workers with acute arsenic poisoning following occupational inhalation exposure (Beckett et al. 1986; Bolla-Wilson and Bleecker 1987; Ide and Bullough 1988; Morton and Caron 1989; Pinto and McGill 1953). Although gastrointestinal effects are not typically associated with arsenic poisoning by inhalation (Pinto and McGill 1953), such effects are a common feature of oral ingestion of high doses of arsenic (see Section 3.2.2.2),

and it is possible that mucociliary transport of arsenic dust from the lungs to the gut could be responsible for the effects in these cases. Exposure levels were not reliably estimated for any of these cases.

The only report of gastrointestinal effects of inhaled inorganic arsenic in animals was a developmental toxicology study in which four of nine pregnant rats died, and one rat was euthanized *in extremis*, between days 12 and 19 of gestation after 30–35 days of exposure to an aerosol of arsenic wioxide at an exposure concentration of 20 mg As/m³ (Holson et al. 1999). These animals exhibited severe hyperemia and plasma discharge into the intestinal lumen at autopsy. Exposure to 8 mg As/m³ did not produce gross gastrointestinal lesions.

Organic Arsenicals. Data regarding gastrointestinal effects in people exposed to organic arsenic in the air are limited. The frequency of gastrointestinal complaints was no higher than controls in workers exposed to arsanilic acid (i.e., 4-aminophenyl arsonic acid) at mean concentrations up to 0.17 mg/m³ in a chemical factory (Watrous and McCaughey 1945). However, this sort of data might easily be biased by workers who chose not to complain about minor symptoms, so no conclusion can be reached. Rats and mice exposed to very high levels (above 3,000 mg/m³) of MMA (disodium salt) or DMA experienced diarrhea (Stevens et al. 1979). The diarrhea could be due to transport of inhaled particulate material from the lungs to the gastrointestinal system or to direct ingestion of the compound (e.g., from grooming of the fur). No gastrointestinal effects were observed in rats repeatedly exposed to 100 mg DMA/m³ 6 hours/day, 5 days/week for 67–68 exposures (Whitman 1994).

#### Hematological Effects.

Inorganic Arsenicals. Although anernia is a common feature of arsenic poisoning following oral exposure in humans (see Section 3.2.2.2), case studies of workers with arsenic poisoning from occupational inhalation exposure reported no effects on red blood cell count (Beckett et al. 1986; Bolla-Wilson and Bleecker 1987; Ide and Bullough 1988; Morton and Caron 1989). The reason for this apparent route specificity is not clear, but might simply be related to dose. No studies were located regarding hematological effects in animals after inhalation exposure to inorganic arsenicals.

*Organic Arsenicals*. No effect on levels of hemoglobin, red cells, or white cells was detected in the blood of manufacturing workers (323 counts in 35 workers) exposed to airborne arsanilic acid dusts at a mean concentration of 0.17 mg/m<sup>3</sup> in the workplace (Watrous and McCaughey 1945). Controls were an unspecified number of unexposed manufacturing workers with 221 complete blood counts. No

hematological alterations were observed in rats exposed to  $100 \text{ mg DMA/m}^3$  for an intermediate duration (Whitman 1994).

### Musculoskeletal Effects.

Inorganic Arsenicals. Few data were located regarding musculoskeletal effects associated with inhalation exposure to inorganic arsenic, and none to suggest the existence of any such effects. Electromyographic examination of the calves and feet showed no differences between control and arsenic-exposed workers in a cross-sectional study of workers at the Ronnskar copper smelter in Sweden (Blom et al. 1985). No studies were located regarding musculoskeletal effects in animals after inhalation exposure to inorganic arsenicals.

*Organic Arsenicals*. No studies were located regarding musculoskeletal effects in humans or animals after inhalation exposure to organic arsenicals.

## Hepatic Effects.

Inorganic Arsenicals. There is no evidence that inhaled inorganic arsenic produces effects on the liver, although few data are available. Case studies of workers with inhalation arsenic poisoning that included liver function tests did not find any evidence of hepatic dysfunction (Bolla-Wilson and Bleecker 1987; Ide and Bullough 1988). No studies were located regarding hepatic effects in animals after inhalation exposure to inorganic arsenicals.

