

Written Transcript On The Line Episode 1.5 “Wood Smoke”

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Charlie Palmer: Welcome back On The Line a podcast for today's wildland firefighters, brought to you in part by The Black. We're joined today by one of the usual suspects, Dr. Chuck Dumke, exercise physiologist from the University of Montana, and then we're also honored to have with us Dr. Tony Ward, who was the chair of the school of public and community health sciences at the University of Montana. Tony is a phd chemist, emphasis in air pollution and so he's here to help us kind of work our way through this discussion of woodsmoke realizing another one of these very, very complex topics that is worthy of a podcast, probably worthy of many, many podcasts. So we're going to make an attempt at getting out there what we can today, at least in this initial podcast on woodsmoke. So Chuck, what can you tell us with regards to the health risks in general that woodsmoke might pose?

Chuck Dumke: Yeah, I love the open ended nature of that question so I can just take it wherever I go.

Charlie Palmer: Go, man.

Chuck Dumke: Well in reality. The forest service kind of came to us, uh, kind of both me and Tony and were interested in the woodsmoke's effect on physiology and I kind of brought the physiology aspect of it. Tony kind of brought the understanding of Woodsmoke and Woodsmoke inhalation. He does a bunch of residential Woodsmoke studies and indeed the wildland firefighter in reality is predisposed for early death and some of those early deaths are from cardiovascular disease, from certain types of cancer including lung cancer. And so, you know, there can be a bunch of finger pointing going on, you know, what is it about a wild land firefighter and their occupation that predisposes them for early death. And is it the risk, is that the stress, is that the physical nature? Is it the self medicating part of it all? And of course our own Dr Palmer has some experience in doing research there and,

Charlie Palmer: and self medicating too some experience, maybe another podcast.

Chuck Dumke: Right. And so we wanted to address this, but it's really difficult to do that sort of steady out in the field. So Dr. Ward and I and one of his graduate students, Matt Ferguson, who's name should be mentioned a lot in this because he helped do a lot of this work, developed a pulmonary core where we were able to start a fire and pump it at known rates into a gas mask that people could inhale while

exercising on a treadmill, believe it or not. Now a lot of you who live in the West know about particulate matter in the measure of particulate matter in the air to those who know a little bit more than that, it's called PM2.5. And that's kind of the measure by which we rate Woodsomke in air. So we expose these volunteers to three different levels. One was clean air, right? 0PM. Then we expose them to 250 and 500 and that's micrograms per cubic meter, but we're just going to say the number from now on and not the units to simplify it. So three different doses, right? Zero, 250 and 500. And we did this in a random order, gave him a week wash out and we exercised them on a treadmill for an hour and a half and this was, we kind of sometimes in the field call this a shotgun approach like let's just intervene and in measure a bunch of stuff and see what we get. And we measured oxidative stress. We measured inflammatory increases in both what's called exhale breath condensate and also in the blood. We measured some cognitive factors and in fact Dr. Palmer was involved in that and we measured pulmonary function, so how much and how quickly you can move air. And we had these volunteers exercise at a rate and use some inclusion exclusion criteria to kind of mimic a real wild land firefighter and it typically on a hike in and we know that that's at an energy expenditure of 22 milliliters of oxygen per kilogram of body rate per minute. So we knew exactly how to set the treadmill, but it was a walking speed. Granted, they weren't in PPE, they didn't have a pack on those sorts of things and not all of them were true wild land firefighters, but at least by their physiological measures could have been they were all men now to kind of spoil the results we actually didn't see, which was unusual compared to the rest of the literature. Any changes in their pulmonary function so they ability to move air right and you take a maximal inhalation and then blow out as fast as you can for maximal exhalation and you get a number of different measures wasn't significantly effected by the Woodsmoke.

