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# **Table S1a.** Max level of personal protective equipment (PPE) worn by all responders.

|  | **Firefighter(n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |
| --- | --- | --- | --- | --- | --- |
| **PPE Ensemble Worn** |  |  |  |  |  |
| Level C \* | 1 (1.6%) | 0 (0%) | 0 (0%) | 0 (0%) | 1 (1%) |
| Level D † | 0 (0%) | 1 (5.0%) | 1 (9%) | 3 (23.1%) | 5 (5%) |
| Firefighter turn-out gear¶ with respiratory protection. | 8 (13.1%) | 0 (0%) | 0 (0%) | 0 (0%) | 8 (8%) |
| Firefighter turn-out gear¶ without respiratory protection.  | 36 (59.0%) | 1 (5.0%) | 0 (0%) | 0 (0%) | 37 (35%) |
| Partial PPE ensemble§ | 3 (4.9%) | 2 (10.0%) |  0 (0%) | 2 (15.4%) | 7 (7%) |
| None | 12 (19.7%) | 16 (80.0%) | 10 (91%) | 8 (61.5%) | 46 (44%) |
| Missing | 1 (1.6%) | 0 (0%) | 0 (0%) | 0 (0%) | 1 (1%) |

\* Level C ensemble includes full-face air purifying respirators, chemical-resistant gloves, proper footwear including Safety steel-toe boots with shanks on the outside, and two-way radio as well as a hard hat.

† Level D ensemble includes coveralls, proper footwear including Safety steel-toe boots with shanks on the outside, goggles/glasses, and gloves. Level D suits don’t require much protection and can be found as firefighter turnout gear, for example.

¶ Firefighter turn-out gear (also known as “bunker gear”) is standard personal protective equipment used by firefighters. This ensemble includes fire-resistant pants, boots, coat, and gloves. Similar to Level D ensembles.

§ Responder wore some PPE, but not all elements required to meet one of the classified ensemble levels; for example, a responder that reported wearing just boots would be considered wearing a partial ensemble.

# **Table S1b.** Reason stated for not wearing personal protective equipment (PPE) (n=46).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Firefighter****(n=12)** | **EMS****(n=16)** | **Law** **Enforcement****(n=10)** | **Other****(n=8)** | **Overall (n=46)** |
| **Reason for not wearing PPE** |  |  |  |  |  |
| PPE was not available at the time | 3 (24%) | 4 (25%) | 7 (70%) | 1 (13%) | 15 (33%) |
| Felt did not need PPE/ was not instructed to wear | 7 (58%) | 5 (31%) | 2 (20%) | 6 (75%) | 20 (43%) |
| Unknown/Unclear/Unsure | 2 (17%) | 7 (44%) | 1 (10%) | 1 (13%) | 11 (24%) |

# **Table S2a.** Proportion of responders experiencing any new or worsening symptom stratified by symptom category and responder type.