*Organic Arsenicals*. No studies were located regarding hepatic effects in humans after inhalation exposure to organic arsenicals. No histological alterations were observed in the livers of rats exposed to 100 mg DMA/m<sup>3</sup> for 67–68 exposures (Whitman 1994).

## Renal Effects.

Inorganic Arsenicals. The limited data available do not suggest any relationship between inhalation of inorganic arsenic and kidney effects. A cross-sectional study of renal function parameters in glass factory workers exposed to arsenic (concentrations unknown) found no meaningful differences from controls in urinary levels of several proteins (albumin, retinol binding protein,  $\beta_2$ -microglobulin, brush-border antigen) used as markers of glomerular damage or tubular cell exfoliation (Foà et al. 1987). Routine

clinical urinalysis was normal when included in case studies of workers with inhalation arsenic poisoning (Ide and Bullough 1988; Morton and Caron 1989). No studies were located regarding renal effects in animals after inhalation exposure to inorganic arsenicals.

*Organic Arsenicals*. No studies were located regarding renal effects in humans after inhalation exposure to organic arsenicals. No renal effects were reported in rats exposed to 100 mg DMA/m<sup>3</sup> 6 hours/day, 5 days/week for 67-68 exposures (Whitman 1994).

# **Dermal Effects.**

Inorganic Arsenicals. Dermatitis has frequently been observed in industrial workers exposed to inorganic arsenic in the air, with the highest rates occurring in the workers with the greatest arsenic exposure (Cöl et al. 1999; Dunlap 1921; Holmqvist 1951; Lagerkvist et al. 1986; Pinto and McGill 1953). Limited quantitative information is available regarding the exposure levels that produce dermatitis, and the high likelihood of co-exposure by the dermal route makes dose-response analysis difficult. A cross-sectional study of workers at a factory where sodium arsenite was prepared found that workers with the highest arsenic exposure (mean air levels ranging from 0.384 to 1.034 mg As/m³ and estimated to average 0.613 mg As/m³) tended to be grossly pigmented with hyperkeratinization of exposed skin and to have multiple warts (Perry et al. 1948). In the same study, workers with lower arsenic exposure (estimated to average 0.078 mg As/m³) were much less affected, but still had a higher incidence of pigmentation keratosis than controls. LOAEL values identified by Perry et al. (1948) and Mohamed (1998) are shown in Table 3-1 and Figure 3-1. NOAEL values for dermal irritation have not been identified. Dermal effects (hyperkeratoses, hyperpigmentation) are also very common in people exposed to inorganic arsenic by the oral route (see Section 3.2.2.2). No studies were located on dermal effects in animals after inhalation exposure to inorganic arsenicals.

Organic Arsenicals. Data regarding dermal effects in people exposed to organic arsenic in the air are limited. Complaints of keratosis were roughly 2-fold higher than unexposed controls in female packaging workers exposed to arsanilic acid at an average concentration of 0.065 mg/m³ and in male manufacturing workers exposed to an average concentration of 0.17 mg/m³ in a chemical factory (Watrous and McCaughey 1945). Limitations in study methodology (e.g., alternate sources of effects were not investigated, workers might choose not to report minor complaints to company officials) make the reliability of this observation uncertain. Female rats exposed to DMA at 6,900 mg/m³ developed erythematous lesions on the feet and ears (Stevens et al. 1979); these lesions did not develop in females

exposed at lower concentrations (4,100 mg/m<sup>3</sup>) or males. It seems likely that these effects were due to direct irritation from dermal contact with the dust. No dermal effects were observed in rats repeatedly exposed to lower levels of DMA (100 mg/m<sup>3</sup>) (Whitman 1994).

### Ocular Effects.

Inorganic Arsenicals. Chemical conjunctivitis, characterized by redness, swelling, and pain, has been observed in workers exposed to arsenic dusts in air, usually accompanied by facial dermatitis (Dunlap 1921; Pinto and McGill 1953). No information was located regarding air levels of arsenic that produce this effect. No studies were located on ocular effects in animals after inhalation exposure to inorganic arsenicals.

Organic Arsenicals. No studies were located on ocular effects in humans after inhalation exposure to organic arsenicals. Rats and mice exposed to high concentrations of DMA (≥4,000 mg/m³) developed an encrustation around the eyes (Stevens et al. 1979). It seems likely that these effects were due to direct irritation from ocular contact with the dust.

