Epidemiology - DeVido

Fri, Jul 21, 2023 10:25AM 49:32

SUMMARY KEYWORDS

people, epidemiology, study, substance, odds ratio, substance use disorder, incidence, concepts, opioid, primary prevention, prevalence, terms, test, individuals, data, talk, treatment, testable, population, risk

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00:00

This presentation is entitled Epidemiology: Core Concepts and Applications. I will now turn it over to Dr. Jeffery DeVido. To begin our presentation.

00:08

Good morning, everyone, and welcome to what I assume is everyone's favorite topic in terms of review for any test, which is epidemiology. And I will do my best today to try to make this as entertaining and as useful as possible. But understand I am starting with epidemiology, which is not necessarily always everybody's favorite topic. So I do have some financial disclosures. As you can read here, that I do have equity shares in Altria, and Philip Morris and Merck through an inheritance. And the opinions I'm going to be talking about today are mine and mine alone and don't represent any official stances on any of these topics related to the folks that I work for.

01:00

So we do have some learning objectives for today, we want to review the dimensions of epidemiology covered in the A...ABPM exam, we want to establish some different approaches for thinking about relearning or learning epidemiology in this context. And we want to then kind of take a look at a couple of different epidemiologic concepts, and see how they actually work in and play out in in a real world study and try to apply some of the things that we're learning. Obviously, we can't cover everything in the field of epidemiology. It's an entire, you know, career's worth of information. But hopefully, this will at least give you a framework for thinking about like the types of things that you need to be thinking about reviewing for the exam, as well as kind of some of the interesting things to be thinking about professionally as you move forward in your careers.

01:53

So here's an outline for how we're going to cover some of those objectives today. And the first part of this, though, is I want to kind of review for folks kind of how you think about studying for epidemiology, or how you think about epidemiology. And I've kind of broken this down into into two sort of categories. And in full disclosure, I'm not an epidemiologist. And maybe that's why they have me actually do this presentation, because I'm not an epidemiologist.

02:21

But the way that I've kind of looked at this as is sort of twofold, which is what do I need to know for the test. There are certain things that you just need to as you remember, from your boards, exams, and other exams are just certain things you need to know certain concepts that you just need to be able to regurgitate on a test. And then they're sort of like, what do I actually need to know professionally? I'm going to try to kind of work those- both of these lines today, as best I can. But I do want to acknowledge the fact that that yeah, there is, especially when it comes to kind of thinking about, like, what do I need to know, for the test, there's some things that I'm just going to have to review, there are some things that I'm just going to have to put back into that short term memory, like I've done in boards exams and other exams that I've taken in the past, for example.

03:05

So this is kind of the official sort of word on sort of like what epidemiology concepts are covered in the exam. And what you can see is that it's pretty broad. And it's pretty nonspecific, in terms of what it is there's epidemiology concepts. This is things like odds ratios, sensitivity, specificity, relative risk, these kinds of things, which hopefully that hasn't, you know, re-traumatized anyone from medical school, or or elsewhere, but the idea being that there's certain core concepts in epidemiology that are just gonna get covered. And then that there are specific sort of epidemiologic facts and epidemiologic ideas that are- that play out in addiction work that are testable in terms of like what's, you know, the relative prevalences of certain substance use disorders and things like that. So that's kind of that's what's officially sort of advertised as what's being covered on the test.

04:07

So when I think about like, how to- how to study for the test strategy, I think about how I've done this in the past. And I'm going to make certain assumptions that many of you have done this in a similar way. And some assumptions that I make are number one, that all of you have had some of this before- that this isn't the first time you're exposed to this. So in many respects, this is kind of a review of something that you've probably seen and or had to memorize multiple times over the course of your career. For the most part, most people don't use these concepts all that much. Like you're not going around in your daily practice of medicine, kind of talking with people about odds ratios. Maybe you are but but most I'm making again, I'm making some assumptions here that most people don't. And I'm also making an assumption of how you might have studied for exams in which epidemiology was covered. And if you're like me, what you probably did is you kind of scribbled things down on an index card and you kind of, you know, stared at that index card right up into the moment that you went into the testing facility and kind of squirreled those index cards away in the locker, and then went in and took the test or kind of reproduced it on the dry erase board. If that worked for you before, then you are probably going to use that again, that strategy again, and I'm not here to say that that's a bad strategy. But it's sort of a "for the test" strategy.