|  | **Firefighter (n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Headache** |  |  |  |  |  |  |
| No | 51 (83.6%) | 17 (85.0%) | 9 (81.8%) | 9 (69.2%) | 86 (81.9%) |  |
| Yes | 10 (16.4%) | 3 (15.0%) | 2 (18.2%) | 4 (30.8%) | 19 (18.1%) |  |
| **Eye Irritation\*** |  |  |  |  |  |  |
| No | 53 (86.9%) | 17 (85.0%) | 8 (72.7%) | 9 (69.2%) | 87 (82.9%) |  |
| Yes | 8 (13.1%) | 3 (15.0%) | 3 (27.3%) | 4 (30.8%) | 18 (17.1%) |  |
| **Ear/Hearing**† |  |  |  |  |  |  |
| No | 59 (96.7%) | 19 (95.0%) | 10 (90.9%) | 13 (100%) | 101 (96.2%) |  |
| Yes | 2 (3.3%) | 1 (5.0%) | 1 (9.1%) | 0 (0%) | 4 (3.8%) |  |
| **Upper Respiratory**§ |  |  |  |  |  |  |
| No | 35 (57.4%) | 14 (70.0%) | 8 (72.7%) | 7 (53.8%) | 64 (61.0%) |  |
| Yes | 26 (42.6%) | 6 (30.0%) | 3 (27.3%) | 6 (46.2%) | 41 (39.0%) |  |
| **Lower Respiratory**¶ |  |  |  |  |  |  |
| No | 52 (85.2%) | 15 (75.0%) | 9 (81.8%) | 12 (92.3%) | 88 (83.8%) |  |
| Yes | 9 (14.8%) | 5 (25.0%) | 2 (18.2%) | 1 (7.7%) | 17 (16.2%) |  |
| **Any Respiratory**\*\* |  |  |  |  |  |  |
| No | 35 (57.4%) | 13 (65.0%) | 8 (72.7%) | 7 (53.8%) | 63 (60.0%) |  |
| Yes | 26 (42.6%) | 7 (35.0%) | 3 (27.3%) | 6 (46.2%) | 42 (40.0%) |  |
| **Cardiac††** |  |  |  |  |  |  |
| No | 56 (91.8%) | 18 (90.0%) | 10 (90.9%) | 12 (92.3%) | 96 (91.4%) |  |
| Yes | 5 (8.2%) | 2 (10.0%) | 1 (9.1%) | 1 (7.7%) | 9 (8.6%) |  |
| **Skin Irritation or Injury**§§ |  |  |  |  |  |  |
| No | 57 (93.4%) | 19 (95.0%) | 10 (90.9%) | 12 (92.3%) | 98 (93.3%) |  |
| Yes | 4 (6.6%) | 1 (5.0%) | 1 (9.1%) | 1 (7.7%) | 7 (6.7%) |  |
|  **Any New/Worsening Symptom** |  |  |  |  |  |  |
| No | 27 (44.3%) | 11 (55.0%) | 6 (54.5%) | 5 (38.5%) | 49 (46.7%) |  |
| Yes | 34 (55.7%) | 9 (45.0%) | 5 (45.5%) | 8 (61.5%) | 56 (53.3%) |  |

\* Eye irritation include eye irritation, and increased tearing (i.e., watery eyes).

† Ear or hearing symptoms include tinnitus, and hearing loss.

§ Upper respiratory symptoms include runny nose, congestion, anosmia, burning nose or throat, cough, and sore throat.

¶ Lower respiratory symptoms include difficulty breathing, wheezing, and burning lungs.

\*\* Any respiratory symptoms include both upper and lower respiratory symptoms.

**††** Cardiac symptoms include fast heart rate/pulse, chest tightness, and chest pain (i.e., angina).

§§ Skin irritation or injuries include skin irritation, rash, blisters, burns and lacerations.

# **Table S2b.** Individual symptoms categorized as “Headache”

|  | **Firefighter(n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |
| --- | --- | --- | --- | --- | --- |
| **Headache** |  |  |  |  |  |
| No | 51 (83.6%) | 17 (85.0%) | 9 (81.8%) | 9 (69.2%) | 86 (81.9%) |
| Yes | 10 (16.4%) | 3 (15.0%) | 2 (18.2%) | 4 (30.8%) | 19 (18.1%) |

# **Table S2c.** Individual symptoms categorized as “Eye Irritation”

|  | **Firefighter (n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |
| --- | --- | --- | --- | --- | --- |
| **Eye Irritation** |  |  |  |  |  |
| No | 54 (88.5%) | 18 (90.0%) | 8 (72.7%) | 9 (69.2%) | 89 (84.8%) |
| Yes | 7 (11.5%) | 2 (10.0%) | 3 (27.3%) | 4 (30.8%) | 16 (15.2%) |
| **Increased Tearing** |  |  |  |  |  |
| No | 58 (95.1%) | 19 (95.0%) | 9 (81.8%) | 12 (92.3%) | 98 (93.3%) |
| Yes | 3 (4.9%) | 1 (5.0%) | 2 (18.2%) | 1 (7.7%) | 7 (6.7%) |
| **Eye Irritation** |  |  |  |  |  |
| No | 53 (86.9%) | 17 (85.0%) | 8 (72.7%) | 9 (69.2%) | 87 (82.9%) |
| Yes | 8 (13.1%) | 3 (15.0%) | 3 (27.3%) | 4 (30.8%) | 18 (17.1%) |