## **Body Weight Effects.**

Inorganic Arsenicals. No studies were located on body weight effects in humans after inhalation exposure to inorganic arsenicals. Female rats exposed to arsenic trioxide dust starting 14 days before mating and continuing through mating and gestation showed a marked decrease in body weight and food consumption at 20 mg As/m³ (preliminary study) and a smaller decrease at 8 mg As/m³ (definitive study), with no effect at 2 mg As/m³ (Holson et al. 1999).

Organic Arsenicals. No studies were located on body weight effects in humans after inhalation exposure to organic arsenicals. Rats and mice exposed to high concentrations of DMA (≥4,000 mg/m³) for 2 hours had an unspecified decrease in body weight gain during the subsequent 14 days (Stevens et al. 1979). No alterations in body weight gain were observed in rats exposed to 100 mg DMA/m³ for 67–68 exposures (Whitman 1994).

## 3.2.1.3 Immunological and Lymphoreticular Effects

Inorganic Arsenicals. A single study was located regarding the immunological and lymphoreticular effects of inhaled inorganic arsenic in humans. Bencko et al. (1988) detected no abnormalities in serum levels of immunoglobins in 47 workers exposed to arsenic (exposure levels not measured) in a coalburning power plant. However, serum levels of other proteins such as transferrin, orosomucoid, and ceruloplasmin were significantly elevated compared to levels in a group of 27 workers from a different plant in which the arsenic content in the coal was 10 times lower. The investigators suggested that the increased levels of ceruloplasmin might be related to higher cancer mortality rates found among these workers.

The immune effects of inhaled arsenic in animals were studied by Aranyi et al. (1985). Female mice exposed to arsenic trioxide aerosol for 3 hours showed a concentration-related decrease in pulmonary bactericidal activity (presumably as a result of injury to alveolar macrophages) and a corresponding concentration-related increase in susceptibility to introduced respiratory bacterial pathogens. Similar results were found when the exposure was repeated over 1- and 4-week periods. The NOAEL and LOAEL values for this study are shown in Table 3-1 and Figure 3-1.

Intratracheal studies in animals offer some support for an immune effect of inhaled inorganic arsenic. Decreases in humoral response to antigens and in several complement proteins were noted in mice given an intratracheal dose of 5.7 mg As/kg as sodium arsenite (Sikorskii et al. 1989), although these changes were not accompanied by any decrease in resistance to bacterial or tumor cell challenges. Animals given an intratracheal dose of GaAs (25 mg As/kg or higher) also displayed a variety of changes in numerous immunological end points (some increased, some decreased) (Burns and Munson 1993; Sikorski et al. 1989). Whether these effects were due to a direct effect on the immune system or were secondary to the inflammatory effect of GaAs on the lung (see Section 3.2.1.2, above) is uncertain.

*Organic Arsenicals.* No studies were located regarding immunological and lymphoreticular effects in humans or animals after inhalation exposure to organic arsenicals.

## 3.2.1.4 Neurological Effects

Inorganic Arsenicals. There is evidence from epidemiological studies that inhaled inorganic arsenic can produce neurological effects. A study by Gerr et al. (2000) reported an elevated incidence of peripheral neuropathy in subjects who lived near an arsenic-using pesticide plant (13/85=15.3%; odds ratio

