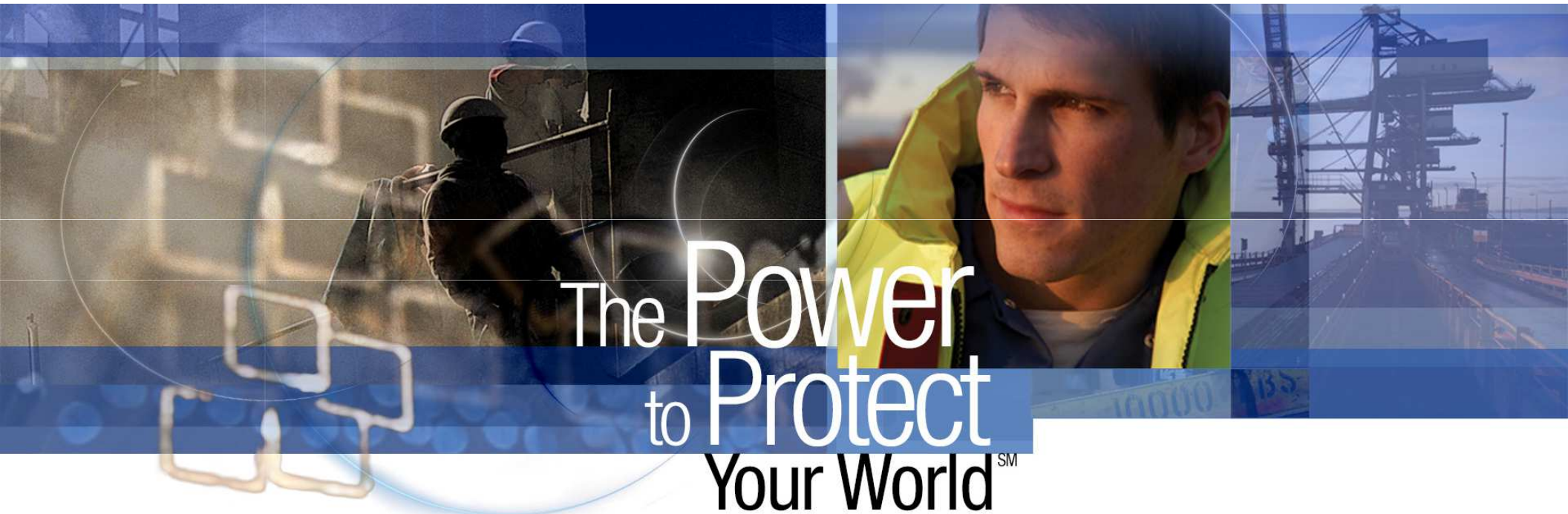


3M Personal Safety Division

Common Challenges of Utilizing Respiratory Protection to Help Reduce Exposures to Ambient Air Pollution



Nicole Vars McCullough, PhD, CIH

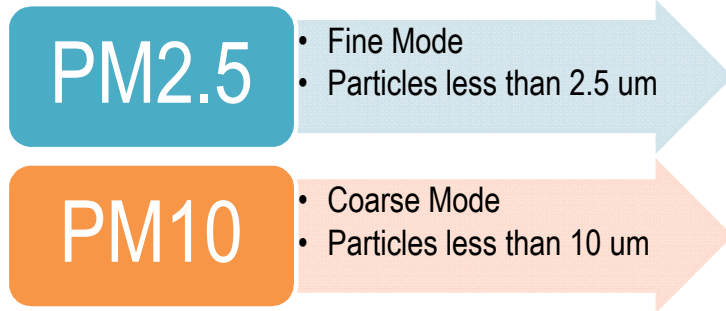
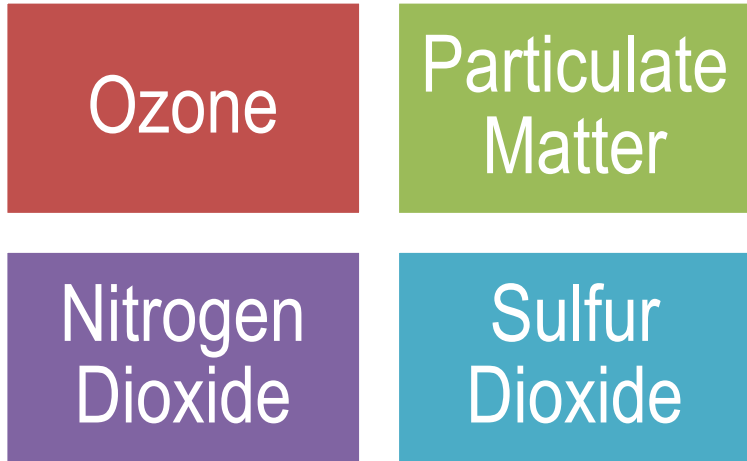
ISRP Prague September 2014