Chuck Dumke:

We saw a few measures in a few others did have an inflammation that did increase with Woodsmoke inhalation. As far as oxidative stress. Oxidative stress actually didn't go up with the Woodsmoke inhalation, but did go up with the exercise when you compared it to rest because again, we took these measures in blood and the exhale, breath condensate etc. Before and after this test, and we even looked at an hour after the test because oftentimes there can be an acute effect that's quickly lost in even an hour after. So again we were looking for some idea of markers that might Be predisposing a wild land firefighter to prolonged health risks and sometimes, and you hear a lot of my bias in this, I call this chasing a ghost, right? And it's like what are you exposed to now that might kill you twenty years from now? Is really difficult to study, but this is one of the ways people address it is how do you measure oxydative stress, inflammatory markers, etc. So one of the things we concluded from this as well, the exposures were a little bit short, right? And of course our human subjects, IRB didn't want us exposing them to humongous levels of PM, right? PM two point five. So 500 is relatively modest. Now we have some measures from the field were firefighters can be exposed routinely to 500 and even spike up into a thousand. and I've seen some evidence of even getting up to 6,000. Again, micrograms per cubic meter, so we weren't able to expose them for the duration that a wild

land firefighter might be exposed to, nor the absolute levels, so that might've been some of the limitations of this study, but some of those things are still coming out as we're continuing to publish that data.

Charlie Palmer: Okay, so really to summarize that, you brought in some subjects. You put them on a treadmill that had an incline, they had to work at a specific intensity while at the same time breathing in various concentrations of either woodsmoke smoke or clean air and bottom line, you didn't really find anything significant with regards to that, correct?

Chuck Dumke: Correct. Not a whole lot of striking results, just a modest increase in a few markers of inflammation, but the challenge might be is that they only exercised and were exposed to the smoke for an hour and a half and have wild land firefighter is perhaps going to have a much longer exposure day by day by day. Right, and I'll throw back at you. You know, one of the things that was important about this study is that we included some cognitive measures. You know, there's the belief that while breathing woodsmoke you might be affecting decision making on the line or affecting, you know, other key aspects of your job that might put you at risk. And so we had this marker of cognitive function and I'll let you speak to that.

Charlie Palmer: Well, yeah, thanks. I mean there is some evidence out there that suggests that woodsmoke can have potentially an impact on cognitive function. So that's one of the things that we wanted to look at them in this same study with Matt Ferguson and so we use some proprietary software from a company called Cambridge Cognition and then we kind of cherry picked some of their tests that they have and came up with a four subtests battery of generally executive function types of exercises. So we were looking at reaction time, attention, memory, and then also visual processing speed gave our subjects then before their exposure and then after their exposure, the same tests, same findings for us. We didn't find anything significant with regards to the exposure to the woodsmoke over this hour and a half trial. So again, what might that mean? Well, it might mean that the exercise attenuated any impacts and simply by exercising any cognitive deficits, we might've seen where counter measured or maybe the smoke wasn't high enough or what, but bottom line is we didn't find any significant results either.

Charlie Palmer: All right, so Tony woodsmoke 101. Let's. If we're going to sit in on a class and learn what we can as we sit here as we record this podcast and what has been a smoke filled Missoula valley and looking at the some of the smoke maps that are out there nowadays and seeing that really huge portions of the of the Western United States are dealing with smoke exposures right now. What can you tell us with regards to Woodsmoke exposure?

Tony Ward: I would say right now woodsmoke. Exposure is front and center on everybody's minds for the last month and a half. We have been in woodsmoke from regional forest fires and local forest fires and it's not just a Missoula issue. I was in Portland a couple of weeks ago and you know, Portland had worse air quality

than than we have in Missoula, which is what just saying something because we have lots of forest fires in our region and all the way up to Seattle and these are and you know, forest fire plumes that are coming down from BC. So what smoke is our primary air pollutant. It doesn't matter what time of the season than it is during the winter months. We have residential woodstove in that is the most common source of heat for most of our rural communities. Basically throughout the northern rockies and even beyond that. Then you where it's cold and there's trees. People are going to burn wood. The problem that we face here during the winter mindsets, we live in these bowls, these valley communities and they're in the winter months, it's cold, so people are using or wood stoves and all of that Woodsmoke goes up into the air and then we have temperature inversion, so that basically just puts a lid on the bowl and allows woodsmoke to build up over a period of time. So summers used to be our good time of the year regarding woodsmoke, but now it seems like every single summer we're facing Woodsmoke from regional forest fires and local forest fires. Now I moved up here in 1997 and uh, you know, before that, that seems like the previous bad fire season was 10 or 20 years before that. Then before that was 30 or 40 years. So it got to the point where it was every five years and now it seems like it's every single summer we were in a bad fire season and these, these fires are really interesting.