[OR]=5.1, p=0.004), relative to subjects who lived farther from the plant (4/118=3.4%). Concentrations of arsenic in soil and house dust were elevated (~30–300 µg As/g) for residences near the plant, according to 1993-1995 monitoring data. Studies of copper smelter workers at the ASARCO smelter in Tacoma, Washington (Feldman et al. 1979), a power station in Slovakia (Buchancová et al. 1998), and the Ronnskar smelter in Sweden (Blom et al. 1985; Lagerkvist and Zetterlund 1994) have demonstrated peripheral neurological effects in workers associated with arsenic trioxide exposure. At the ASARCO smelter, the prevalence of clinically diagnosed peripheral neuropathy was markedly higher in arsenicexposed workers (26/61=43%) than controls (4/33=12%), and although the difference in mean nerve conduction velocities (NCV) was not statistically significant, mean peroneal motor NCV was lower in arsenic-exposed workers than controls and all 12 cases of abnormally low NCV occurred in the arsenic group (Feldman et al. 1979). In the study of 70 workers in Slovakia, the investigators described 16 cases of arsenic intoxication. Among these, 13 had signs and symptoms of sensory and motor polyneuropathy on both upper and lower extremities, 10 were diagnosed with pseudoneurasthenic syndrome, and 6 suffered from toxic encephalopathy (Buchancová et al. 1998). The average length of exposure was 22.3 years (SD  $\pm 8.4$  years) and the average arsenic exposure in inhaled air ranged from 4.6 to 142.7 µg/m<sup>3</sup>. Similar results were observed at the Ronnskar smelter, where Blom et al. (1985) reported significantly increased prevalence of workers with abnormally low NCV in the exposed group, and lower, but not statistically significant, mean NCV in five peripheral nerves. A follow-up study on the Ronnskar workers 5 years later found that the prevalence of abnormally low NCV remained significantly increased in the exposed workers, but that the decrease in mean NCV was now also statistically significant in the tibial (motor) and sural (sensory) nerves (Lagerkvist and Zetterlund 1994). Blood lead was monitored in this study as a potential confounder, but levels were low and not considered likely by the researchers to have had any influence on the results. The follow-up Ronnskar study provided enough information to estimate that mean arsenic exposure was 0.31 mg As/m<sup>3</sup> and lasted an average of 28 years in the exposed group, and this LOAEL is shown in Table 3-1 and Figure 3-1.

The literature also contains several case studies of workers with inhalation arsenic poisoning who developed neurological symptoms. Although these studies do not provide reliable information on exposure levels or conclusive evidence that the observed effects were related to arsenic, the findings are suggestive. Symptoms in these cases included not only indicators of peripheral neuropathy (numbness, loss of reflexes, muscle weakness, tremors) (Ide and Bullough 1988; Morton and Caron 1989), but also frank encephalopathy (hallucinations, agitation, emotional lability, memory loss) (Beckett et al. 1986; Bolla-Wilson and Bleecker 1987; Morton and Caron 1989). Both peripheral neuropathy and encephalopathy are associated with oral exposure to inorganic arsenic (see Section 3.2.2.4).

The possible association between arsenic in air and neurological effects in children has also been examined. A study by Bencko et al. (1977) reported that children of approximately 10 years of age (n=56) living near a power plant burning coal of high arsenic content showed significant hearing losses (increased threshold) compared to a control group of children (n=51) living outside the polluted area (Bencko et al. 1977). The effect was most marked at low frequencies. The precise site affected within the auditory pathway was not determined and could have been in the periphery, centrally-located, or both. A small study of children in Mexico reported a significant negative correlation between tests of verbal IQ and urinary arsenic in children (n=41) living in an urban area near a smelter complex (Calderón et al. 2001). Exposure concentrations were not available in either study.

No studies were located regarding neurological effects in animals after inhalation exposure to inorganic arsenicals. Mice given a single intratracheal dose of 200 mg/kg of GaAs displayed a decrease in overall activity 6–8 hours later, but no additional neurological evaluations were conducted on these animals (Burns and Munson 1993).

Organic Arsenicals. Data regarding neurological effects in people exposed to organic arsenic in the air are limited to a single study. The frequency of central nervous system complaints was no higher than controls in workers at a chemical factory exposed to arsanilic acid at mean concentrations up to 0.17 mg/m³ (Watrous and McCaughey 1945). Although peripheral nerve complaints were higher in arsenic packaging workers (mean exposure=0.065 mg/m³) than in unexposed controls, this was not the case in manufacturing workers with higher arsenic exposure (mean=0.17 mg/m³). This suggests that the effects on the peripheral nerves in the exposed packaging workers were not due to arsenic. The reliability of these data is limited by shortcomings in the study methodology (e.g., the data might easily be biased by workers who chose not to complain about minor symptoms). No studies were located regarding neurological effects in animals after inhalation exposure to organic arsenicals.