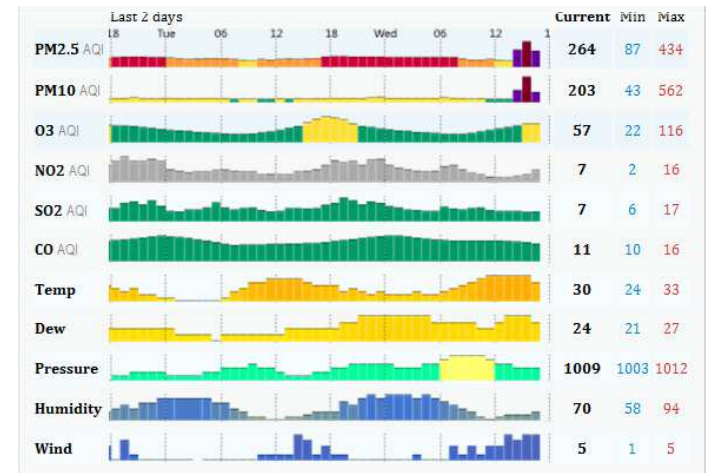
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- These slides were shared during the ISRP Conference September 2014. The content was valid as of the date of presentation, though information can change at any time in the future.
- The content of these slides is for those participating in the meeting.
- The content of these slides was accompanied by significant and often clarifying verbal discussion. If you have questions or desire further explanation, please contact Nicole McCullough
- Thank you

Ambient Air Pollution



AQI



<http://aqicn.org/city/beijing/>



Particulate Air Pollution - PM2.5

- In a new report, WHO reports that in 2012 around 3.7 million people died as a result of exposure to ambient fine particulate matter.*
- “Measurement of fine particulate matter of 2.5 micrometers (μm) or less in diameter (PM2.5) is considered to be the best indicator of the level of health risks from air pollution.”**
- Fine particles, those smaller than 2.5 μm , are typically composed of particles from combustion, wood, biomass and fossil fuels, including automobiles and industry.*
- Exposure to fine particle pollution can cause premature death and harmful cardiovascular effects such as heart attacks and strokes, and is linked to a variety of other significant health problems.**

WHO*, <http://www.who.int/mediacentre/news/releases/2014/air-quality/en/>, US EPA**,



PM2.5 Standards

- The primary annual fine particle standard is designed to protect against health effects associated with both long- and short- term exposure to PM2.5.**
- The primary 24-hour fine particle standard is designed to work with the annual standard to provide supplemental health protection against short-term fine particle exposures, particularly in areas with high peak PM2.5 concentrations.**
- Health effects can be expected when the PM2.5 annual mean concentrations are in the range of 11-15 $\mu\text{g}/\text{m}^3$ * The WHO has set the annual mean limit as 10 $\mu\text{g}/\text{m}^3$.

