

## Technical Day Minutes 9/19:

- *Rye Baerg from SCAG started off the meeting with a few housekeeping items. He mentioned that we were recording this session to reflect any needed follow-up items and to accurately reflect the conversation happening today. He also encouraged the audience to grab the handouts in the back of the room as a supplement to the slides.*
- *Dr. Elizabeth Baca from the Governor's Office of Planning and Research (OPR) thanked the audience for attending this discussion, and specifically thanked several members from SCAG, SGC, OPR, and Urban Design 4 Health for helping to put this day together.*
  - *Dr. Baca described the Technical Advisory Committee that was a predecessor model in 2014 that came together to be instrumental with thought leadership about variables in scenario based planning tools and the structural connection with the literature. She then mentioned the names of the following TAC members:*
    - *Sue Babby, Deborah Cohen, Brandon Dean, Keith Lawton, Mark Bradley Art Wendell*
- *Dr. Nicole Iroz-Elardo from Urban Design 4 Health (UD4H) described her background, PhD from Portland University; spent many years doing health impact assessments for the State of Oregon for climate and transportation work with MPOs. She then mentioned she is managing UD4H's health equity portfolio. She then encouraged the audience to speak up as there would be a lot of technical items at the meeting.*
- *Dr. Iroz-Elardo then went into the goals of the meeting:*
  - *One of main goals is further interdisciplinary planning through use of this tool.*
- *She then asked the audience members present to introduce themselves and say what they were looking to get out of the meeting:*
  - *Christine Corrales: SJCOG transportation planning side, RTP in SJ county. Looking for introduction into model.*
  - *Leonard Seitz- CALTRANS, transportation modeling*
  - *Nina Jackson, SBDPH*
  - *Josh Lee, SBTCA, transportation side and public health sides. County has UF model they are working with so wants to learn more.*
  - *Cat Callahan with Placeworks, transportation and land use planner hoping to be able to use the tool for clients.*
  - *Will Nicholas, LACDPH health impact evaluation center for health impact assessments to connect policies.*
  - *Bill Sadler, Public Health Alliance*
  - *Lara Turnbull LBDH*
  - *Chanda Singh LACDPH*
  - *Trav Ichinose, OCPHD health promotion specific division that does range of work including safe routes to school*
  - *Jason Vargo, new to office of health equity at CDPH*
  - *Meredith Millet, CDPH climate change and health equity program*

- Maggie Witt, CARB research division staff lead on land use and transportation planning research, interested in learning about various tools that can be leveraged.
- Cynthia Garcia with the CARB, population study section, lead on health portion of tools and have been following urban footprint since the beginning.
- Salomeh Wagaw, epidemiologist with RCDPH whose largest initiative has built environment component and chairwoman of committee looking at chronic disease protection, equitable lens and planning.
- Demi Espinoza, safe routes to schools partnership, transportation and public health agencies, community engagement background, working with public health agencies to support narrative
- Irene Vidyant,
- Miguel Vasquez, RCPHD working with Salmay, urban planner by trade, intersection of urban planning and health, healthy cities network and active transportation network
- Elizabeth Baca
- Rye Baerg
- Solange Gould, CDPH OHE, health equity policy implementation unit, climate change and health equity program
- Fernando Alvarez SBCPH
- Jim Soonene, associate secretary at HHS, part of TAC in 2014 with Elizabeth Baca interested in collaboration, member of key staff of SGC
- *Dr. Iroz-Elardo then went into the goals for this meeting:*
  - 1. Further interdisciplinary understanding of health modeling and its intersection with land use/transportation planning.
  - Address model technical challenges, data inputs required understanding demographic versus built environment—mostly long term situation planning.
  - Provide use case examples—understand from you what you thing next steps are for model development.
  - Understand next steps for model development and its applications and hear what the audience needs in terms of using the Urban Footprint tool moving forward.
- *Dr. Iroz-Elardo then established the agenda for the day:*
  - Background on how we got to this point.
  - A discussion of scenario planning for epidemiologists
  - An overview of the CPHAM and NPHAM development process
  - A Technical review of CPHAM and NPHAM
  - Break
  - A discussion of use case examples
  - Lunch break
  - Modeling challenges
  - Break
  - A discussion on what is next