# 3.2.1.5 Reproductive Effects

Inorganic Arsenicals. No studies were located regarding reproductive effects in humans after inhalation exposure to inorganic arsenicals. Reproductive performance was evaluated in female rats exposed to 0.08–20 mg As/m³ (preliminary study) or 0.2–8 mg As/m³ (definitive study) as As<sub>2</sub>O<sub>3</sub> 6 hours daily from 14 days prior to mating through gestation day 19 (Holson et al. 1999). No changes occurred in the precoital interval (time to mating), mating index (percentage of rats mated), or fertility index (percentage

of matings resulting in pregnancy). The NOAEL values for this study are shown in Table 3-1 and Figure 3-1.

*Organic Arsenicals*. No studies were located regarding reproductive effects in humans or animals after inhalation exposure to organic arsenicals.

# 3.2.1.6 Developmental Effects

Inorganic Arsenicals. Developmental effects associated with occupational and environmental exposure to airborne arsenic have been investigated in a series of studies at the Ronnskar copper smelter in northern Sweden (Nordström et al. 1978a, 1978b, 1979a, 1979b). In comparison to a northern Swedish reference population, female employees of the smelter had a significantly increased incidence of spontaneous abortion (Nordström et al. 1979a), and their children had a significantly increased incidence of congenital malformations (Nordström et al. 1979b) and significantly decreased average birth weight (Nordström et al. 1978a). Increased incidence of spontaneous abortion and decreased average birth weight of children were also found in populations living in close proximity to the smelter (Nordström et al. 1978a, 1978b, 1979b). While these data are suggestive of developmental effects associated with occupational and environmental exposure from the smelter, the reported effects are not large, the analyses include only limited consideration of potential confounders (e.g., smoking), and there are no data relating the apparent effects specifically to arsenic exposure.

Ihrig et al. (1998) conducted a case-control study of stillbirths in the vicinity of a Texas arsenic pesticide factory that included estimation of environmental arsenic exposures using atmospheric dispersion modeling and multiple regression analysis considering arsenic exposure, race/ethnicity, maternal age, median income, and parity as explanatory variables. There was a statistically significant increase in the risk of stillbirth in the highest exposure category (>1•0 ng As/m³, midpoint=682 ng/m³). Further analysis showed that this increase in risk was limited to people of Hispanic descent, who the researchers speculated may be an especially sensitive population due to a genetic impairment in folate metabolism. Interpretation of this study is limited by small numbers of cases and controls in the high exposure group, lack of data on smoking, potential confounding exposures to other chemicals from the factory, and failure to take into account previous years of deposition in the exposure estimates.

Arsenic has been shown to produce developmental effects by inhalation exposure in laboratory animals, although it is unclear whether or not the effects occur only at maternally toxic doses. Mice exposed to

22 mg As/m³ (as As<sub>2</sub>O<sub>3</sub>) for 4 hours on days 9–12 of gestation had serious developmental effects (significant increases in the percentage of dead fetuses, skeletal malformations, and the number of fetuses with retarded growth), while those exposed to 2.2 mg As/m³ had only a 10% decrease in average fetal body weight, and those exposed to 0.20 mg As/m³ had no effects (Nagymajtényi et al. 1985). The study was limited by failure to quantify malformations on a litter basis, discuss the nature and severity of the observed malformations, or report on the occurrence of maternal effects. No increases in fetal resorptions, fetal mortality, or malformations, and no decreases in fetal body weight occurred when rats were exposed to 0.2–8 mg As/m³ (as As<sub>2</sub>O<sub>3</sub>), 6 hours daily from 14 days prior to mating through gestation day 19 (Holson et al. 1999). At the 8 mg/m³ exposure level, toxicity was observed in the dams, including rales, a dried red exudate at the nose, and lower gains in net body weight than controls. In a preliminary dose-range study, there was a marked significant increase in postimplantation loss (primarily early resorptions) and consequent marked significant decrease in viable fetuses per litter at 20 mg As/m³, a concentration that also produced severe maternal effects including mortality (Holson et al. 1999).

The NOAEL and LOAEL values for increased risk of stillbirth in humans identified by Ilnig et al. (1998) and those for developmental effects in rodents found by Nagymajtényi et al. (1985) and Holson et al. (1999) are shown in Table 3-1 and Figure 3-1.

*Organic Arsenicals*. No studies were located regarding developmental effects in humans or animals after inhalation exposure to organic arsenicals.