WHO*, <http://www.who.int/mediacentre/news/releases/2014/air-quality/en/>, US EPA**



2005 WHO Maximum Guideline Values

PM_{2.5}

10 µg/m³ annual mean

25 µg/m³ 24-hour mean

PM₁₀

20 µg/m³ annual mean

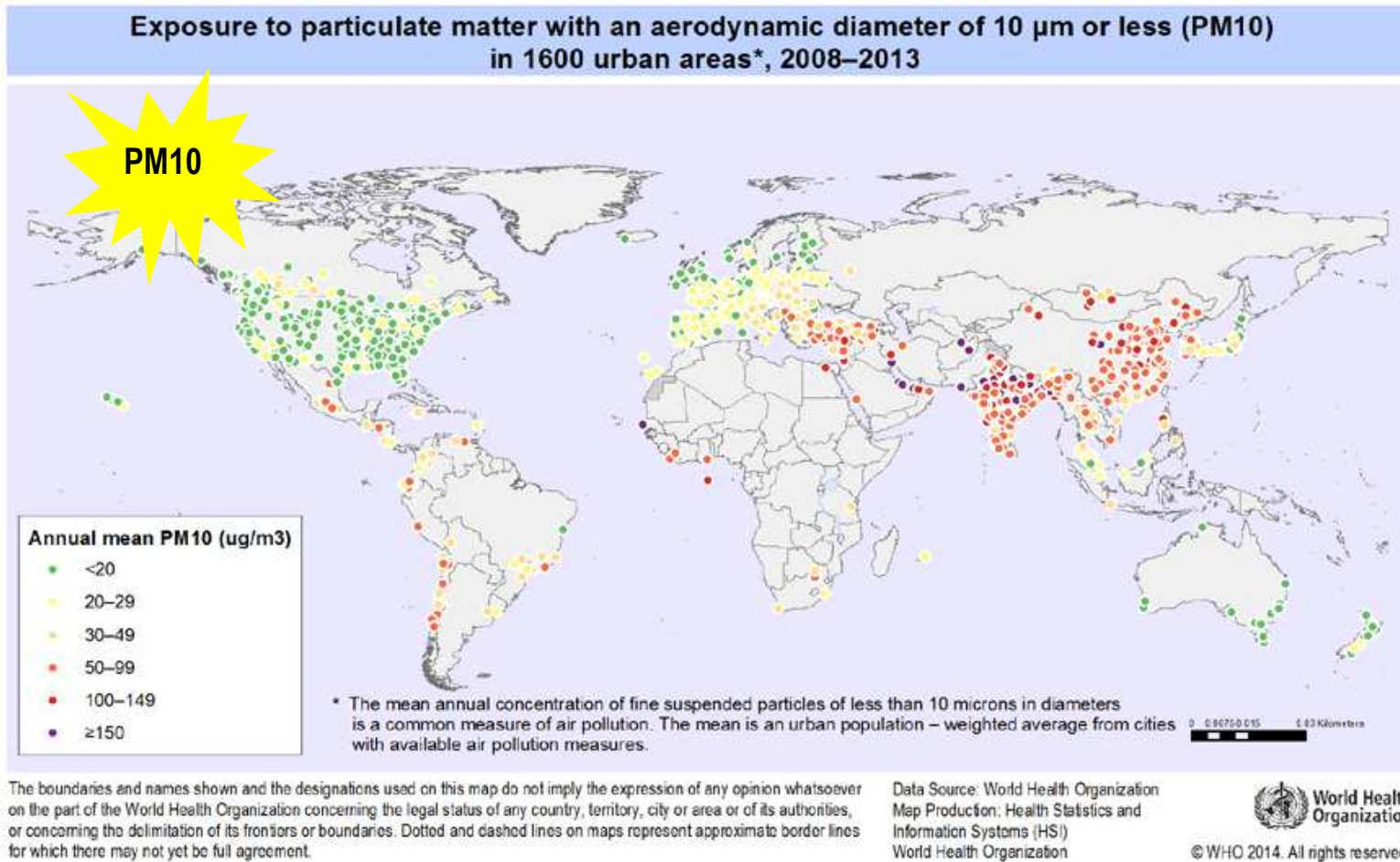
50 µg/m³ 24-hour mean

US EPA AQI Breakpoints based upon PM 2.5 exposure limits, 2012

AQI Category	Index Values	Revised Breakpoints (µg/m ³ , 24-hour average)
Good	0 - 50	0.0 – 12.0
Moderate	51 - 100	12.1 – 35.4
Unhealthy for Sensitive Groups	101 – 150	35.5 – 55.4
Unhealthy	151 – 200	55.5 – 150.4
Very Unhealthy	201 – 300	150.5 – 250.4
Hazardous	301 – 400	250.5 – 350.4
	401 – 500	350.5 – 500