Tony Ward:

This year we went from, you know, predicting that it was going to be a really good fire season, just even a month and a half, two months ago, good moisture. You know, we had a wet spring and then just a couple of weeks of really intensely hot weather and dry conditions. Forest dried out and then you get a couple of, uh, you know, dry thunderstorms passing through with lightening and all of a sudden we have a bad fire season and with very little rain in the forecast. Actually rained yesterday for the first time and what, 44 days, which is a record here in Missoula, you know, we are just in in smoke year round basically. So as far as air pollution, it's a good business to be in here in western Montana and one of the things that our research group is interested in is what are the health effects of breathing and what smoke.

Tony Ward:

When we talk about the residential woodstove studies, we're not necessarily focused on measuring what it is, what the levels are outside, what we are more concerned about are what are people breathing inside of the homes, especially if you're a sensitive population, a little kid, an elderly person or somebody that has compromised breathing or cardiovascular disease. So I'm sensitive populations so we have a couple of studies that we. We measure levels of woodsmoke within homes and then we do interventions to reduce levels of smoke and then we see how that improves the health of the participants are living inside the homes. So that keeps us busy during the winter months. But I got my interest in woodsmoke research when I first came up here to, to Missoula and then we had a really bad fire season. I think that was the summer of 2003. So one of the worst forest fire seasons smoke wise that we've had here in Missoula, you know, in the last 20, 30 years measured high levels of Woodsmoke outdoors during that period of time.

Tony Ward: And really got us thinking an listening to the messaging about trying to protect the populations and also trying to protect the people that are fighting the fires. What are they being exposed to for one. And then secondly, how do you protect those folks? So the opportunity to study woodsmoke, especially from forest fires is opportunistic. So there has been multiple summers where we were prepared to deploy lots of air samplers and inside of homes and and other things. And a forest fire season didn't materialize. A good example is several years ago we were working with the forest service and it was a hot shot team and we put a bunch of air samplers on this group. We went out to fish creek, which is about 40 miles west of here, kind of out in the middle of nowhere and uh, they were practicing on a prescribed fire and uh, they deployed and then the forecast called for a thunderstorm late that afternoon, so after three hours of hanging samplers on them and then watching the team deploy up to side of the mountain, they call it that at the last second. So everybody came back and uh, you know, everybody went home and then the next day they deployed to California for the rest of the summer. So that is a good example of the world of trying to do wildfire, smoke research, doing that. Residential Woodsmoke studies are in a practical sense of way easier because we know what's going to be cold during the winter. We know people are going to be using their woodstove day after day after day, all winter long, winter after winter after winter. So it's been kind of a shift in our research looking at residential Woodsmoke exposures. But at the same time, the opportunity is at to study forest fire smoke now is with us every single summer.

Charlie Palmer: We'll hear then the air quality is at a certain level. At the top of that scale is hazardous and we see recommendations like residents of Seeley Lake should just move. At least for now, they should just leave town. What can you tell us about the scales and just general kind of air quality and what some of these, these measures are these metrics mean with regards to the quality of the air that's outside?

Tony Ward: Well, one we were talking about the public when we're talking about, you know, what people are breathing outdoors. There's standards that are set fire to the environmental protection agency for PM2.5, the 24 hour average that determines if it's safe or clean air or not is 35 micrograms per cubic meter. So basically if you are below 35, that's a good thing. That's considered good or clean air for the most part. On a typical nice day. Uh, the Missoula surrounding communities will have 10 to 15 micrograms per cubic meter. So that's a good day. What we're seeing in, in seeley lake right now is something really shocking to me. Concentrations that have spiked over 900 micrograms per cubic meter. Twenty four hour averages between 200 and 300 micrograms per cubic meter. Here in missoula. We're looking at, I think on our worst days this week, anywhere between 40 and 50 micrograms per cubic meter on 24 hour average.