05:25

That's that's kind of like whatever you need to do to kind of memorize some of the formulas or concepts for the test, you know, you're going to use those again, most likely in in preparation for this

test. And the last assumption is that you've had this before, and it's probably been shoveled in in large volume over a short amount of time. So this is the sort of like drink from the fire- fire hose analogy, where it's sort of like a lot of material coming in very quickly. And that this is how a lot of people have gotten their epidemiology.

05:57

So I, I have no disclosures in terms of like, I get no financial benefit if people go back, and they review their USMLE Step 1 first aid book, for example. This is just you know, they update this every year. But this is just the 2021 cover of this. This is what I and many other people have used for studying basic epidemiology concepts for some of our USMLE boards exams. And if that worked for you before, it might be a good idea to kind of look back at it, I think it's a pretty good, it has a pretty good overview of some basic concepts in epidemiology. So you don't get too drawn too far off field, while at the same time, gives you a sense of some of the important concepts so that you can review those. So again, I just put this up here, because it might be familiar to people. And it might be worth thinking about kind of pulling that back out again, and just kind of skimming back over some of the epidemiology portions in that review text.

06:56

So in terms of our course, right now, in terms of our- what we're going to cover here, I mean, ask folks to kind of stay on your toes here a little bit. Because I am going to bounce around a little bit, I'm gonna talk about some epidemiology concepts. And then I'm going to talk about sort of prevalences. And some important numbers, at least numbers that I think are important and are testable. So stay on your toes. I remember I gave this talk in years past and some someone had commented like well do do meerkats, and this is a meerkat, by the way, do meerkats even had toes, and I actually had to look it up. And in fact, they do they have four toes. They're related to the mongoose or mongooses, mongeese, whatever the however, the plural is, and mongoose actually have five toes, but meerkats have four toes, but they are actually considered toes. So anyway, stay on our toes.

07:44

So here we go. Let's do a quick matching exercise. Let's look at this and visit two very fundamental concepts in epidemiology: incidence and prevalence. I do think it's very important to understand the difference between these because sometimes we use these interchangeably, but we shouldn't, because they actually mean different things. So again, we're in a pre-recorded talk here. So I'm not going to wait for the audience to respond to them, because we'd be here all day. But the idea here is let's do a quick matching exercise, let's think about sort of what is incidence?

08:16

Well, incidence is a rate it represents the number of new cases of a condition, or a symptom or a situation and number of new cases, over the number of people at risk during a specified time period. So again, it's number of new cases that are coming into the population. So here's the here's a diagram that I think helps drive this concept home. And also kind of helps us explain prevalence as well. And the difference between incidence and prevalence. Incidence represents the risk of a

disease, the new cases coming into a population in a period of time. So if you look at the bathtub, it's like the water coming out of the spigot into the tub, that new water that's coming in. That's the incidence, the rate of that new water entering the bathtub, as opposed to prevalence, which we'll talk about in a second, which is really kind of the amount of water that's being held in that bathtub at any given time. In order to determine incidence, therefore, you need to know how many new cases. you need to know how much water is coming into the tub. So if you just look at the level of the water in the tub, you're gonna miss the number of new cases or the amount of or the new water that's coming into the bathtub. So this is an important concept to determine incidence, we have to actually observe a group of people, a population of people, over time and observe the new cases that enter that population in that amount of time that we're observing them.

09:51

So these are prospective studies, things like the Framingham Heart Study, cohort studies, where we look at people in a population of people who might be at risk. And we measure the new cases that are coming into that population over a period of time. That's incidence. And an example in the addiction world of incidence, of how we measure incidence, was the Epidemiologic Catchment Area study that was done in the 1980s. This actually tracked people and resurveyed the same people over different time periods over over a decade or about a decade worth of follow up. So you were actually able to see the same people how many of them developed addiction, how many of them develop mental health issues. That allows us to track incidence.

10:39

This is different than prevalence. As we talked about before, prevalence really is the bathtub, the water that's in the bathtub, and act- prevalence actually gives us a sense of what the public health burden of a disease is at a particular time. Cross sectional surveys, point in time surveys, give us a good idea of prevalence, how much how much of this disease is in the population at this given time, how much water is in the bathtub at this particular time.

11:10

So a great example of a cross sectional survey that gives us great data on prevalence is the National Survey on Drug Use and Health, which is done by SAMHSA. Every year, the NSDUH. We're going to talk in a minute a little bit more about what you know what goes into that study. But I wanted to kind of introduce the idea that there are cross sectional surveys, if you're just looking at a point in time, and you're not tracking those same people at different time points later on, then what you're getting is prevalence, you're getting sort of how much- how- what is the current state of the condition in that population at that time.