<http://www.who.int/mediacentre/factsheets/fs313/en/>

<http://www.epa.gov/airquality/particlepollution/2012/decfsstandards.pdf>



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Health Statistics and Information Systems (HSI)
World Health Organization



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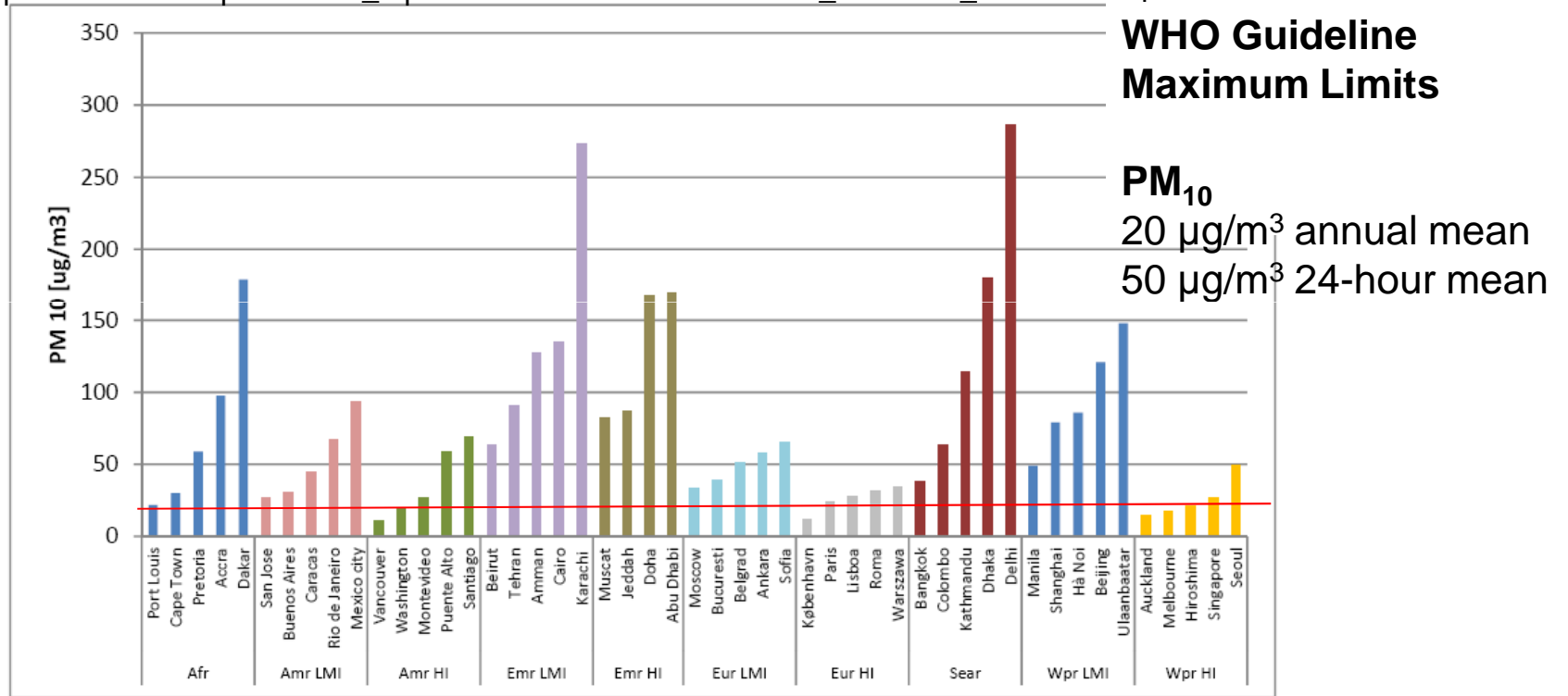
http://www.who.int/gho/phe/outdoor_air_pollution/exposure/en/



WHO: PM10 levels for selected cities by region, for the last available year in the period 2008-2012.



http://www.who.int/phe/health_topics/outdoorair/databases/AAP_database_results2014.pdf?ua=1



PM₁₀: Fine particulate matter of 10 microns or less; Afr: Africa; Amr: America; Emr: Eastern Mediterranean; Eur: Europe; Sear: South-East Asia; Wpr: Western Pacific; LMI: Low- and middle-income; HI: high-income.