Tony Ward: So these concentrations are significant and the messaging that you're hearing from the health department about, you know, basically don't breathe the air in Seeley Lake, that that's significant. That's something that I personally have not heard before and really begs the question of what are some other interventions

that you can do for these folks? One thing that comes to mind is stay indoors, but some of our research studies that have shown that there's just as high concentrations of Woodsmoke indoors and there isn't directly outdoors. You know, maybe the message should be, you know, use a filtration unit. If you have access to one or like they're saying, you know, go to a, a clean business, you know, someplace that has clean air. I think there's some things that the health department is working really hard with and some challenging situations and lack of resources and, and you know, it's, it's a complex issue.

Chuck Dumke: So if you don't mind, I feel like we need to make the link then to the PM amounts and health effects. We kind of sounded like our study failed and showing anything but that would be somewhat incorrect and pointing out that, you know, PM indicators that are worn by wildland firefighters that are exposed to 300, 400, 500 while working on the line for hours on end. Unlike our study, which was just an hour and a half, do come back and demonstrate reductions in pulmonary function. And you know, that's one highlight to the effects of the woodsmoke. But it is interesting that if you smoke a cigarette right, your pulmonary function will go down, but an hour after that cigarette, your pulmonary function is backup. And somewhat similarly, at least in somebody who only smokes one, right? I'm not talking about two packs a day sort of person, but that relates to the wild land firefighter in days of exposure, years of exposure, etc.

Chuck Dumke: If you measure pulmonary function in a wild land firefighter away from the fire, they don't look any different than your normal healthy age and sex matched control. They have normal pulmonary function, but where else is that? Having an effect systemically is what is very difficult in a research situation to study. So one of the successes of our study that we mentioned earlier in the pulmonary core at the university of Montana is we were able to pinpoint markers that are more sensitive to woodsmoke. Then perhaps the exercise component, like if we were only interested in the effects of exercise and oxidative stress, I could basically prescribe you exercise that would elevate your oxidative stress. But what about what markers are going to be sensitive to the physiology of inhaling woodsmoke. And by doing it in a lab, we were able to measure a ton of different things that would take it out into the field. would've been nearly impossible. Now we have the ammunition to go out and hopefully measure in wildland firefighters and in fact Tony and I and, and our, our team, um, which include a number of different researchers have written grants that have been scored pretty well but yet haven't been funded to do exactly that, to now take our lab results out into the field and be specific to the markers that are woodsmoke sensitive to see how the wild land firefighter is responding and indeed could also use it in the residential atmosphere as well.

Tony Ward: And I'll add that there's a tradeoff when you do the controlled studies indoors so that the center for environmental sciences is what sponsors that pulmonary and inhalation facility director Henri holian is the boss there. I talked briefly about, you know, the study that we did at fish creek with hanging sampers on folks and then you know, the, then that's the end of the fire season. So that is

reality. That is an actual field study that they kind of underscores the difficulties. One of the difficulties of doing field research, so when working with Chuck, we designed this, this inhalation facility study with the treadmill and the participants and and really had a controlled setting. One of the challenges was how do you expose people to representative concentrations of Woodsmoke that are supposed to simulate what somebody fighting a fire out in the middle of nowhere, hiking up and down mountains, spending days on end, you know, in the wilderness being exposed to high levels of woodsmoke, how do you represent that and replicate that in the laboratory and it's nearly impossible.

Tony Ward: We can get in the ballpark, but they're really, you know, replicate those exposures is very difficult. And a good example is the type of smoke that we use. We used an old wood stove as a source of, of Woodsmoke. Now you might think that smoke is smoke is smoke, but smoke is actually very different depending on what the, the burning characteristics are. Burning conditions are what the fuels are and that in itself is a whole field of study. But Chuck has, right, we got into ballpark. I think it really gave us some information on what are the next steps and then taking some of that information and applying it to the field studies I think is one of the next steps that we're all interested in really getting at what are people being exposed to and then ultimately what recommendations can we do to make them safe.