#### 3.2.1.7 Cancer

Inorganic Arsenicals. There is convincing evidence from a large number of epidemiological studies that inhalation exposure to inorganic arsenic increases the risk of lung cancer. Most studies involved workers exposed primarily to arsenic trioxide dust in air at copper smelters (Axelson et al. 1978; Brown and Chu 1982, 1983a, 1983b; Enterline and Marsh 1982; Enterline et al. 1987a, 1987b, 1995; Ferreccio et al. 1996; Järup and Pershagen 1991; Järup et al. 1989; Lee and Fraumeni 1969; Lee-Feldstein 1983, 1986; Lubin et al. 2000; Mazumdar et al. 1989; Pinto et al. 1977, 1978; Sandstrom et al. 1989; Viren and Silvers 1999; Wall 1980; Welch et al. 1982) and mines (Liu and Chen 1996; Qiao et al. 1997; Taylor et al. 1989; Xuan et al. 1993), but increased incidence of lung cancer has also been observed at chemical plants where exposure was primarily to arsenate (Bulbulyan et al. 1996; Mabuchi et al. 1979; Ott et al. 1974; Sobel et al. 1988). In addition, several studies suggest that residents living near smelters or arsenical chemical plants may also have increased risk oflung cancer (Brown et al. 1984; Cordier et al. 1983; Matanoskii et

al. 1981; Pershagen 1985), although the increases are small and are not clearly detectable in all cases (e.g., Frost et al. 1987). The strongest evidence that arsenic is responsible for the observed lung cancer comes from quantitative dose-response data relating specific arsenic exposure levels to lung cancer risk. These data are available for arsenic-exposed workers at the ASARCO copper smelter in Tacoma, Washington (Enterline and Marsh 1982; Enterline et al. 1987a, 1995; Mazumdar et al. 1989), the Anaconda copper smelter in Montana (Lee-Feldstein 1986; Welch et al. 1982), eight other U.S. copper smelters (Enterline et al. 1987b), and the Ronnskar copper smelter in Sweden (Järup and Pershagen 1991; Järup et al. 1989). A common limitation of these studies is confounding exposure to other chemicals, such as sulfur dioxide, and cigarette smoking.

Enterline and Marsh (1982) reported a significant increase in respiratory cancer mortality (standard mortality ratio [SMR]=189.4) based on 104 observed respiratory cancer deaths and only 54.9 expected over the years 1941–1976 in a cohort of 2,802 male workers employed for ≥1 year between 1940 and 1964 at the ASARCO smelter. When the cohort was separated into low and high arsenic exposure groups, with mean estimated time-weighted average arsenic exposures of 0.054 and 0.157 mg As/m<sup>3</sup>, respectively (based on work history, historical urinary arsenic measurements, and an experimentally derived relationship between urinary and inhaled arsenic), respiratory cancer mortality was significantly increased in both groups in a concentration-related fashion (SMR=227.7 and 291.4 in the low and high groups, respectively). Enterline et al. (1987a) re-analyzed these data using improved exposure estimates that incorporated historical measurements of arsenic in the ambient air and personal breathing zone of workers. Respiratory cancer mortality was significantly increased in a concentration-related fashion in the low (SMR=213.0), medium (SMR=312.1), and high (SMR=340.9) arsenic exposure groups, which had mean estimated time-weighted average arsenic exposures of 0.213, 0.564, and 1.487 mg As/m<sup>3</sup>, respectively. An alternative analysis of these data by Mazumdar et al. (1989) produced similar results. Enterline et al. (1995) extended the mortality follow-up from 1976 to 1986, but reported findings similar to the earlier study in a less thorough analysis. The CEL from Enterline et al. (1987a), the most complete analysis of the ASARCO cohort with the best exposure estimates, is presented in Table 3-1 and Figure 3-1.

Respiratory cancer mortality was significantly increased (SMR=285) based on 302 observed respiratory deaths between 1938 and 1977 in a cohort of 8,045 white male workers employed for at least 1 year between 1938 and 1956 at the Anaconda smelter (Lee-Feldstein 1986). When workers were categorized according to cumulative arsenic exposure and date of hire, hmg cancer mortality was significantly increased in all groups hired between 1925 and 1947. Workers in the lowest cumulative exposure group