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Published: Tuesday June 25, 2013 MYT 12:00:00 AM
Updated: Tuesday June 25, 2013 MYT 9:20:38 AM

Haze: N95 masks give be protection, says expert







PETALING JAYA: People should wear the N95 mask to eliminate haze completely as ordinary face masks would hardly protect the weather, said consultant cardiologist Tan Sri Dr Ridzwan Bakar.

He said this was because haze particles mostly consisted of fine particles that were 2.5 micrometres or smaller (a grain of sand is about 2,000 micrometres).

How Good are N95 Masks For Pollution?

Dec 14 2009 Air Pollution, Prevention









UPDATE: This article is old, from 2009; I have an updated article here from 2013 with a review of the best research as well as a review of three independent comparison tests of masks.

I get a lot of questions from expats, especially bikers and people walking to work, who wonder whether any type of mask is helpful. I also bike to work so I was curious as well. We've talked a lot about N95 masks for the flu, but how well do they work for pollution?

I previously discussed a [fascinating small study](#) done here in Beijing, with subjects walking along second ring road wearing masks. They had researched common masks and decided on the 3M company's 8812 mask as the best for the study, which is N95 rated and also has an exhalation valve to help breathing and prevent fogging of eyeglasses. They compared this to other masks and decided that the 8812 was the best option for this test due to effectiveness, price and comfort. Here again is the graph:



New Posts Archives 中文文章

- Bike Helmets in China: A No-Brainer
- My First Book: A Journey To Good Health in China
- My TEDx Talk: Yes, You Can Live Healthy in China
- 在北京，寻找心仪的有机农场
- Awesome Trio of Pollution Mask: The Winners and Losers
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- 让孩子看多久屏幕最合适?
- Organic Homemade Yogurt in China: So Easy!
- 小心身边的塑料制品

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Recommendations for general public respirator use for air pollution

- **Ministry of Health Malaysia** <http://www.moh.gov.my/english.php/pages/view/179>
 - Airborne particles causing haze may be as small as 2.5 microns. **The use of the surgical mask will not prevent one from inhaling the small airborne particles.** Therefore the recommended protection is the use of the respirator.
- **US Embassy of Singapore, July 2013** http://photos.state.gov/libraries/singapore/6771/consular/Updated_Message_Air_Pollution062113.pdf
 - Respirators, such as N95s and other filtering facepiece respirators, may provide additional protection. **Paper masks or surgical masks provide little protection.**
- **US Embassy of China** <http://beijing.usembassy-china.org.cn/20130201-pm25-steps.html>
 - **Should I wear a dust mask if I have to go outside?**
 - **Do not rely on dust masks for protection. Paper "comfort" or "dust" masks are designed to trap large particles, such as sawdust. These masks will not protect your lungs from small particles such as PM2.5. Scarves or bandanas won't help either.**
 - **Disposable respirators known as N-95 or P-100 respirators** will help if you have to be outdoors for a period of time. It's important that you wear the respirator correctly, however.
- **Singapore Ministry of Health**
 - **Is the N95 mask an adequate protection against the haze? Does it protect against PM2.5? • N95 masks are designed to seal to the face of the wearer. This way, most of the air that the wearer breathes in has to go through the filter and not through the gaps between the mask and the wearer's face.** Haze particles are predominantly made up of fine particles that are 2.5 microns or smaller (PM2.5). Studies have shown that N95 masks do provide good protection against the haze as they are at least 95% efficient against fine particles that are about 0.1 – 0.3 microns. It is even more efficient (99.5% efficient) against particles that are 0.75 microns and larger.