- *Dr. Baca then went into a background on the programs, and a discussion about why the state was funding these efforts:*
  - When working on projects it is good to look back and see where we have come from. I will be using the TAC slides to help us see how far we have come in these efforts.
  - I use to teach on the clinical side and was a pediatrician for low income kids. One thing that I saw that was very prevalent was that kids are suffering from adult diseases and they often have shorter lives and poorer health. The US is leading in child obesity which is not an area we want to lead on.
  - Here is a report from the Urban Land Institute looking at percentage of GDP with health expeditors which varies across income levels and racial groups
    - In 2002, chronic diseases cost CA \$70 billion which represents 80% of CA health care expenditures.
  - There are so many interactions with the built environment, air quality, and physical/mental health.
  - One of challenges currently presenting itself is that we need to pursue connections to better integrate planning and public health. This will lead us to think differently and do cutting edge work. In fact, many planning agencies are already doing similar work, so how do we bring public health into those tools that they are already using.
  - Systems thinking trying to get us to breakthrough innovations which is related to the parable of the blind men who come upon an elephant. The men have to figure out what the thing they are feeling is, and they all are feeling different parts of the elephant. A fight breaks out as they each press their own interpretations of what they are feeling until someone who is sighted comes along and shows them how they are all right from their own perspectives. Similarly, we must all have discussion about the data and uncover, layer by layer, what is underlying.
  - CA planning Roundtable definition of a healthy community:
    - A Healthy community is one that strives to meet the basic needs of all residents, livable and inclusive communities, provide ample choices and opportunity to thrive economically, environmentally and culturally, but must being with health.
  
- *Dr. Iroz Elardo then gave more background to set the stage for today's discussion:*
  - UD4H appreciates the state's leadership in setting the stage for this discussion, and is grateful to OPR for pushing this effort forward.
  - CPHAM represents scenario planning for Epidemiologists and is a comparative risk assessment as scenario planning
  
- *Dr. Iroz-Elardo then walked through the RTP/SCS planning cycle and covered the theoretical background about healthy planning:*
  - The social and built environment matters, especially with its interconnections with transportation infrastructure, walkability,

greenspace, travel and activity patterns filtered through public health all show why it is important to link land use and transportation planning

- Influencing behaviors: dietary intake, physical activity, social interaction
  - The land use and transportation worlds all have exposure implications: air pollution, noise, traffic safety and crime. Decision makers often want to see different options modeled out to fully understanding decision implications.
  - All of these influences individual biological responses: BMI/obesity, systemic inflammation, stress
  - Increasingly understanding that stress and inflammation from exposures have huge implications on the cellular level and can lead to chronic diseases, both physical and mental, that lead to healthcare utilization and cost in terms of paying doctors and lost productivity
  - The trick is to find the best way to integrate land use and transportation planning. Scenario planning is one such method for analyzing and comparing the impacts of various land use and transportation alternatives. And these models are getting better and better over time. Typical impacts considered include financial costs, transportation accessibility and housing availability.
  - More recently, health impacts are being added to scenario planning as planners learning that health has framing value that might speak to decision makers and the public in ways that are impactful. And there is an essential public participation component along the way. Modeling can help the public and decision makers compare contrasting options to find the best, most equitable outcome.
- One things that drives scenario planning are local Regional Transportation Plans, which regions must do in order to get federal transportation funding. These are usually updated every 4 years and:
    - Must forecast population and business growth for 20 years, articulate policy program and investment funding levers. It takes about a year to get through procedure to fully adopt, and planning for RTPs starts in earnest about 2 years out from due date. RTPS are visionary documents that are not binding, and locals must buy-in and orient their actions around the plan for it to be successful.
    - If you're looking to influence one of these plans, start early because usually by the time the plan hits the public, you're too late. Recommend that you start calling your MPO to say want to be in on the next cycle of the RTP. Discussions usually begin a year after the previous plan so plan ahead.
    - The RTP usually includes performance measures that can be tracked over time, and health traditionally has only been addressed in terms of traffic safety and air pollution exposure. Active transportation strategies are often included but physical activity outcomes often are not. Environmental Justice (EJ) and Title VI also lend well to health equity

analysis. Active Transportation strategies are making their way in and are quickly being integrated into these plans, but physical activity is still not often included as performance measures. EJ lends itself to health analyses, but often EJ advocates don't see the health impacts of their work.

