I’m an Associate Professor of Epidemiology at the Yale School of Public Health, as well as the school’s Associate Dean for Diversity, Equity and Inclusion. It is my pleasure to step in for Professor Donna Spiegelman today to introduce our speaker, Dr. Lingrui Liu. Before I do that though, I’d like to acknowledge that today’s seminar is sponsored by both the Yale Center for Methods and Implementation and Prevention Science, or CMIPS and the Yale Center for Implementation Science. Based at the Yale School of Health, CMIPS develops and disseminates innovative methodological approaches to address implementation gaps and improve public health worldwide. Strategically selecting the issues that carry the greatest burden and hold the greatest promise for amelioration right now. If you would like to be informed about future CMIPS seminars, please let William Tutle know in the chat and he will add you to the CMIPS listserv. Based at the Yale School of Medicine, YCIS accelerates the late stage translation
of evidence-based treatments, practices and policies to improve the health of the residents of New Haven and beyond. Its Yale Scholars and Implementation Science, or YSIS program is the training core of the center. YCIS is funded by a five-year National Heart, Lung and Blood Institute K-12 award and is designed to train junior faculty and postdoctoral fellows in late stage dissemination and implementation science. Turning to our speaker today, Dr. Lingrui Liu is an associate research scientist in the Department of Health Policy and Management at YSPH as well as a K-12 EL Scholar Implementation Science at the Yale Center for Implementation Science. Her research focuses on healthcare management and organizational studies, healthcare systems, quality improvement, patient safety, decision science and implementation science. Dr. Liu received her doctorate from Harvard University.
The title of her talk today is, "Qualitative Comparative Analysis: Applying to Research on Public Health Interventions."

Welcome Ling, over to you.

Thank you Matt and thank you William,

and also Donna for having me today,

have this opportunity to present

the qualitative comparative analysis,

relative new methodology to public health.

And I consider this opportunity

as a way to discuss with our scholars

and also broader the community,

to explore the utility of this method

in public health, in intervention, evaluative science.

And I am not expecting to use this opportunity

as an education of this method,

like within this 30 or 40 minutes.

And so today, I am going to introduce

this new method to you and also discuss about

the literature

and the discussion of the utility of QCA methodology

in implementation sense.

And lastly, I will use empirical study from my work,

set as an example to show a little bit

about my experienced business method.

So what is QCA?
So in one short sentence, it uses Boolean logic to identify all possible combinations of variables, conditions. It’s a QCA terminology that influences the outcome, and also as scholars and we are very curious about the receptiveness of this matter and what are the publication opportunities of using this method. And the good news, that it welcomes for growing opportunities on conferences and also the publications in journals that have been majorly published in business, management, political science, and also is emerging in public health and health services research journals. But we also acknowledge the challenges exist, that’s mostly in how to visualize the findings from the QCA and how to interpret and how to communicate this non-QCA experts in our scholarship. And here, I cite a figure from the latest math book from Melloo and he is based in Europe and so his book has summarized the recent journal articles published on QCA. You can see that public health is emerging, but it is still relatively new. And here, I would like to summarize three main features of the QC methodology.
and I first consider it is a mixed method that bridges the qualitative and quantitative analysis.

So it’s a non-additive and nonlinear method that is to identify all the combinations of necessary and sufficient conditions, the factors for an outcome.

And so for using QCA, it requires the researchers to have the familiarity of these cases to have the in-depth knowledge of your cases, but also it’s enables the researchers to examine the cross-case patterns.

So it acknowledges the diversity and also heterogeneity of the research study, with regard that it allows the researchers to identify what are the different solutions of different combinations of the conditions for the occurrence of the outcome of your interest.

And second feature, I think is important to understand QCA is to assess the sufficient and necessary conditions for the success or failure of the outcome.

So it’s very different from our conventional statistic influence techniques.