11:50

So now I'm gonna pivot for a second to talk about prevention. Because this is a concept- the primary, secondary tertiary prevention are very testable concepts that do, you know, have the potential of popping up in this test or other tests or even in your professional life, but it's important to understand and take a second to review what is meant by primary, secondary and tertiary prevention.

12:16

Primary prevention refers to interventions that we are making on a population or an individual that we're trying to prevent the future incidence, new case, we're trying to prevent someone from getting a particular, you know, condition or disease or particular set of symptoms, whatever it might be. Primary prevention is upstream, we're trying to prevent people from ever developing any symptoms, from ever developing the condition.

12:50

Secondary prevention refers to those individuals that let's say have, have have some initiation, they're experimenting, let's say the good example is within within the addiction world is that you've got adolescents that are starting to experiment with substance use. So a secondary prevention effort would be aimed at kind of taking those individuals that have already started and experimented, tested the water and try to then decrease the prevalence of that specific problem in in the population. So we want we want to kind of detect early. The purpose of secondary prevention is we really want to detect early and prevent a condition from getting chronic and getting severe.

13:38

Tertiary prevention, however, is when we're looking at individuals that already have the condition. It has become chronic, let's say or they've got the full fledged condition and symptoms. And in tertiary prevention, we're now trying to minimize the harms that are coming as a result of having that. So for example, like somebody who has opioid use disorder, and we're starting them on buprenorphine or methadone, right? This is kind of a tertiary prevention issue, we're trying to prevent that person from dying from overdose, we're trying to prevent that person from getting hepatitis C or HIV or other communicable diseases as a result of their drug use. So tertiary prevention is kind of like they already have it. Now we're trying to minimize the harms that are going to come from that. So again, testable concepts, primary, secondary, tertiary intervention.

14:25

Let's now take a look. Again, this is the meerkat kind of stay on our toes, we're kind of bouncing around the different things. In many of your other talks, you're going to get a lot of substance specific epidemiologic information, you're gonna get oh, this is the prevalence of opioid use disorder. This is the prevalence of, of this, that or the other condition. In this in this talk with me here today, I'm going to try my best to kind of give big picture rather than kind of go through each and every substance and look at sort of different prevalences but in certain instances, it may be interesting and it may be noteworthy so I'll get to that.

15:00

So let's look at the big picture. This data is from the NSDUH survey, which means that we're looking at a point in time survey, which means we're looking at prevalences. So, here are some of the, you know, just general prevalences. Again, probably not earth shattering or shocking to people. Past

month general substance use and vaping among...and nicotine vaping among people aged 12 and older in 2021. So this is the most recent data set on on this topic. So you see alcohols way you know, way up at the top. Tobacco products are next. We have nicotine vaping is kind of separated out from tobacco specific products. We have marijuana, they, again, the survey still queries with the term marijuana as opposed to cannabis. The thing that I just highlight here is that we separate out the stimulants, and I'm in California and stimulants are a big problem out here. And we can I like to just kind of also give people a sense of like, well, if you clump all this all the stimulants together cocaine, methamphetamine, prescription stimulant, misuse, you see, you know, you put them together and it becomes a much more significant number, rather than kind of seeing them separated out individually.

16:12

The other thing that I'm going to come back to that I want to highlight on this slide that I think is interesting is looking at hallucinogens. So hallucinogens are 2.2 million, according to this in terms of past month substance use, based on survey data, which puts it higher than cocaine and methamphetamine. Now, again, we're gonna circle back to that, but I just wanted to highlight that and kind of have people dog-ear that, so that when we come back to it, we'll, it'll have some context.

16:41

So I needed to... there... Okay, so next big picture slide. This is people aged 12 or older with a past-year substance use disorder. So and like what substance they have their substance use disorder with. So you can see here that alcohol, and drug use, marijuana, these remain high, but this is an important slide to look at because this is telling us sort of like this is the these are the number of people with based on the survey that actually have substance use disorder so full-fledged substance use disorder, as opposed to just dabbling or, you know, past month use. These are folks that have the full-fledged substance use disorder.