- Three software scenario and planning tools
  - Envision tomorrow, Community Viz, and UrbanFootprint (UF)
  - UF is the most technically detailed, smallest scale, most intense, and the health module matches that.
  - The idea with UF is that users can paint or sketch scenarios
    - Requires translating RTP strategies into land use and transportation variables
    - As computing power increases, users are able to do this in real time and see performance metrics change—public participation and decision-making tools
  - Public health model links to the underlying scenario that helps source the data inputs and increases consistency with a big planning process. This consistency is a big help to MPOs to get true results.
- Two physical activity models:
  - Land use regression and relative risk application
    - Relative risk: WHO Heat ITHIM, sourced from literature, usually meta-analysis and average health change due to increase in physical activity minutes
    - Land use regression: NPHAM, CPHAM: predictive equation includes land use/transportation, demographics, health risk factors included physical activity internal estimation and obesity
    - Both of these do run on comparative risk assessments and burden of disease
    - ITHIM approach: burden of disease, critical stat to understanding existing conditions, transportation modeling for regional change in exposure of minutes. The tool is a-spatial in terms of the built environment and uses Relative risks to predict health impact from epidemiological meta-analysis and generalizes from other places and cultures by gender and age groups, describes the average relationships for average exposure with no income or race controls
      - Runs through metabolic equivalents and applies relative risks, physical activity, air quality component, and traffic safety component.
    - CPHAM approach is land use regression model, directly link built environmental and demographics to physical activity obesity and health outcomes. Predictive models defined through regression modeling based on large sample surveillance data, objectively

measured physical activity when possible. Inclusion of built environment and demographic covariates in equation which means you can get place-specific estimates and have an ability to play with demographic and social equity controls that you could not get with IPHAM. Help understand why mode shift is different, grounded in the place. Looks at equity implications and sensitivity analysis.

- Obesity as a moderating pathway: example excluding mediating and moderating pathways solely based on built environment and chronic diseases while ITHAM just goes straight to chronic disease.
- Believe true that built environment has impact on chronic disease beyond obesity which is why CPHAM is such a useful module.
- Inputs and output differences
  - CPHAM—inputs: built environment variables and demographics. Scale: fine grain
  - Outputs: intermediate outcomes, physical activity and BMI/obesity. Morbidity as measured by prevalence rates or cases which is an effective way of measuring morbidity to decision makers.
  - ITHAM: inputs in physical activity minutes but becomes a challenge because you have to determine what those minutes are. Scales=usually regional but suggests caution because the tool can sometimes assume average risks with non-average places. The outputs are avoided mortality and morbidity as measured by disability adjusted life years. This measure can be limiting because decision makers don't always quite know what the measurement captures.
- Scenario planning example in CPHAM
  - Determine benefits of proposed infill project on physical activity and health of nearby residents so must determine relative impacts of alternate transportation and land use scenarios on diabetes and cardiovascular disease. Very similar to comparative risk assessment in environmental health. The tool really allows the user to look at which scenario is performing better.
- History:
  - UD4H has been at this tool a long time: started in Atlanta in 2005, moved to 2007 in King County, Washington. The team began having discussions in 2011 about adding CPHAM to urban footprint, and finally added a model in 2012 to San Diego and Toronto. In 2015, added CPHAM for urban footprint 2.0, doing national public health assessment model for 2017.