And by looking at the sufficient and necessary conditions for the success or failure of the outcomes,
it provides researchers or the practitioners the approach to identify more than one solution or we call recipe to an outcome. And also the presence or the absence of these factors in relation to the other conditions might be key. And also in QCA study and the specific factors explain the success does not imply that their absence would lead to the failure. And the third feature, I think is important, is that QCA is ideal, given the nature of this matter. It’s very ideal for the small to intermediate sample size research design. And because it’s within this range, like 10 to 15 cases, there are often too many cases for researchers to keep all the knowledge about all the cases, but too few cases for most conventional statistical techniques. And here I share a few important methodology references, which may be helpful if some of you are interested to read and explore more. And so come to our interest, what is the utility of this method in implementation science?
And I found two literature which I found they are very useful for me to understand what has been done in this area. And so one is the systematic review by Hanckel and which is just published is out at BMC Public Health and the other report paper and has been using, apply the QCA to identify the features of the strategies related to mental health care for children and adolescents by the RTI and it has been published as agency for healthcare and quality research publication series. So I think those two are very useful if you want to read more. So here, just to summarize, So here, I want to show you the sample research questions or rationale for using the QCA that you may be interested to consider.
whether QCA’s potential approach for you to use in your research or analyzing your data. So the simple research questions, you can see that QCA also answers questions, “What combinations of the components might serve as recipes for success.” Of the outcome or if you are interested to identify the critical features or characteristics of the implementation program that leads to the successful implementation outcomes or if you are interested to identify what are the necessary or sufficient conditions or factors that are key to the implementation of this public health intervention. And also I want to say the QCA is mostly used in the description or explanation studies. So in the description studies, it’s very straightforward QCA, you can use QCA to summarize the patterns across your cases or used in explanation studies that help you test your existing hypothesis and choose to test out whether your empirical cases can be reflected by some or any combinations of the factors from this existing theory. And here is the QCA research cycle.
So it starts to pose the research problem and ask the research question, and to figure out the scope of your research question. Then use the existing theories, or like the empirical evidence, to consider to select which cases into your study. Then you will need to select the conditions, like conditions are the factors, you can under consider those are the factors. And then the key steps are to calibrate the data and to conduct the analysis. To identify the necessary conditions and also the sufficient conditions. The full process is an iterative process that you will need to come forth and back to adjust with the scope of your research question and also the selection of cases and the thresholds. And the decision rules for calibrating your data sets. And so the strengths and weakness of the QCA implementation science has been discussed. In a way that it provides a systematic approach for understanding the mechanisms that work in implementation across the context. And the weakness however have been reported related to the data availability limitation, especially on ineffective interventions.
And the software packages are evolving, still in development, but a few packages are major and ready for use and you can go to this website for a full list, and for the major softwares have been developed as the FSQCA, QCA software and also there are a few packages developed on our environment that are for use. And here I want to just show a few examples of visualizing the QCA findings. And so, in the existing literature I found that the Venn diagram and also the chart table have been mostly used and again it’s evolving and so scholars and researchers are still exploring what are the most efficient ways to communicate with our audience about the findings from the QCA study. So here I want to use one example study from my work that I collaborated with my colleagues and we use data from primary care practices to explore the system features of primary care practice that promotes better provider experience. And this work had been variously published at Academy of Management and also Healthcare Management Review. So in this study
we focus on the providers in primary care practices
and we know that the primary care providers also experience low rates of clinical work satisfaction and high rates of burnout and the poor satisfaction may adversely affect the quality of care they deliver to their patients and adversely related to patient outcomes.
And what have been not exams or studies much
is what are the system level features affecting the provider’s satisfaction in their clinical work practice?
So in this study we asked a research question, "Which system features and in what combinations can help to improve primary care provider’s clinical work satisfaction?"
And this study was conducted in collaboration with 19 Harvard affiliate primary care practices and we surveyed a total of 19 managers and a total of 854 primary care providers completed the survey.
And for the managers of the survey and interview, one manager of each of these 19 primary care practices.