# **Table S2d.** Individual symptoms categorized as “Ear/Hearing”

|  | **Firefighter (n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |
| --- | --- | --- | --- | --- | --- |
| **Ringing in Ears** |  |  |  |  |  |
| No | 60 (98.4%) | 19 (95.0%) | 10 (90.9%) | 13 (100%) | 102 (97.1%) |
| Yes | 1 (1.6%) | 1 (5.0%) | 1 (9.1%) | 0 (0%) | 3 (2.9%) |
| **Hearing Loss** |  |  |  |  |  |
| No | 60 (98.4%) | 20 (100%) | 11 (100%) | 13 (100%) | 104 (99.0%) |
| Yes | 1 (1.6%) | 0 (0%) | 0 (0%) | 0 (0%) | 1 (1.0%) |
| **Ear/Hearing** |  |  |  |  |  |
| No | 59 (96.7%) | 19 (95.0%) | 10 (90.9%) | 13 (100%) | 101 (96.2%) |
| Yes | 2 (3.3%) | 1 (5.0%) | 1 (9.1%) | 0 (0%) | 4 (3.8%) |

# **Table S2e.** Individual symptoms categorized as “Upper Respiratory”

|  | **Firefighter(n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |
| --- | --- | --- | --- | --- | --- |
| **Runny nose/congestion** |  |  |  |  |  |
| No | 48 (78.7%) | 18 (90.0%) | 8 (72.7%) | 11 (84.6%) | 85 (81.0%) |
| Yes | 13 (21.3%) | 2 (10.0%) | 3 (27.3%) | 2 (15.4%) | 20 (19.0%) |
| **Loss of sense of smell** |  |  |  |  |  |
| No | 60 (98.4%) | 20 (100%) | 11 (100%) | 12 (92.3%) | 103 (98.1%) |
| Yes | 1 (1.6%) | 0 (0%) | 0 (0%) | 1 (7.7%) | 2 (1.9%) |
| **Burning nose or throat** |  |  |  |  |  |
| No | 58 (95.1%) | 19 (95.0%) | 8 (72.7%) | 11 (84.6%) | 96 (91.4%) |
| Yes | 3 (4.9%) | 1 (5.0%) | 3 (27.3%) | 2 (15.4%) | 9 (8.6%) |
| **Coughing** |  |  |  |  |  |
| No | 41 (67.2%) | 15 (75.0%) | 8 (72.7%) | 8 (61.5%) | 72 (68.6%) |
| Yes | 20 (32.8%) | 5 (25.0%) | 3 (27.3%) | 5 (38.5%) | 33 (31.4%) |
| **Sore throat** |  |  |  |  |  |
| No | 53 (86.9%) | 18 (90.0%) | 9 (81.8%) | 9 (69.2%) | 89 (84.8%) |
| Yes | 8 (13.1%) | 2 (10.0%) | 2 (18.2%) | 4 (30.8%) | 16 (15.2%) |
| **Any Upper Respiratory** |  |  |  |  |  |
| No | 35 (57.4%) | 14 (70.0%) | 8 (72.7%) | 7 (53.8%) | 64 (61.0%) |
| Yes | 26 (42.6%) | 6 (30.0%) | 3 (27.3%) | 6 (46.2%) | 41 (39.0%) |