- UD4H has two tools actively utilized
  - CPHAM version 1 and 2
  - NPHAM version 1 finished, version 2 under development

*Miguel asked:*

- How does this relate to Calenviroscreen and health disadvantage impacts?
  - Dr. Iroz-Elardo: No direct link to calenviroscreen as it is outputting current conditions, while CPHAM is about predicting 20 years into future. It may not be same data, but existing baseline data can be complimentary to both tools?
- How is education rates taken into account in the tool?
  - Dr. Iroz-Elardo: It is not except filtered through demographics
- Is there a mental health component in the tool?
  - Dr. Iroz-Elardo: There is not except through filtered through demographics
- Is this applicable to rural communities?
  - Dr. Iroz-Elardo: For situations like that you might want to use IPHAM because CPHAM is particularly useful in urban and suburban environments.

*Leonard asked:*

- How does this relate to the RTP and required modeling processes:
  - Dr. Iroz-Elardo: We are literally taking built environmental parcel level data and taking data points to make variables that then get fed through predictive equations. Urban Footprint is based in census data.
  - Mike McCoy: transportation predictive routine in UF is calibrated to regional models, difficult process requiring hand coding to be done.
- *Dr. Iroz-Elardo went on to highlight that:*
  - CPHAM 2's purpose is to integrate enhanced localized health metrics into UF to predict health impacts associated with contrasting proposed changes
  - NPHAM was funded by US-EPA to be a nationally applicable health impact tool to empower communities and developers. It currently has its own advisory panel like the UF Technical Advisory Committee.
  - Scale and model differences between the "PHAMS."
    - CPHAM 1=Seattle/Atlanta study area on 150m grid
    - CHPAM 2= 30 county, 5 regions of CA with loaded CA Household Travel Survey and CA Health Interview Survey
    - NPHAM is based on all of CA, block group of built environment buffers and transportation data coming from CA Household Travel Survey and health data going from CA Health Interview Survey.

*Will asked:*

- Is there an update of CPHAM that happens with RTP updates?

- Dr. Iroz-Elardo: SCAG is CPHAM's biggest user, and as they get into their newest RTP cycle we will be asking them if there is anything else they want to add on. With that, we need to figure out who pays for the updated capabilities. With CPHAM, it is not obvious about who pays for next the next round. With NPHAM, there is an update plan as long as US-EPA funding remains.

*Will asked:*

- Certain of these data sources get updated every 4-6 years. I don't mean major new additions, but do you have an update plan for census data?
  - Dr. Iroz-Elardo: Most of this data is sourced using 2012 data. We are having a problem with changing definitions of physical activity as definitions are changing in the surveys. We are currently grappling with those inconsistencies and have such a range and variations in CA of the many places, people and types which is why we are still picking up relationships that we think we are.
  - Rye Baerg: MPOs are in same boat when it comes to transportation data. Not going to have travel data before our next RTP, and are piecing it together best and most consistently we can to match available health, travel and built environment data.
  
- Dr. Iroz-Elardo then went into a Technical Review of CPAM v2:
  - Dive super deep in approach, model input variables: what's needed and how do you get it, how does built environmental variation affect what can be done with tool, model outputs using CPHAM
    - You can have the most predicative model and it can be utterly useless in real life because variables in it are not meaningful, and can't be sourced making them utterly meaningless to decision makers and the public
    - Every variable included in a model must also be available in the application at a spatially disaggregate level. Predictive vs. explanatory modeling procedure used.
    - Predictive vs explanatory modeling:
      - Predictive modeling was used to developed CPHAM
        - Inductive process/data mining with goal to provide the most accurate prediction or a chosen outcome and statistical significance is not a priority. Insignificant variables may still improve predictive power.
        - Strengths of approach in large sample sides: CA Household Travel Survey and CA Health Interview Survey participants which allows to run cohort specific model development with 4 age groups.
        - Allows subdivision of adult populations into income levels for further difference. Walking for transportation or walking for recreation is also divided in the model as the literature proves that lower incomes have different interaction with the built environment.