Our hypothesis is to look
at our automated outcome of increase, the system outcome,
providers clinical work satisfaction,
and this outcome is positively related,
as the system features of primary care practices
that include the team dynamics
and provider perceptions of safety culture
and also the care coordination among the providers
to their patient care.
And further, the hypothesis is that the enabling functions
of these primary care practices,
including operational functions,
that goes into eight domains,
and also the health information technology HIT functions
are positively related with each of our system features,
the overall team dynamics,
the provider perceptions of safety culture
and also the care coordination among providers.
And within the operational care process functionality
we categorize into eight domains.
So including appointment and referral system
for high risk patients and also for routine patients,
abnormal test result management,
cancer screening for high risk patients
and also for routine patients,
patient center care, patient safety
and care transitions across the primary care practice
and emergency departments or the hospitals
or the other specialist departments
and the data, so we use the self-assessment service
for primary care providers variables,
including the clinical work satisfaction and team dynamics,
provider perceptions of safety culture and care coordination
among the providers towards patient care.
And for enabling functions,
they surveyed and interviewed the managers of the practice
on a total of eight domains
of the operational care process functions
and also 42 items of HIT functions.
And so, the method is we use the QCA
and again it’s based on Boolean logic.
Here are just a few examples of the logic
and logic or, or negation knots
that is used in Boolean logic.
And so, we use QCA to compare the cases
to identify the combinations
of necessary and sufficient conditions,
the variables that trigger the outcome.
And in QCA the key step is to construct the Truth Table.
And here is an example from one hypothesis,
of testing one hypothesis in our study.
And so you can see that this is a table
that includes eight rows and so the table is a two case power table and we have three explanatory variables here and one outcome. So we have a total of eight rows and each row we can consider as a recipe that’s a combination of the logically possible conditions. And the one indicates the presence of this factor in this recipe and the zero indicates the absence of this factor in this recipe. Then the other main methodology is to use the Quine-McCluskey algorithm to reduce the roles of the Truth Tables to bring equations and to minimize the combinations which yields the prime recipes. And QCA uses two goodness-of-fit statistics and what is consistency? So it’s range from zero to one and it indicates the strength of association between the conditions and outcome and the coverage also ranges from zero to one and it indicates the proportion of the cases that are covered in a specific recipe. So here in our study, it indicates the proportion of the practice sites that have a specific bundle. Here is an example of the consistency and coverage scores
from testing this hypothesis in our study. And here I want to talk again about a few main features of QCA method. So it identifies the combinations of the conditions, capable of yielding the same outcome and therefore it can be multiple pathways and the outcome and non-outcome may require different explanations. So it is important that you define the outcome in your testing, for example in the example which I just presented, the outcome we define as grade level satisfaction among the primary care providers. So the non-outcome is the lower level satisfaction among the primary care providers and so it requests the researchers to test the separate sets of the combinations of the factors, leads to the outcome or the non-outcome. So it contrasts with the next effects thinking that usually have been applied that usually have been applied in conventional statistical techniques. And in this study using the QCA, the rationale for choosing QCA is that it enable us to identify the system level characteristics that influence the provider experience. And the findings, so the first task, the contribution of each system features
to our system outcomes. The team dynamics provide a perception of safety culture and peer coordination among providers. Each of those three system features with the outcome of increase, the raised clinical work satisfaction and we can see that it’s yields very high consistency and modus coverage. And then we test the bundles of these system features, like team dynamics and provider perceptions of safety culture together, you can see it yield very high consistency and also high coverage and also the provider perceptions of safety culture and peer coordination among providers, you can see the consistency remains very high but the coverage drops and also we test all of them together like the set relations of the three system features based the outcome. And you can also see that the consistency remains high, but the coverage is relatively low, it’s only 0.32. And so, we are expanding the analysis to include our enabling functions of the primary care practices and in our argument, in our final results.
and we identify there are three key components of the operational care process functions. One is the number three, abnormal test result management and the number five, cancel screening for high risk patients. And number eight is the care transitions across the primary care practice and emergency departments or hospitals and plus this HIT functions, that they together are the core factors consisting of the solutions which would yield to the outcome of our interest, like the strong team dynamics and also greater level provider perceptions of safety culture.