17:23

The common thing that comes up I, you know, in terms of testing and also kind of general, you know, conversations about addiction is Okay, so we've got all these people that have substance use disorder, do they get treatment? Well, the answer is generally and has been the case for for a long time, that the data bears out that that most people who need substance use treatment don't get substance use treatment. This is just some data comparing 2020 versus 2021. broken down by age group in terms of the percentage of people that are getting treatment. And you can see the generally we've got you know, of people that needed substance use treatment, we're we're generally hovering a little bit less than 10% of those individuals. And that's been a fairly consistent number for a number of years of these individuals that are getting treatment.

18:16

So looking at this a little bit closer by demographic... I... and I'm going to talk a little bit more specifically about demographics in a minute. But this to kind of look at sort of who's getting treatment by, you know, race and ethnicity, you can see here, the breakdown, which at first glance, you might look at this and say Okay, so the the non-Hispanic, American Indian, or Alaskan Native population is

getting much more... is having access to treatment much more than other populations. This is where kind of like looking at the details might be helpful, because we've seen the error bar on this particular bar is pretty, pretty wide. What that's indicative of is it's just a low number. So the precision of the data that they've gotten for that population may be subject to wide variation. So again, just to kind of introduce though, the the the idea that there that what we see in terms of how people access treatment does not necessarily cleanly divide amongst all populations. That different demographics and races might see things might have different experiences of that.

19:25

Where do people get treatment from? You know, again, some might argue that saying self-help groups as treatment is not actually accurate. But they still include it in the survey as sort of like where people are seeking help, let's say, from their addictive disorders, you see how self help groups is by far the place where most people when they're getting treatment, or claiming that they're getting treatment is from self help group and you can see the rest of the breakdown there.

19:54

This is a very interesting slide that SAMHSA started to include a few years ago that I I'd really love kind of highlighting here because I think it frames the story of what we're seeing epidemiologically in a slightly different light. So I mentioned before that, let's say that roughly 10% of the individuals that need substance use treatment or would benefit from substance use treatment, about 10% of them are accessing that treatment, that means 90% are not accessing that treatment. So a common conception previously was like, well, people aren't accessing this treatment, because they are, you know, because they, they're the access, the treatment programs just aren't available, it's an access problem. If there was more treatment available then people would be accessing it, and you see that that 90% shrink.

20:46

Well, interestingly, as they do this survey, they've added the additional questions that ask sort of, like, you know, of those of you who are saying that you don't, you know, that you're not getting access to treatment, what's your, what's your motivation, like, what's your interest in getting treatment, and what they found here is that, again, these are of the individuals that 90% That, that would benefit potentially, from treatment of their addictive disorders. 97% of them or nearly 97% of them are saying that they did not feel like they needed treatment. So that really reframes the the problem, or reframes the issue a lot differently. So now we're looking at 90% of these individuals that that need treatment, 9... 97% of them are saying, like, you know, I, I don't feel like I need treatment. So again, it's it paints a slightly different picture of what we're up against in, in looking at tackling the addictive disorder issues.

21:50

I put these next couple of slides in just as a reminder that addiction does not necessarily occur in isolation, and that we've actually seen significant increases in... this a serious mental illness. This has been trending up since 2015. So the trend began even before the pandemic, and that we're seeing

that that in conjunction with, with sort of the the issues related to substance use, we're seeing issues related to mental health more broadly, also increasing over the course of the past 10 years. Why is this significant? Well, because people, especially people with serious mental illness, they are much, much more likely to have issues with substances.

22:34

So what you're seeing in the bar graph here is that the red bars represent those individuals that have serious mental illness, and their use patterns of substances. So we see that across the board, if you have serious mental illness, you are more likely to be using substances. Again, this might be somewhat commonplace, but the more severe your mental health issues, the more likely you are to be using substances. And it's an important data point to to recognize and to remember.

23:03

In con- in conjunction with this, we see that, you know, folks, you know, you this is now youth aged 12 to 17 have significant, you know, a lot of them have been thinking about suicide, which is a pretty scary thing to acknowledge. But if we look at this, you know, when we're talking about, you know, nearly 13% of 12 to 17 year olds had serious thoughts of suicide in the past year based on the survey, again, that's probably an underestimate, because it's a survey like not everybody answers surveys truthfully. But you can see the numbers there.

23:41

And this is just an interesting thing that they've started to incorporate into the dataset, which is asking people COVID-19 specific questions. And what you can see here is that that many of the individual, you know, a significant proportion of folks are saying that they had serious thoughts because of the COVID 19 pandemic, and its impacts. So again, I put that there to kind of acknowledge the situation, and the relationship between mental health and substance use.