http://www.pqms.moh.gov.sg/apps/fcd_faqmain.aspx?qst=2fN7e274RAp%2BbUzLdEL/mJu3ZDKARR3p5NI92FNtJidq/7qjGcwTQZhzZShssnLIYVfFo4BSbPRckkfAbSovHyWldmvtcHxs7IDjat4jhmTd8CvaXrWm46oDifFmcMV0LCINaRUzq7o22MhUYaevlxIQXP04an68nX8AQY8mRAcGswT9mz1VPttrJuD9e1q6Gxh1%2BARiva5HFFLEkvAqRbVZS3aOdOfqjTng5oIMtk142OifqBdNGg%3D%3D

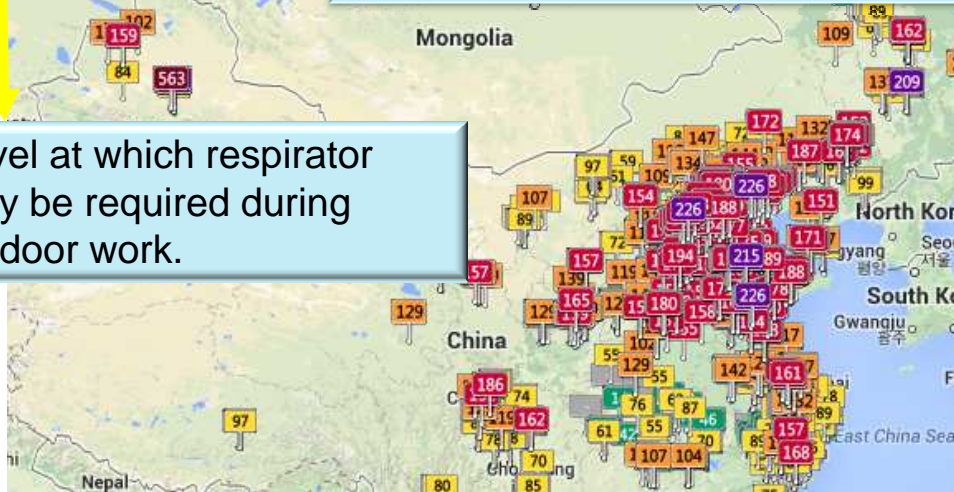
Poor Air Quality May Influence Worker Health Policy in China

AQI	Air Pollution Level	Health Implications
0 - 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk
51 - 100	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 - 150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 - 200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects
201 - 300	Very Unhealthy	Health warnings of emergency conditions. The entire population is more likely to be affected.
300+	Hazardous	Health alert: everyone may experience more serious health effects

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Level at which respirator would be recommended during outdoor work.

Level at which respirator may be required during outdoor work.



Beijing Administration Worker Safety has recently drafted a standard regarding the use of approved respirators for workers working outside during days of heavy and severe pollution. If adopted, respirators would have to meet the requirements of GB2626-2006 such as a KN90 or KN95.

Air Quality Index Sept 18, 2014 at 15:10

<http://aqicn.org/map/world/>

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Challenges Associated with use of Respirators for Worker Exposure to Air Pollution

- When to require respirator use for outdoor workers?
 - No Occupational Exposure Limits for particulate matter
 - Measurements are real-time
 - Measurements can differ by reporting agency
- Workers with existing lung problems
 - Will the respirator help or hurt?
- Outdoor workers are exposed to same levels off the job when outside
 - Should respirators be required for transit? What are the implications for non-outdoor workers traveling to work?
- Reusable respirators may be needed at times to help reduce exposures to O₃, NO_x,