So to interpret what we have found in the QCA analysis, "Favorable team dynamics combined with a strong safety culture contribute most to the greater clinical work satisfaction." And, "Provider-perceived safety culture acts as a core sufficient condition that presents in both recipes, yielding for PCP’s great clinical work satisfaction."

For the most empirical appliances, "A strong safety culture is not sufficient on its own..."
practice also needs to create and also implement the highly functioning teams."

Like to encourage them to foster the strong team dynamics,

visiting the primary care practices.

And also our findings indicate the, "HIT functionality alone is not sufficient to achieve the desired outcomes."

This is occurring a lot with what we know from the literature, because a lot of literature found that HIT generates a few benefits, but also to overly emphasize on the utility of HIT may bring a few adverse effects, like to increase the volume of the workloads to providers and contribute to their burnout issues.

So from our analysis, QCA analysis, it identifies that the HIT functionality is a core component, but alone, it’s not sufficient to help our providers to improve their clinical satisfaction. And also look at the operational care process functionalities and we found that the common features of the three factors which we identify, they represent it’s importance to enable the functions, identify urgent or complex acute illness.
and also request the collaborations across institutional settings. And this served as the key factors within the operational care process functionalities that can enable our providers to achieve better team dynamics and also their perception of safety culture. And now I want to discuss a little bit more about the practice implications of using the QCA in our study. I see the most attractive part of using QCA is that it helps to generate the message that can be very useful and practical for our managers or the practitioners, in-house systems, for them to use because usually they are more interested what are the solution pathways that we can implement in our systems, rather than increase on the net effects of each individual factors, effect on the outcome. So using QCA, it presents the multiple solution pathways for our practitioners, what are the most key factors you can focus and, or prioritize, in order to achieve the outcome of your implementation outcome or outcome interest. So in our study,
because the real obstacles in primary care practices is usually not possible to enable or to invest the resource to improve all the conditions or all the factors in our primary care delivery system. And so to identify the bundles can be the prioritized targets for our managers to emphasize if they want to improve their provider’s work satisfaction. And our study also highlights the human-centric nature of the physician clinical work satisfaction, like how HIT is important as a core components, but it has to work, function, with the other key factors together and it informs the need for non-regulatory strategies. And we also acknowledge there are a few limitations. So by using QCA, we’re not able to generate the causal claims. And also in QCA, one approach, like to calibrate the data actually is to refer to the existing empirical evidence, but because the QCA is relatively new for public health, evaluative science or health services research, so external standards or empirical evidence that published
for data calibration are not yet available or established.

And also QCA method may be prone to the type one errors.

And I want to stop at here and also welcome for a few questions

And if you have data sets that you think may consider QCA as an approach
to analyze your data to answer the research question,

what QCA can help to work best.

And so welcome to Rachel and I’m very passionate

on exploring computer exploration of this method

in implementation science studies.

Thank you very much.

Any questions?

Yeah, hi Lingrui, this is Donna.

Hi Donna.

Hi, thank you for the excellent and clear talk.

I really appreciate it.

I have a couple of questions.

So this one is sort of a point of information.

I came in a little late unfortunately

and I didn’t catch those two measures.

What is consistency?

And there was something else,

another measure that was appearing

on a number of your slides?
Yeah, so one is consistency and one is coverage. So consistency indicates the strength, you can consider as the p value, it’s very like the p value in regressions and it indicates the strengths of the association.

I’m sorry, the strength of the association of what with what?