24:10

So let's take a quick look here at a few specific substances. Because some trends- some trends and things I think are important to acknowledge. So tobacco use, we can see going back nearly 20 years, we can see that the trends of past- past month, tobacco cigarette use for individuals 12 and older has been going down. Which is great. And that's totally something that we should be celebrating.

24:38

At the same time we saw... now this is data from, you know, from from 2017, 2018, around the surge in youth e-cigarette use and the vaping, the tobacco vaping surge that happened in 2017 and 2018.

24:54

So we would think that like okay, we've got tobacco cigarette use going down, we've got vaping going up. But then something interesting happens in 2020, which is that we see a drop off in the youth vaping. And we might ask ourselves a question like, Why? Why might this have happened? Again, if we were in person, I might ask the audience and see what kind of ideas come up. But in the absence of that, I'll just tell you, one of the major reasons that people think that the student vaping dropped off in 2019 into 2020. And by the way, this started before the pandemic. So we can't blame the pandemic for this- has to do with the the the widespread banning of flavored tobacco or nicotine vaping cartridges. So the reason I put this in here is because now we're talking about a specific example of a primary prevention. So remember, primary, secondary, tertiary.

25:52

Here, we have a primary prevention, the goal here was, let's stop people from even trying this stuff in the first place. So let's take the flavors out of it, to make it less appealing. And sure enough, it had an impact on the youth vaping prevalences, and incidences as a result of that, so again, is an example of primary prevention.

26:15

So this is something that is is fairly consistent from year to year just looking at current binge and heavy alcohol use among people 12 and older. Remember, binge drinking represents drinking five or more drinks on the same occasion. Or for women drinking four or more drinks on the same occasion, at least once in the past 30 days.

26:37

Heavy alcohol use refers to binge drinking on five or more days in the past 30 days. So the reason I separate this out is because binge drinking carries a higher risk than sort of any alcohol use or or just you know, as we might say, social alcohol use, and then heavy alcohol use carries an increased risk in terms of other medical complications or sequela. So what does this data tell us? This data tells us that half of all drinkers in the US are binge or heavy drinkers. So half of all the drinkers in the US are drinking in a pattern that has with- that carries with it significant risk of medical or other social harms.

27:15

And what we saw during the pandemic was... and everybody, I think, rightly is focused on opioid use and opioid overdoses. But what we're seeing is actually alcohol is responsible for more deaths than the opioid epidemic, but it doesn't get as much media play. But again, just a reminder, alcohol is there and alcohol is causing a lot of problems and people continue to use alcohol in a high risk pattern in the US.

27:46

So let's talk about opioids. prescription opioid pain reliever misuse has gone down. This is terrific. We can see the data here, the prevalence data from 2015 to 2020. Yet, as many of you know, overdoses and deaths related to opioids are going up. So how do you reconcile this- if you've got prescription

and deaths related to opioids are going up. So how do you reconcile this? If you've got prescription opioid use going down and you've got overdose deaths going up? Either you've got, you know, a situation where there's a non-prescription opioid that has entered the market and everybody's using that and switched over to that, or the the whatever opioid is on the market is more deadly. In other words, that the the few you know, the people that have access to that or use that are subject to higher risk of death or or some other morbidity.

28:34

So... well, it turns out that it's a little bit of both and fentanyl. Again, you'd have to live under a rock to not have heard of sort of the issues around fentanyl. But I think it's an important concept that is testable from the standpoint of of, you know, generally we've seen a decrease in opioid use and in particular prescription opioid misuse. But yet we've seen an increase in deaths and a lot of that is attributed to synthetic opioids such as fentanyl.

29:00

This is a somewhat, you know, scary slide in some respects from the standpoint of thinking about perceived risk among people 12 and older, of different substances, so that the longer the bar is the more perceived risk people feel around use of that substance. So conversely, the shorter the bar, the less perceived risk. So this has been pretty consistent for many years now that smoking marijuana weekly is felt to have a low risk or is perceived to have a low risk for individuals. Why is this important?

29:38

Well, you know, because it also I think, demonstrates part of the story that epidemiology helps us tell, which is why would people be thinking that cannabis is less risky than cocaine? Well, then you can look at studies and you can make arguments about this too. But I would argue that what's also happening is this interplay between sort of what people are are receiving on from the media side of things, the information that they're receiving. That is talking a lot about, you know, you know, here's here's cannabis, it's good for what ails you, it's natural. It's a plant, it can't possibly hurt you. And people get that message, especially youth get that message. And as a result, they perceive less risk. They say, Well, you know, Woody Harrelson has a cannabis dispensary. So, you know, everybody loves Woody. How can...? You know, how can it be dangerous? How could it potentially have any harms for me?