# **Table S2f.** Individual symptoms categorized as “Lower Respiratory”

|  | **Firefighter/Hazmat(n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |
| --- | --- | --- | --- | --- | --- |
| **Difficulty Breathing** |  |  |  |  |  |
| No | 56 (91.8%) | 16 (80.0%) | 9 (81.8%) | 12 (92.3%) | 93 (88.6%) |
| Yes | 5 (8.2%) | 4 (20.0%) | 2 (18.2%) | 1 (7.7%) | 12 (11.4%) |
| **Wheeze** |  |  |  |  |  |
| No | 59 (96.7%) | 19 (95.0%) | 10 (90.9%) | 12 (92.3%) | 100 (95.2%) |
| Yes | 2 (3.3%) | 1 (5.0%) | 1 (9.1%) | 1 (7.7%) | 5 (4.8%) |
| **Burning in Lungs** |  |  |  |  |  |
| No | 55 (90.2%) | 18 (90.0%) | 11 (100%) | 12 (92.3%) | 96 (91.4%) |
| Yes | 6 (9.8%) | 2 (10.0%) | 0 (0%) | 1 (7.7%) | 9 (8.6%) |
| **Any Lower Respiratory** |  |  |  |  |  |
| No | 52 (85.2%) | 15 (75.0%) | 9 (81.8%) | 12 (92.3%) | 88 (83.8%) |
| Yes | 9 (14.8%) | 5 (25.0%) | 2 (18.2%) | 1 (7.7%) | 17 (16.2%) |

# **Table S2g.** Individual symptoms categorized as “Cardiac”

|  | **Firefighter/Hazmat(n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |
| --- | --- | --- | --- | --- | --- |
| **Fast Heart Rate** |  |  |  |  |  |
| No | 60 (98.4%) | 19 (95.0%) | 10 (90.9%) | 13 (100%) | 102 (97.1%) |
| Yes | 1 (1.6%) | 1 (5.0%) | 1 (9.1%) | 0 (0%) | 3 (2.9%) |
| **Chest Pain/Angina** |  |  |  |  |  |
| No | 57 (93.4%) | 19 (95.0%) | 11 (100%) | 12 (92.3%) | 99 (94.3%) |
| Yes | 4 (6.6%) | 1 (5.0%) | 0 (0%) | 1 (7.7%) | 6 (5.7%) |
| **Any Cardiac** |  |  |  |  |  |
| No | 56 (91.8%) | 18 (90.0%) | 10 (90.9%) | 12 (92.3%) | 96 (91.4%) |
| Yes | 5 (8.2%) | 2 (10.0%) | 1 (9.1%) | 1 (7.7%) | 9 (8.6%) |

# **Table S2h.** Individual symptoms categorized as “Skin Irritation or Injury”

|  | **Firefighter(n=61)** | **EMS(n=20)** | **Law Enforcement(n=11)** | **Other(n=13)** | **Overall(n=105)** |
| --- | --- | --- | --- | --- | --- |
| **Irritation, pain, or burning of skin** |  |  |  |  |  |
| No | 59 (96.7%) | 19 (95.0%) | 10 (90.9%) | 12 (92.3%) | 100 (95.2%) |
| Yes | 2 (3.3%) | 1 (5.0%) | 1 (9.1%) | 1 (7.7%) | 5 (4.8%) |
| **Laceration** |  |  |  |  |  |
| No | 59 (96.7%) | 20 (100%) | 11 (100%) | 13 (100%) | 103 (98.1%) |
| Yes | 2 (3.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 2 (1.9%) |
| **Broken Bones** |  |  |  |  |  |
| No | 61 (100%) | 20 (100%) | 11 (100%) | 13 (100%) | 105 (100%) |
| Yes | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| **Burns** |  |  |  |  |  |
| No | 61 (100%) | 20 (100%) | 11 (100%) | 13 (100%) | 105 (100%) |
| Yes | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| **Any Skin Irritation or Injury** |  |  |  |  |  |
| No | 57 (93.4%) | 19 (95.0%) | 10 (90.9%) | 12 (92.3%) | 98 (93.3%) |
| Yes | 4 (6.6%) | 1 (5.0%) | 1 (9.1%) | 1 (7.7%) | 7 (6.7%) |