Of explanatory. I’m trying to not use the terminology from our regression or statistics to explain the QCA, because they are definitely two different methods. But because of my experience of presenting this method, I know that usually it’s helpful to borrow some terminology from the conventional statistic analysis to interpret the terminology in QCA. And so back to your question, so consistency indicates the strength of the relationship between the explanatory variables and the outcome. So actually in QCA, because it’s based in Boolean logic, it’s actually not, variables is the conditions. So it’s identifying what are the necessary and sufficient conditions.
562 00:36:02.550 --> 00:36:07.500 that would lead to the occurrence of the outcome.
563 00:36:07.500 --> 00:36:12.500 And the other measure is the coverage,
564 00:36:14.720 --> 00:36:17.910 it also ranges from zero to one.
565 00:36:17.910 --> 00:36:22.910 It tells the proportion of, for example, in my studies,
566 00:36:23.190 --> 00:36:26.130 the proportion of the practice sites
567 00:36:26.130 --> 00:36:29.790 which have the specific bundle,
568 00:36:29.790 --> 00:36:32.973 so it tells the empirical appliance.
569 00:36:33.870 --> 00:36:38.870 Because in QCA, you first identify given your conditions
570 00:36:38.910 --> 00:36:43.910 and also the case data, you could identify
571 00:36:44.190 --> 00:36:48.030 what are all the logically possible solutions,
572 00:36:48.030 --> 00:36:53.010 but logically possible solutions are not all applied
573 00:36:53.010 --> 00:36:55.710 in your empirical cases.
574 00:36:55.710 --> 00:37:00.710 So coverage tells within your empirical cases,
575 00:37:01.440 --> 00:37:06.440 what the proportion of your cases have a specific bundle
576 00:37:08.010 --> 00:37:12.603 or a specific solution, I hope it helps!
577 00:37:14.130 --> 00:37:17.040 <v Donna>Sort of, well I had a couple of other questions,</v>
578 00:37:20.033 but let’s see if other people have questions first.
579 00:37:32.280 --> 00:37:33.900 <v Luke>Thanks for the great talk,</v>
580 00:37:33.900 --> 00:37:35.970 I have a question about the early part
581 00:37:35.970 --> 00:37:37.530 of the thematic analysis part.
582 00:37:37.530 --> 00:37:40.080 Is that different in qualitative comparative analysis
583 00:37:40.080 --> 00:37:40.913 than it would be,
584 00:37:40.913 --> 00:37:42.630 maybe with other more traditional techniques
585 00:37:42.630 --> 00:37:45.240 or does it sort of operate similarly?
586 00:37:45.240 --> 00:37:49.268 Obviously you’re applying these codes
to what you’re learning from the sites.

Sorry, I missed the first part of your question.

I’m asking a little bit about how you code these themes from the data that you’re getting from the participants.

is that different than you do in traditional qualitative, say, thematic analysis.

or does it operate according to similar rules?

This is a great question.

Yeah, actually this touches up on the key part of the QCA analysis.

Given my experience working with this method, I consider, it’s kind of a build up on the conventional qualitative or quantitative analysis,

that you have a few cases and then you will apply the conventional qualitative coding.

to your data, for example you have interview data.

and also then the additional steps, you need to calibrate your data to re-skill your data.

into membership range,

just the two in very simple words is from zero to one,

like rescale your data into zero to one.