30:36

What this tells us and this is this is reported sort of what people first use in the past year, the people that are initiating use of substances in the past year, what we see is that cannabis and alcohol are the two most common things that that people have reported initiating their use on in the past year.

30:56

So I told you, I promised I'd come back to this issue of hallucinogens, not because hallucinogens are

sort of this huge public health threat, but it it it does highlights some of the concepts that we've been talking about and that I've been introducing, which is that we have been seeing that there is a slight increase in hallucinogen use year over year. And we're seeing that hallucinogens are used by a lot of different people based on the survey results. And why might that be especially amongst youth? Like, why might it be that we're seeing increases in use of hallucinogens?

31:34

Well, again, to the argument that I made before around cannabis, is it possible that this becomes an area of thinking about primary prevention, where if the if we've got celebrities talk- raving about their experiences with various hallucinogenic substances, and kids are receiving that, does that potentially provide an area where we can think about primary prevention to, to mitigate sort of the the allure of of some of these substances in in the general population?

32:07

So. So there are a couple other important parts of the epidemiologic story that that I really think are important to highlight. So let's look at race and ethnicity. This is a 2021 data that I put together based on SAMHSA's data that they've released through the NSDUH based on race and ethnicity, and different substance use patterns. I put this up here and I color-coded this simply to kind of give people a sense of there are- the columns- that the each column represents a different, you know, different race or ethnicity. And versus the national average, which is the the column on the far left with the with the black numbers in it. And as you scan, just scan this chart, if the column has all light blue, that means that you know, or the numbers that are light blue means that those- for those particular substances in that particular demographic, their use pattern is less than what the national average is.

33:10

Conversely, if it's red, it's above. So you can see from this, you know, pretty significantly that the black, African American column and the American Indian-Alaskan Native column have a lot of those numbers that represent being higher than the national average for these different... these different metrics of measuring substance use, like past year marijuana use, past year substance use disorder, etc.

33:40

Recently, the NSDUH also started collecting some data on some limited subsets of what they entitled sexual minority groups. And in their... this is just contained within bisexual, gay, and lesbian. Same principle here, if it's red, that means that it's above the the average for what is identified as straight individuals. Again, I didn't, these are the terms that the the NSDUH uses in the survey, you can see across the board, sexual minority groups have disproportionately higher impact and use patterns of substances and alcohol, which again, very noteworthy, I think, for us to be bearing in mind, and this doesn't even include sort of the full range of sexual identities that that... and gender identities that we that we have in the populations that we work with.

34:33

And I'd be remiss to not also kind of make mention of another sort of important epidemiologic phenomenon in our country in particular, which is where do a lot of people end up who have substance use disorders and a lot of them end up in jail or incarceral settings.

34:48

Gender is another thing that is important to acknowledge. Women tend to initiate substance use later than men. Women also tend to have an accelerated course of the disorder otherwise known as telescoping. And women with substance use disorders tend to have more severe impairment in employment, social/family, medical and psychiatric functioning relative to men.

35:10

Okay, let's take a step back. Let's talk here briefly about a study so that we can dive into kind of using some of these concepts. So here's a meta-analysis. And by the way, I'm not putting this up here necessarily to say like, this is the world's greatest study, but it brings out some epidemiologic concepts that are good review. So let's look at this study, which is framed around a question, does marijuana cause psychosis? This is a very common question that we get, I think, in addiction work, and I think as healthcare providers in general. So what is this study?

35:44

So this study is a systematic review and a meta-analysis. And a systematic review is more than just putting together studies. There's a science to seeking out all manner of studies, including the, you know, industry-negative studies that people don't normally see. So a systematic review really is the science of pulling all of these things together. And, you know, a meta-analysis is actually the analysis of that, that data that has been pulled together systematically.

36:11

So what do they do in this study, they, they, they included, provided data on cannabis consumption prior to the onset of psychosis. This... cohort and cross-sectional studies were included. So they could actually look at things like incidence. And they you can see what they included in terms of 18, you know, studies that were brought in for systematic review, and then 10, that were included in the meta-analysis representing a big number of people.