#

# **Table S3.** Adjusted logistic regression results for all exposures/risk factors and symptoms assessed

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Headache** | **Eye Irritation** | **Ear/Hearing** | **Upper Respiratory** | **Lower Respiratory** | **Skin Irritation/Injury** | **Cardiac** |
| *Predictors* | *Odds Ratios* | *CI* | *Odds Ratios* | *CI* | *Odds Ratios* | *CI* | *Odds Ratios* | *CI* | *Odds Ratios* | *CI* | *Odds Ratios* | *CI* | *Odds Ratios* | *CI* |
| **Exposed to smoke\*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| No | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  |
| Yes | --- | --- | --- | --- | --- | --- | 2.83 | 0.81 – 13.31 | 2.98 | 0.53 – 56.36 | --- | --- | 1.15 | 0.17 – 23.19 |
| **Exposed to ash/debris\*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| No | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  |
| Yes | 2.09 | 0.70 – 7.23 | 4.22 | 1.19 – 20.53 | --- | --- | 3.74 | 1.52 – 10.04 | 6.14 | 1.59 – 40.72 | 0.47 | 0.09 – 2.29 | 6.45 | 1.06 – 126.49 |
| **Rating of Perceived Exertion**† |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Light (Borg Rating 6 - 12) | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  |
| Hard (Borg Rating >12 - 20) | 3.62 | 1.15 – 13.10 | 5.65 | 1.61 – 23.93 | --- | --- | 2.99 | 1.25 – 7.50 | 2.82 | 0.89 – 10.04 | 1.64 | 0.32 – 9.38 | 1.53 | 0.34 – 7.52 |
| **Used PPE During Response\*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Yes | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  | *Ref* |  |
| No | 1.27 | 0.42 – 3.90 | 1.21 | 0.39 – 3.84 | 0.24 | 0.01 – 2.16 | 0.6 | 0.25 – 1.43 | 0.84 | 0.26 – 2.60 | 3.09 | 0.57 – 24.31 | 1.01 | 0.21 – 4.60 |

**Note**: Each exposure/risk factor was assessed separately for each symptom category; CI = 95% confidence interval; Ref = reference category; “—” indicates model did not converge.

\* Models include responder age and response hours worked covariates to control for confounding.

† Models include responder age, response hours worked, and responder type to control for confounding.

# **Table S4.** Reasons that symptomatic responders did not seek medical care or evaluation.

|  |  |
| --- | --- |
| **Reason cited for not seeking care** | **Symptomatic RespondersWho Did Not Seek Care\*** |
| **(n=44)** |
| **Symptoms Not Serious Enough** | 34 (77%) |
| **Dislike Doctors** | 3 (7%)  |
| **No Time to Go** | 0 (0%) |
| **Worried About Cost** | 2 (4%) |
| **Worried About Losing Job** | 0 (0%) |
| **Unclear/No Response**† | 7 (16%) |
|  |  |

\* Responders were allowed to select multiple reasons for not seeking care.
† Did not select reason for not seeking care and did not provide reason.

# **Table S5.** Proportion of symptomatic first responders still experiencing new or worsening symptoms at least one month after responding to the incident, stratified by symptom category and responder type.