Charlie Palmer: Alright, so for the listener who might be interested George Broyles is a forest service employee. Did some fantastic work with regards to looking at this issue specifically with regards to firefighters. George published a piece simply called smoke exposure that came out in 2013. That was the result of about four years of field studies on George's part, so that gets into a greater level of complexity than we ever will on this podcast. But again, for somebody who's interested in learning more about it with regards to how it impacts firefighters specifically, they can go to that. We know from a historical standpoint that the government really started an interest in woodsmoke and the yellowstone fires of 88, and so here we are, what almost 30 years later with this continued interest in what impacts does Woodsmoke have a on our firefighter population and we still don't really know the answer to that question. Thank goodness for you two, and many others who are trying to answer some of those questions. Chuck or tony all thrown at you and I know as a, as a firefighter, the first line of defense was a throw the red bandana over your mouth and cinch it down and get your head back in there and go to work. Kidding ourselves probably right? I mean because it sounds like size does matter. In this case, that size being particulate matter, the idea that the smaller that particulate matter, the deeper it can get embedded into your lungs and probably then or into your system and the more impacts that it has. Then so are there things, since this is kind of a specific firefighter podcast, realizing we might have some other listeners hopefully as well, but for the firefighter, is there anything that they can do? Is the bandanna any help? Is a... Is a surgical mask of any help or are they just really going to have to deal with it?

Tony Ward: Yeah, that's a. That's a great question and you know, besides looking really cool, I don't know that they do a great deal of protection for somebody to exposed to high levels of woodsmoke. The particles that we're talking about are microscopic and the reason that they're so bad for us as because when we breathe them in, they are so small that they can bypass our nose hairs and make it deep down our respiratory tract and cause the adverse health effects. So bandanas, I don't think our recommended not something I would certainly recommend or the painters masks for that matter. For the public, there are cartridges that are meant specifically are made specifically to protect you from very small particles. Whether that's a, that would be taken up by wild land firefighters is a different question altogether, but for the public there are cartridges that people can buy that are meant specifically to protect you from PM.

Charlie Palmer: Know, that the, uh, the two point five is in reference to the size of the particular matter that maybe that's obvious, but that's two point five microns and microns is super small. So you know, it could get through the fibers, have a bandana and indeed when you breathe through a bandana you're not really getting your air through the bandanna. You're getting it through all the gaps, around the side. And that's true about the painters mask as well. So in reality, no those are not effective, but there are different measures of PM size and there's PM 10 and there's PM two point five. And I think there, tony me in there 25. You know when you are in an area of a forest fire, you often have ashes, you know, falling on your car. That's not what's causing your health risks. You know, it's the, the microscopic naked to the eye, air particulate matter.

Charlie Palmer: So as I've kind of tried to prepare myself for this podcast and get at least a little bit up to speed on what's out there, who just consistently through the literature, what came up was this idea that longitudinal studies are necessary in order to learn more. In other words, we need to track people in the population that we're interested in and track them for a long period of time longitudinally than to see what impacts, if any they're experiencing. So longitudinal research has some real challenges. They're necessary but they're just not being done. What can you guys tell us about that?

Chuck Dumke: I'll speak a little bit to this. I think tony probably has more experience but you're referring kind of to epidemiology, kind of maybe retrospective data. You know, tony was talking about our study in the lab and the limitations of it, you know, but one of the benefits of it that allow us to now translate it out to the field is, you know, if we were to just go out and collect blood and wild land firefighters and see things go up, it's hard to determine, well maybe this guy worked harder than that guy or got hotter because heat stress and physical activity and intensity and their PPE gear, how much weight they're carrying, the sawyers versus the engine crew, all of that could also be affecting it.

Chuck Dumke: And those are uncontrollable out in the field. Now to bring it back to your question, which was...

Charlie Palmer: From a longitudinal standpoint,

Charlie Palmer: So, okay, now we're looking at each other and then the mic, like should we cut this piece or are we just part of my job? We haven't decided. Let's just, let's just say go.

Chuck Dumke: So to translate that to the longitudinal piece would require, you know, measuring some of these markers over years and decades and that's very difficult to do. And something where, you know, funding agencies got to be in place for that sort of thing and that's very difficult to find. So sometimes you're reliant on either case studies people die and you retrospectively try to make some sense of it or epidemiological studies. And I referenced that earlier on when I talked about there's some evidence that wildland firefighters die prematurely, but then you're challenged with the y and I don't think that is capable of being addressed with our current database.