36:42

What did they find? And this is the important epidemiologic thing. So what did they find? They found an odds ratio of 3.9 with a 95% confidence interval of 2.84 to 5.34, for the risk of schizophrenia and other psychosis-related outcomes among the heaviest cannabis users compared to non-users.

36:59

So what can we say about this study? Well, number one, we can look at sort of like, how quality is the evidence that's included here. This is the pyramid of quality of evidence with the top being systematic reviews and meta-analyses. The next rung being randomized, controlled, double blind studies. And as again, we think about this particular study, we say, Oh, this was a systematic review and meta-analysis. So this is kind of a top of the quality of, of data pyramid. So we can say, high quality, kind of, we're likely to get a higher quality kind of result from this type of study than we are from, you know, case reports, for example.

37:40

So let's review for a second, the different types of studies, we have experimental studies, and we have observational studies. Experimental: lab, or, you know, working with specific people in controlled environments. That's how we get controlled, randomized, controlled trials. Observational: this is when we're looking at things like cross-sectional surveys, as well as longitudinal studies like cohort studies and case control studies that are either prospective or retrospective. Again, just a review of the types of studies that are out there.

38:08

So now let's look at this. What do we do in in a study like this? Or what is this study telling us? This study is trying to tell us what's the risk of smok- if you use cannabis, what's the risk that you're going to develop psychosis? So in this study, the epidemiologist and the bios, biostatisticians are looking to kind of quantify risk.

38:31

I put the Death Star there because you know, there's no bigger risk than the Death Star. So here are some different formulas for thinking about quantifying risk. This is one of those things that I would always scribble on the back of the index card, to take a look at during, you know, just kind of try to diffuse into my brain before the test. But we can see sort of different ways of breaking down this essential, you know, essentially this relationship between exposure and development of a particular condition. And you can see there's absolute risk, there's odds ratio, there's relative risk, there's absolute risk reduction, and you can see the formulas- the number needed to harm, number needed to treat. And you can get a sense of the array of different ways of kind of splitting up this data to get different information out of it in terms of quantifying risk.

39:21

In this study, they used odds ratio. So what is an odds ratio? Well, an odds ratio is a ratio of odds. I love saying that, because it's, you know, that doesn't explain anything, but it is exactly what it is, which is a ratio of odds. The odds ratio tells you that the higher, the higher the odds ratio, the stronger the association potentially is between the exposure and the outcome. If an odds ratio is one, then that means that the ratio of the odds shows no association between the exposure and the

outcome. So the odds ratio of one is something really important that we're actually trying to avoid. And then you can see kind of the actual sort of, you know, textual representation of what odds ratio means.

40:07

So let's do an example of odds ratio. So imagine, if you will, that we're trying to get a sense of the relationship between getting breast cancer and driving an American car versus a non-American car. If no correlation exists between these two, then the ratio of those with disease who drove American cars, relative to the those who didn't, would likely be close to one because there's no association, it shouldn't matter if you drive an American car or a Japanese car, in terms of your risk of getting breast cancer. And that would, and that would play out. And that would be that would tell you that the likelihood of getting breast cancer is not related to the type of car that you drive. It's more related to other factors or chance. So that's what the the, again, back to this idea that an odds ratio of one- What does that represent? What that represents is that, that the exposure does not necessarily correlate with being able to say that that leads to the outcome that you're looking at.

41:11

So let's go back to this, this cannabis paper. And let's take a look at this and say like, Okay, we'll make sense of this. What does this actually mean? So the cannabis paper is saying that an association was found. And that the the reason that they can say that they found an association is because the odds ratio is 3.9. That's bigger than one bigger than one speaks to the higher likelihood that there is an association between the exposure and the outcome that you were studying.

41:40

So but what about this confidence interval? Oh, the confidence intervals. So the confidence interval, it says here, the 95% confidence interval is 2.84 to 5.34. Well, let's unpack that and understand what that means. What- the 95% confidence interval refers to the fact that statistically, we're 95% confident that if we repeated this study, the true mean, the odds ratio that we would get, would fall within the stated range between 2.84 and 5.34. So this also means that we're 5% unsure. But statistically, being 5% unsure is tolerable when looking when looking at a study like this. So the again, what this is telling you is that there's a high likelihood there's a there's a high likelihood of a strong association between the exposure of cannabis and the outcome of psychosis. It cannot tell us definitively that cannabis causes psychosis, because there still is that lingering 5% uncertainty.