| Still experiencing… | **Firefighter****(n=34)\*** | **EMS****(n=9)\*** | **Law Enforcement****(n=5)\*** | **Other****(n=8)\*** | **Overall****(n=56)\*** |
| --- | --- | --- | --- | --- | --- |
| **Headache** |  |  |  |  |  |
| No | 5 (50%) | 2 (67%) | 1 (50%) | 4 (100%) | 12 (63%) |
| Yes | 5 (50%) | 1 (33%) | 1 (50%) | 0 (0%) | 7 (37%) |
| **Eye Irritation** |  |  |  |  |  |
| No | 5 (63%) | 2 (67%) | 2 (67%) | 4 (100%) | 13 (72%) |
| Yes | 3 (37%) | 1 (33%) | 1 (33%) | 0 (0%) | 5 (28%) |
| **Ear/Hearing** |  |  |  |  |  |
| No | 1 (50%) | 1 (100%) | 1 (100%) | 0 (0%) | 3 (75%) |
| Yes | 1 (50%) | 0 (0%) | 0 (0%) | 0 (0%) | 1 (25%) |
| **Upper Respiratory** |  |  |  |  |  |
| No | 16 (61%) | 3 (50%) | 1 (33%) | 5 (83.3%) | 25 (61%) |
| Yes | 10 (39%) | 3 (50%) | 2 (67%) | 1 (16.7%) | 16 (39%) |
| **Lower Respiratory** |  |  |  |  |  |
| No | 3 (33%) | 2 (40%) | 1 (50%) | 0 (0%) | 6 (35%) |
| Yes | 6 (67%) | 3 (60%) | 1 (50%) | 1 (100%) | 11 (65%) |
| **Cardiac** |  |  |  |  |  |
| No | 2 (40%) | 1 (50%) | 1 (100%) | 0 (0%) | 4 (44%) |
| Yes | 3 (60%) | 1 (50%) | 0 (0%) | 1 (100%) | 5 (56%) |
| **Skin or Injury** |  |  |  |  |  |
| No | 3 (75%) | 1 (100%) | 1 (100%) | 0 (0%) | 5 (71%) |
| Yes | 1 (25%) | 0 (0%) | 0 (0%) | 1 (100%) | 2 (29%) |
| **Any Symptom** |  |  |  |  |  |
| No | 19 (55.9%) | 4 (50.0%) | 3 (60.0%) | 6 (75.0%) | 33 (59.0%) |
| Yes | 15 (44.1%) | 4 (50.0%) | 2 (40.0%) | 2 (25.0%) | 23 (41.0%) |

\* n indicates total number that reported at least one symptom. Note that denominator for each symptom changes because this is based on the number of responders that reported experiencing the specific symptom.

# **Figure S1.** Histogram of reported symptom onset date for all symptoms.



\* The natural gas pipeline explosion occurred on August 1, 2019. All 105 responders working within the evacuation area on August 1, 2019 for some time. Three reported returning and working on August 2, three reported returning and working on August 3, and one returned and worked on August 4.

# Personal Protective Equipment (PPE) Questions

* What level of PPE were you wearing when you responded to the incident at this location?

 None

 Level “A”

 Level “B”

 Level “C”

 Level “D”

 Firefighter turn-out gear with respiratory protection.

 Firefighter turn-out gear without respiratory protection.

 Other types of protection (such as gloves, eye protection, hardhat, steel-toed shoes)

 *If selected, ask*: Please specify the type of protection:

* What type of protection were you wearing (select all that apply) at this location?

 None

 Non-sterile exam gloves

 Surgical gloves

 Face mask without protective shield

 Face mask with protective shield

 Non-splash resistant disposable gown

 Splash resistant disposable gown

 Protective eye glasses/goggles

 Supplied air respirator

 Respirator with cartridge/HEPA filters

 If selected, ask: Please specify the type of cartridge/filter:

 Other If selected, ask: Please specify the type of protection:

# Personal Protective Equipment (PPE) Showcard Level Descriptions\*

|  |
| --- |
| **Level A:** The highest level of protection for the skin, eyes and respiratory system that are all at risk when exposed to the dangerous chemicals in any state. Level A suits require: Full face Self Contained Breathing Apparatus (SCBA), two-way radio, proper footwear including safety steel-toe boots with shanks on the outside, and chemical-resistant gloves. |
| **Level B:** Very similar to Level A, the Level B suit is extremely protective and the difference is that these suits contain less skin and outer body protection compared the aforementioned level. These are utilized when the wearer may require less skin protection but still a very high level of respiratory protection. Level B suits require: full face Self Contained Breathing Apparatus ([SCBA](https://en.wikipedia.org/wiki/Self-contained_breathing_apparatus)), two-way radio attached either inside or outside the suit to avoid contamination, chemical-resistant gloves, proper footwear including Safety steel-toe boots with shanks on the outside, secured wrist, ankles, and face-piece and waist areas for splash protection |
| **Level C:** The most commonly used suit, the Level C, possess similar characteristics as Level B but does not have the same level of respiratory protection. The suit predominately used when the hazardous material is identified, measurable and contained, is utilized when contact with the substance will not cause harm to the skin. Level C suits require: full-face air purifying respirators, chemical-resistant gloves, proper footwear including Safety steel-toe boots with shanks on the outside, and two-way radio as well as a hard hat. |
| **Level D:** The least protective of the four suits, the Level D protection suit is mostly used in areas such as a construction site and provides zero protection from chemical exposure. Level D suits require: pair of coveralls, proper footwear including Safety steel-toe boots with shanks on the outside, goggles/glasses, and gloves. Level D suits don’t require much protection and can be found as firefighter turnout gear, for example. |

\* showcard levels based on <https://www.osha.gov/SLTC/emergencypreparedness/gettingstarted_ppe.html>

# Borg Rating of Perceived Exertion Showcard

|  |  |  |
| --- | --- | --- |
| **How you might describe your exertion** | **Borg rating of your exertion** | **Examples (for most adults <65 years old)** |
| None |  6 | Reading a book, watching television |
| Very, very light |  7 to 8 | Tying shoes |
| Very light  |  9 to 10 | Chores like folding clothes that seem to take little effort |
| Fairly light  | 11 to 12 | Walking through the grocery store or other activities that require some effort but not enough to speed up your breathing |
| Somewhat hard  | 13 to 14 | Brisk walking or other activities that require moderate effort and speed your heart rate and breathing but don’t make you out of breath |
| Hard  | 15 to 16  | Bicycling, swimming, or other activities that take vigorous effort and get the heart pounding and make breathing very fast |
| Very hard  | 17 to 18  | The highest level of activity you can sustain |
| Very, very hard  | 19 to 20  | A finishing kick in a race or other burst of activity that you can’t maintain for long |

Adapted from Borg GA. Psychophysical bases of perceived exertion. Med Sci Sports Exerc. 1982;14(5):377-81.

# List of individual symptoms and mapping to symptom categories

|  |  |
| --- | --- |
| **Individual Symptom** | **Symptom Category** |
| Irritation, pain, or burning of skin | Skin Irritation/Injury |
| Broken bones | Skin Irritation/Injury |
| Laceration | Skin Irritation/Injury |
| Burns | Skin Irritation/Injury |
| Irritation/pain/burning of eyes | Eye irritation |
| Increased tearing  | Eye irritation |
| Ringing in ears | Ear/Hearing |
| Hearing loss | Ear/Hearing |
| Headache | Headache |
| Fast heart rate/pulse  | Cardiac |
| Chest tightness or pain/angina | Cardiac |
| Burning lungs | Lower Respiratory |
| Difficulty breathing/ feeling out-of-breath | Lower Respiratory |
| Wheezing in chest | Lower Respiratory |
| Blurred vision/double vision | Other Neurologic |
| Loss of consciousness/fainting | Other Neurologic |
| Inability to urinate or pee | Other Neurologic |
| Concussion | Other Neurologic |
| Runny nose/congestion | Upper Respiratory |
| Loss of sense of smell | Upper Respiratory |
| Burning nose or throat | Upper Respiratory |
| Sore throat | Upper Respiratory |
| Coughing | Upper Respiratory |