And there are two approaches in QCA,

one is crisp QCA and one’s fuzzy sets QCA.
So basically you set up, you need to discuss this, the empirical experts and also who has the knowledge about the cases to decide what are the thresholds to be used to rescale your data sets, like the codes used to calibrate your data sets into the range of zero to one. So for example, you have to define what are the three thresholds you need to use, to calibrate the outcome of grades level satisfaction among primary care providers. So these surveys, the original survey uses zero to five scores, but in QCA there are a few decision rules like consider the statistical characteristic of your data and also refer to the existing empirical evidence and also your knowledge, the researcher’s knowledge about your data, your cases. And together you decide what are the decision rules to set up the thresholds to rescale the data sets, to rescale the data on the outcome variable into the zero to one. So for each of your variable you have the same principles of decision rules, which would lead to yields into different thresholds.
for each of variables to be rescaled into that range,
like zero to one range.
Is that helpful?
I had a question, somewhat related to what Luke asked and maybe my question will also kind of get into more depth.
So it sounded like what you were just describing was the process of defining your outcome of sort of clinician satisfaction and defining how you’re gonna take something more continuous score or continuous measure into a binary outcome where you could do something like QCA, on the other side of the predictors or the factors that you are associating with satisfaction, it sounds like in this study you were using a survey, potentially with some validated measures of certain factors. Related to Luke’s question, I feel like I’ve seen some presentations of QCA where they’ve used qualitative interviews or focus groups and they’ve sort of coded, using standard qualitative methods, coded the outcomes or the factors and then kind of used that group consensus.
to sort of translate that coding into quantitative,
I wondered if you could talk to us more about that,
'tcause I feel like QCA to me has a lot of potential in mixed methods approaches
as a way to formalize that hypothesis generation process
that you so nicely kind of displayed here.
So I'd love to have you talk a little bit more about the different applications of QCA in surveys
versus more pure qualitative interviews and open-ended responses.
Yeah, and this is a great question.
So from my understanding of this matter, I consider this a mixed matter and yeah it is true that it can be case oriented QCA
or variable oriented QCA, but I understand in a way, that’s the nature of the case
or variable is the same thing.
I mean, ideally you can design the data collection after,
as I show like in the reference, like the research starts phase,
you have the research problem, you have approximate research question you want to explore
and you refer to the existing theory
to guide you post the hypothesis
and to guide your data collection, to help with your data design. And you apply the QCA to analyze these data sets. But in practice, like for example in our study, and we first have the service completed in the whole program and then we figure out our research question, it’s more interesting at the system level, at the primary care practice level. And we were very curious to explore how QCA can help us to answer this question. So we have our data already completed and the compliments with the interviews, like the small size interview, the qualitative interview for the manager of each primary care practices, but ideally, if you can apply the QCA, consider to use this method at the stage of asking your research question and write your proposal and to combine the implements, the way how to design your data collection, either the service or qualitative interviews in your data collection, in the way that the QCA would need, like the qualitative data or quantitative data. So that’s one limitation of our study that we were not able to confirm that we want to use the QCA then we use the QCA framework.
to guide our data collection. And so now I have a project that I work with my here and Donna and also our colleagues in China that we now already proposed the research questions as the hospital level or like the organizational level. and we will use the QCA frameworks to help guide our data collection. So that will solve a few issues that may come out as the limitations of the study. And also another thought related to your question about using qualitative and quantitative data in the QCA analysis, so in my study, the majority of my data is the survey data. But from my study of this method, that for working with QCA in the qualitative data that after using the traditional qualitative coding you will need to take additional steps, to calibrate the data into scale of zero to one to indicate the extent to which of your variable, from the lower membership to higher membership, you can understand the way the lower performance of this variable to the higher performance of this variable in this study.
Yeah, did I answer your question?

I think so.

 Somehow getting group consensus, in terms of quantifying,

almost like labeling of a variable.

So for example, I’m really thinking about how much this might be of relevance to Leslie,

the work you’ve done in positive deviant studies,

sort of identifying sites or organizations that are really excelling,

or individuals that are really excelling and the sites that maybe are not.

And then using QCA to sort of label some of the factors that might be potential drivers.

And I think Ling what I’m hearing you say is that you would have to assign some numerical scale to those factors, in terms of their presence or absence and maybe ranges along that scale.

Yeah, yeah.

Yeah, I am still mystified by this.

and I’ve heard Ling talk about it,

maybe a half a dozen times.

I really wanna learn and understand, I really do.

and, you know, each time I get a little closer, but in this instance,

the calibration to me feels really daunting.