42:52

So this brings us to the null hypothesis. Oh, no, not the null hypothesis. So what is the null hypothesis? The null hypothesis is a starting point that we use in studies like this, that expresses there being no difference or relationship between the disease and the risk factor. We start from a skeptical point that there's no association between these two, as opposed to the alternative hypothesis where, you know, some difference or relationship exists based on you know, based on the

exposure. And what we're setting out to do in studies like this is we're setting out to either prove the null hypothesis, in other words, no association, or prove that they're- that reject the null hypothesis and say that there is an association between these two.

43:41

So what this means is that there's also a possibility that we might make mistakes. So when we state that there is an effect, when none actually exists in reality, we're making a false positive error, which is a type one error or an alpha error, you might have heard of this.

43:56

And if we're stating that there is not an effect, when one does exist, we're making a false negative error or type two or beta error. So what does this mean for this study? This study, what it means is that we can't say that this study proves that cannabis causes psychosis. What we can say is the study says that there's a strong association based on this study between exposure, especially exposure to large amounts of cannabis, and the development of psychosis.

44:32

So finally, here in the last couple of minutes, I want to review one other important epidemiologic concept that is pretty testable, which is looking at this idea of- and I'm going to cut to the chase on this a little bit- sensitivity and specificity. So the the way that I look at this, as I say, Okay, why the heck is his urine toxicology screen negative?

44:51

So, here's the here's the conundrum. You got an individual that comes into the emergency room, who reports that they're taking methadone. They get a urine toxicology screen in the emergency room and the toxicology screen is negative for opioids, or negative for opiates, whatever the- however, it's listed on that study that's done in that emergency room. So question is, why is it negative? And he says he's taking it, but the test is saying, you know that he's not taking it or it's the test is negative. What does that mean?

45:25

So this must mean that he's not taking the methadone, right? Well, this is where we can actually think about sensitivity and specificity. And the two-step process that we that we look at for drug screening. We have a screening test, and we have a confirmatory test.

45:43

And sensitivity. So screening tests, we want to be very sensitive, we want a screening test to be very sensitive, because as you can see, and this is where like, if you intuitively understand what's being

asked here, or what's being represented here, it actually starts to make a lot more sense. In a sensitive test, we have true positive over true positive plus false negative, which means that a 100% sensitive test is going to be a test that has almost no possibility of a false negative, meaning that you're not going to miss anybody who has the condition. That's a good screening test.

46:23

However, you might get some false positives. That's where sensitivity comes or specificity, I'm sorry, comes in. So in specificity, a highly specific test is going to be one where the, the false positive possibility is going to be near to zero. So you want you want as high as you want a confirmatory test to be very specific, because you don't want to say that somebody has the condition, who doesn't actually have the condition, which is different than a screening test, where you want to make sure that you don't miss anybody who has the condition. But the cost of that is that you might catch some people and say that they have the condition, but they don't actually have the condition, in which case, you would send them for confirmatory testing, which would be much more specific.

47:15

So what's happening with this particular case of the guy that comes in says he's on methadone, and the test doesn't bear that out? Well, we've got a situation in which we have a high sensitivity screen for opiates, those metabolized to morphine, it's a high sensitivity screen for opiates, those that are metabolized to morphine, but low sensitivity for synthetic opioids, methadone. In other words, the test doesn't test for methadone. Because the test is not very sensitive for you know, which is not very sensitive for individuals that might be taking synthetic opioids. But it is very sensitive to catch those individuals who might be using other opioids that get metabolized through morphine, and then are detectable in that manner. And methadone, remember, is not metabolized to morphine.

48:10

So what we've done today: we've gone over a lot of different things, I'm sure I've probably gone shortly over my time, if not longer, but I tried to set a framework for understanding how you might think about studying for the test and sort of where you might find some important ways to review some of these concepts. We've looked at just a couple of broad addiction trends and important prevalence pieces of data to try to drive home some concepts, especially around primary, secondary, tertiary prevention, as well as inc- you know prevalences. Of, of note with several substances. And then in the final part of this talk, we've tried to kind of employ some epidemiologic concepts that are commonly used in studies that you might encounter in the real world, and also might be testable in a, you know, in a testing situation such as this.

49:08

So with that, I will say, there's this meerkats again, or that that meerkat again, who's relaxing now with his four toes, not five. And I, I'll have to double check and see if meerkats actually have thumbs too I don't think they do, but that'll be for my next year's talk. So with that, I thank you very much.