Tony Ward: The longitudinal studies are, are kind of the gold standard. Especially if you could do it over a long period of time. Follow a large group of firefighters, you know, for decades that would certainly, uh, answer a lot of questions. It's also complex too and it cost money. And uh, the thing that you follow one firefighter, you know, year after year after year, they're going to have different exposures every single year too. And maybe the final effect that you see or the final result is, is not directly tied back to the forest fire smoke. Maybe they had a really terrible diet for for many years or they lived in a woodstove home and breathe in high, levels of woodsmoke from residential wood stoves, or they were a cigarette smoker. Lots of different variables, but ideally we have an endless supply of money and we could follow a large group of firefighters and and really had an idea of what they're exposed to and some of the other parameters are a or that period of time. That would be the gold standard.

Chuck Dumke: You know, one of the challenges of a longitudinal study like that is what's your control group, is it the normal, typical american who if the image that pops in your head is the one that pops in mind, is overweight, obese drinks a lot of alcohol. You know, they've got their own health risks to worry about and you know, they're dying from other things. So if you're going to do a longitudinal study to see the effect of woodsmoke on wildland firefighters, you got to have a similarly active group. Right? And they need to be working in a stressful environment in the heat. And be exercising and have everything but the woodsmoke to be a true control group and that's impossible, you know, so there's all these different components that are factoring into the health and a lot of times those other things I mentioned, the exercise, poor diet choices, or other types of choices, alcohol, cigarettes, et cetera, have similar health risks to the woodsmoke. So how do you parse out the actual inhalation of the woodsmoke and that's actually some of the importance of the residential studies that Tony is doing

Tony Ward: and I will mention there's a couple of folks at the university of Montana that are doing some pretty cool research that it, that are focused on the longitudinal

studies. Dr. Aaron Simmons and Dr. Curtis Noonan or are both doing some really cool projects and going after that, that very question. Not an easy question at all to answer.

Charlie Palmer:

And so for our firefighters that might be listening and hopefully our core demographic, there are some things that they can do or that they probably should be aware of and some of these had been teased out then and in some of the research that has been done, I mentioned George Broyles is work and some of the things that George identified as being big contributors then to exposure number one would be mop up. So when we have firefighters in positions where they are mopping up, this is one of their highest areas of where they are exposed and so potentially mop up might need some revisitation or some discussion amongst the firefighter population about... Because I know that I've seen it in my time, is just a mindless mop up where it's, there's really nothing else to do. So let's just stick them out there mopping up, you know, a half a mile from the fire's edge. You know. Is that exposure really necessary? Well maybe not, but at times it might be right to make sure that that fire is going to be controlled. But can we look at mop up and realize them? If we're trying to minimize exposure, that's one of the big places that had happens. Holding is another big spot where firefighters are just exposed to a lot of Woodsmoke. In other words, you're on the downwind side, you're the side of the fire where it's pushing that way and you're trying to hold it there. You're going to eat a lot of smoke. if you're in that position. It's just kind of one of the givens that if you're in that spot, whether it's prescribed or or suppression, you're going to eat a lot of smoke that day and then the third one was the dozers, especially those dozers that have opened cabs. Those people that are operating and running. Those things just get exposed to a lot of different things. If that machinery doesn't have a canopy and a filtration system and all of that. So those are some things that can be looked at. And then the other thing that's come out of some research is just again, the firefighters ability to be able to recognize when they're dealing with a lot of Woodsmoke because they're going to have some symptoms.

Charlie Palmer:

Whether it be the eyes that are watering or a headache or a scratchy throat or tearing eyes or whatever it might be, and then just listening to your body's symptoms that are giving you a heads up that you're probably encountering a little bit too much Woodsmoke and that you need to figure out a way to get out of it or do something differently. So I thought that was interesting in the piece of research that I found of just realizing it's part of the job. Unfortunately in helping firefighters do a better job of recognizing some strategies that they can incorporate perhaps or managers can incorporate to keep their folks out of it a little bit more than might be happening now. Final thoughts. Chuck, what do you got?