Like as the analog and a qualitative data set,
if we imagine, those of us, there’s a bunch on the panel here who do qualitative work.
You know, if you’re in a large group of coders, getting consensus on a construct can be really hard.
Just even what is this thing?
And so then to have to parse that even further to say like, yes, no, it exists.
If you’re imagining, I don’t know, some intangible quality,
if in our work, if we’re looking at organizations and the way they behave and dimension of culture.
So I think how this might work in these small case studies,
these positive deviant studies where you may have 10 or 12 organizations or units of analysis,
would be having to move from not only consensus around coding, so how do you interpret a particular piece of qualitative data,
but then this fuzzy piece, like where’s the boundary?
Is it a yes or no?
Is it a leadership engagement?
Is it there, yes or no?
So that to me feels daunting.
But if one could accomplish that in the coding of the narrative textual data,
it seems like there’s huge potential to look differently
at combinations of patterns, which to me, continues to be the takeaway here, trying to distill through many, many combinations of variables, if we look at organizational culture measures, a hundred variables, how do you find the right combination of the six that are gonna get you the farthest, if you’re somebody who needs to intervene, if you’re trying to intervene organizationally. But yeah, I’m on a learning curve, that’s for sure. But I could see Mona, how it might help in those kinds of designs. But there’s a lot of work on the qualitative interpretation side, I think. Thank you for your insights and comments Mona. Yeah, at the beginning I said this is not a educational workshop about the method and I consider this a forum where we can discuss and to explore further as I present, display, methods relatively new to probably health and evaluative science. And so I consider this an opportunity, I can introduce the method to our broader audience and if you have more data set,
or you have a similar research question that you think are similar to this
and you may consider to use the QCA to help with your analysis.
And as you see the years, like they’re pretty new,
like recent, three or four years
and also have been most conducted in high income country settings.
So I see there is a huge room for implementation science scholars
and practitioners to explore.
And I’m also on the learning curve!
And back to one point, firstly mentioned
about how to select the case and also select the variables,
from my experience and the study of the method
is like, now I think it’s important
you have the hypothesis from existing theory,
to guide you.
It’s not possible to include all the factors
of relevance in your analysis,
such as you use the calibrated data
to construct the Truth Table, the two two case power table.
For example, you have three conditions or three explanatory variables,
you will have eight rows.
Think about this way,
you have eight explanatory variables, you will have over 200 rows, it’s eight multiplied by eight. So you have to limit, what are the key variables extracting from existing empirical knowledge or the theory to guide you, select the case and also variables. And I think it’s important to also keep in mind the outcome. I think yeah, definition of your variables and also calibrating your data are very important, because I consider it’s a way to help you to summarize or describe the patterns of the relations between your condition variables and your outcome variable, yeah. (Dr. Liu Laughing) So Ling let me ask, what might be the last question or it shouldn’t even be asked, ’cause people probably have to wrap up and go. But to me, like the two to the K table that’s I don’t wanna say just, but that seems to be very similar if not identical to what happens in a full factorial design. And then once you have the factorial design and you have all the factors, there are different approaches to kind of using regression
and variable selection, even machine learning to try to pick what main effects there might be and combinations and whole packages and so forth.

That might be the most effective with respect to an outcome.

So I'm not sure how this is different from that, once you get to the quantitative side, there probably isn’t time to say and maybe we just need to look more carefully and people get to similar spots from different starting points.

But I’m wondering if this analysis is done after an intervention is conducted or is this observational research to try to develop the intervention and figure out which two to the K combinations are the best ones to test now in a randomized trial?

‘Cause all of this is also very close to the MOST design of Linda Collins. But I don’t know, maybe it’s just some comments or food for thought and we probably should let people go and maybe Ling, we can talk about it some other time?

Yeah, and I just agree with your comment.

I’d say now the QCA scholarship,
they are discussing about applying this method to longitudinal, like large sample sets and also combine with the techniques from the conventional statistics, like the machine learning, like that’s what you mentioned. But that is like too new. I think that probably, at this point, probably we want to start from the beginning to understand this method and also encourage some exploration of the utility of this matter in our implementation science projects. But yeah, a lot of insights and comments are very helpful today from our audience, yeah, thank you. I’m reading the message on charts. Well, I don’t know if mayor, maybe he has left, thank Ling for this very interesting presentation and thank everybody for participating. And yeah, we’ll look forward to further discussions about this and looking at the relationship between these different approaches in implementation science to building complex multilevel interventions that are effective and cost effective. So thanks everyone and bye-bye.
Dr. Liu>Thank you, bye!</v>