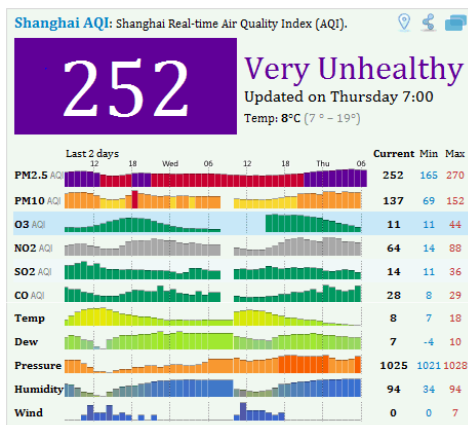


Challenges Associated with General Public Exposure to Air Pollution

- Cannot immediately or easily engineer out the hazard
- Hazardous levels of air pollution are relatively common
- Exposures are inconsistent and difficult to predict
 - Measurements are real-time
 - Measurements can differ by reporting agency
- Personal evaluation of hazard may differ from actual risk level
- Lung conditions may affect an individual's risk level to air pollution
- No consistent government recommendations for mask or respirator use



The decision to wear a mask or respirator may be based upon the reported AQI, the visibility and an individual's personal health status or a combination of these factors.



Visibility Range & Air Quality Index (AQI)

If you can clearly see or if the AQI is...	The Air Quality is likely...	You should take the following precautions:	Health effects may include:
10 miles or better or AQI: 0-50	GOOD	None	None likely
5-10 miles or AQI: 51-100	MODERATE	None	People with preexisting heart and lung diseases may experience some discomfort. Consult with your physician.
3-5 miles or AQI: 101-150	UNHEALTHY FOR SENSITIVE GROUPS	People with pre-existing heart and lung diseases, the elderly, and children should limit outdoor exertion.	Aggravation of pre-existing heart and lung disease symptoms are likely.
1.5-3 miles or AQI: 151-200	UNHEALTHY	People with pre-existing heart and lung diseases, the elderly, and children should avoid outdoor exertion. All population segments should limit outdoor exertion.	Respiratory effects in all population segments likely. Increased aggravation of pre-existing heart and lung disease symptoms. Premature mortality (death) among the most sensitive populations.
1 mile or AQI: 201-300	VERY UNHEALTHY	People with pre-existing heart and lung diseases, the elderly, and children should consider relocating to a "clean air" area. Everyone else should avoid outdoor exertion.	Significant increase of adverse respiratory effects in all population segments likely. Significantly increased aggravation of pre-existing heart and lung disease symptoms. Premature mortality (death) among sensitive populations.
Less than 1 mile or AQI: 301-500	HAZARDOUS	Everyone should avoid any outdoor exertion. Remain indoors if possible. Relocate to a "clean air" area if necessary.	Serious risk of adverse respiratory effects in the general population. Serious aggravation of preexisting heart and lung disease symptoms. Increased premature mortality (death) among sensitive populations.

http://www.deq.idaho.gov/media/864664-Visibility_Range.pdf



Challenges Associated with Providing Respiratory Protection for the General Public's Exposure to Air Pollution

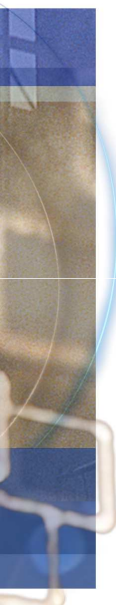
- Benefits of sporadic use
- Mask vs Respirator?
- Training and education on the capabilities and limitations of respiratory protection
 - Air pollution is more than just particulate
 - The importance of fit and wear time
- Sensitive populations
- Children



General Public Respiratory Protection for Particulate Air Pollution

Is government approval necessary or appropriate?

- Do the current government approvals for respirators (e.g. N95, FFP1, KN90, etc.) have too high performance requirements?
 - Filtration
 - Pressure Drop
- Many current government approvals include a total inward leakage panel conducted on people as part of the approval
 - Current panels include adults only
- How important are the non-performance aspects of government approval?
 - Quality Plans?
 - User Instructions?
 - Additional claims?



Summary

- Air pollution is becoming a recognized concern of the general public and employers in certain cities and countries.
- A small population of the general public is using masks or respirators to help reduce exposures.
- Masks and respirators are available but the situation regarding use is uncertain.
 - No clear or consistent guidelines for product performance or selection and use.
- Experts in airborne hazards, public / occupational health and respiratory protection should engage in discussion and determine the appropriate level of guidance needed.



3M Personal Safety Division

THANK YOU



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