Chuck Dumke:

Well, I think you touched on an important point at the end there about management. You're right. You kind of take on some of this risk when you take on the job. I would add to George's list as well. Prescribed burns, some of the highest PMs found in wildland firefighters is on prescribed burns as well, but the

management piece in rotating crews from those critical outposts I think is an important consideration and there's really good evidence to suggest that when the stimulus is removed, the health outcome is improved. So if you're always going to be on a prescribed burn every day for three weeks, right? That's an unfair assignment that needs to be rotated with somebody else so that you get time away from that. A Woodsmoke exposure, same thing with the mop up and other pieces is hopefully that there is, um, administrative decisions that can help reduce that exposure. Now as far as what is spoken to the, to the residents, you know, in the residential community when it's in your home and it's in your valley, you know, that becomes a bigger challenge. You know, people do evacuate, people try to reduce it by turning on their air conditioning and they're home filters. Trying to avoid large ventilation rates. And I word it that way because when I go out and exercise and, you know, questionable air, right? You just reduce your intensity and try to not increase your ventilation rate in to try to reduce your overall accumulative exposure that way.

Tony Ward:

The one thing I would add for the firefighters is that they have good air in the in base camp or fire camp. We have done a study way back in 2009 Marcy McNamara, one of our former graduate students and some other folks measured PM two point five and carbon monoxide within several base camps and Washington, Oregon and California I believe. And what they showed is that there is pretty high levels of particulate matter. What smoke within the base camp. Also there was higher levels during the nighttime. Then there was during the daytime so that, that points at, uh, you know, identifying what are some areas to work on. Maybe not have your base camp or fire camp located in an area that is receiving lots and lots of smoke. Maybe you know, if there's some way of regulating the amount of diesel exhaust within the base camp or just having some type of particular filter on the diesel generators and the exhaust so that it's a complex issue on there.

Tony Ward:

I'm sure there's tons that go into where to locate a fire camp and base camp, but I think knowing what some of the issues are will help you address what those issues are for the public. One thing that people can do, especially if you're an acceptable population, is the use these air filtration units inside your home and we've done some studies where we have seen on average a 60 percent reduction in woodsmoke within these homes. When they use these filtration units. I'm just like you can buy at Walmart or Costco, a \$200, \$150 to handle on your air filtration unit. You see about a 60 percent reduction in particulate matter, so that's one easy thing that you could do. Just plug it in and let her run back to the Missoula city county health department. You know, Again, this is complex issues that when you're making recommendations for people to leave their community, leave your homes, that's tough. Like I said, it's a complex issue, lots of factors and you know they're doing the best they can given the scenarios, but I think filtration units are one thing that people can do within our homes.

Charlie Palmer:

Yeah, and you touched on a lot of really interesting things that are. One of them that jumped out to me then it was just how much of a challenge these incident

management teams have and just how tough their positions are and their jobs and the and the decisions that they have to make because just for instance, on the smoke alone, let's, okay, let's move farther away from the fire perhaps so that we don't have to deal with as much. Smoke impact will then automatically you've increased driving times and you've heightened risk exposure in a different way to. You fixed, you fix one problem and now you've exposed yourself to a different problem. These are the things these folks deal with on a continual basis, day in and day out, and what a fabulous job that these folks do. A, I guess my final thoughts.

Chuck Dumke: Sorry, one more point. Tony reminded me of this and it's not published. It's anecdotal data and but it's solid. It's been presented at a scientific meeting was in these in collecting PM counts and in collecting carbon monoxide exposure in wild land firefighters who are actually working on the line, the highest that they were exposed to for carbon monoxide was actually in base camp and that was largely not from the fire but from the diesel and the diesel generators and so sometimes maybe even not the placement of the camp, but the placement of those things down wind can reduce some exposure to some of the health hazards that I'd get involved in the airborne contaminants.

Charlie Palmer: Just Another highlight of how complex it is. Yeah, and I guess my final thought would be the. It's probably the new normal. Unfortunately what we're dealing with in Missoula, what the west is dealing with is probably the new normal. We have snowbirds in the winter, I mean, we might be getting to the point of having smoked birds in the summer where you literally move and go somewhere to get out of the smoke. Snowbirds, do it to get away from the snow. We might have people that are, that are doing it, especially sensitive populations, uh, that are having to get out of the smoke. And that's not even considering our wild land. Firefighters who would just not an option. They're just having to deal with it day by day by day in our hats off to you folks for having to do that. Dr. Tony Ward. Thank you for your time, Dr. Chuck Dumke. Thank you as well for your time.

Speaker 4: You've been listening to On The Line, a podcast for today's wild land firefighter our audio engineers, Mike Matthews, production assistant Joey Moore and I am your host, Charlie Palmer. Thanks for listening and we hope to connect with you again.