- Outcomes in CPHAM:
  - Recreation physical activity, minutes daily
  - Walking
  - Biking
  - Auto, obese population percentage, high blood pressure percentage, heart disease percentage, diabetes type 2 percentage
  - Stratified by age: (children, teens, adults, seniors)
  - Adults further stratified by income
- Advantages of CPHAM is that we have model variables
  - Age, sex, race/ethnicity, educational attainment, employment status, homeownership, income, household size, vehicle availability, disability status, presence of children.
- Model variables--Built environment:
  - Categories:
    - Walkability index:
      - Dwelling unit count, residential density, retail floor area, non-residential FAR which says how much parking lot you have (this can measure whether the location is a big box store or mixed-use), distance to nearest retail, distance to nearest restaurant, land use mix, intersection density how connected, local street length

Miguel: My understanding is that this tool is focused on regional planning but what scale can this be applied? If a local planner is processing a project and part of the idea of reviewing the project is to determine the positive/negative impacts, could a local planner use this tool?

- Dr. Iroz-Elardo: If you know how to change variables, you can report on any scale that you want. But really small areas that are like senior apartments, but I would caution that specific use of the tool because of the specific type of population.

Cynthia: Is it possible to find out through documentation the 30 place-types and how these were aggregated into the model?

- Dr. Iroz-Elardo: Place-types are color coded and that information can be sent out.
- Mike McCoy: There is a very long technical manual that can be posted on SGC's website for those that are interested.

Does the FAR included industrial space?

- Dr. Iroz-Elardo: retail floor area tells you something about the makeup of the building. FAR talks about how much floor ratio is available given lot size, can help you flag different parking lots. Open space/parkland not calculated in FAR.

Jason: How were these figures decided?

- Dr. Iroz-Elardo: These figures are the result of years of work, and have been worked out over the years based on comparative journal articles in the academic world.
- Mike McCoy: In preparing information to the legislature to get AHSC seen as a viable Greenhouse Gas reduction strategy, SGC prepared bibliography that has dozens of journal articles that substantiate the relationship between these housing/transportation/health relationships. In fact, these are commonly emerging scenario planning metrics throughout the field.
  
- Transit access measurements:
  - Transit stop count, distance to nearest transit stop, rail transit access
  - Major road index:
    - Major street length, any major road?
  - Regionally accessible
    - Regional residential accessibility
    - Regional employment accessibility
  - Distance to nearest school
  - Park access

Are there opportunities to incorporate quality of these variables?

- Dr. Iroz-Elardo: The land use mix is well qualified, and we used a streetscape model to see trash on ground, sidewalk quality, pedestrian/bike quality. This is actually a useful tool because it can help decision makers know what to invest more money in. The models are fitted, and almost all the models are run using the adult population and expectations have to do with how activity is defined. We only use adults because children are not surveyed in CHIS for walking for transportation. We also have duplicative efforts for walking going on between the health and travel surveys. Health is self-report and travel is reporting. People tend to overestimate physical activity unless they write down every single trip.
  - All models start with a common set of socioeconomic and demographic covariates. This goes into every single model at first. Covariates that decreased predictive accuracy thrown out and vice-versa.
    - Built environment variables tested one-at-a time
      - Correlated variables that were strong predictors were combined into indices, correlated variables that were consistently weak were removed. Final variable selection was forward step procedures with cross-validation prediction effort used to determine which variables to retain. Lot of up front work to determine cross-tabs and correlation. Have a good sense of what is co-linear and then we put into an index so that they do not drop out or

fight for significance. What makes it challenging is that different co-variants often are in tension and fall out.

*Meredith asked:* does this mean that you can only make a prediction for each age range?

- Dr. Iroz-Elardo: Tend to start with the *adult* model but need to be careful when monetizing in order to ensure that it is your only denominator to not unduly influence the data. You can then do populated weighted average at end to combine data.

*Jason asked:* Are the weights in here?

- Dr. Iroz-Elardo: We are using forest procedures for IMPHAM and I don't know how the indices weights are spelled out.

Dr. Iroz –Elardo then continued with a model overview:

- Let's start with likelihood to have heart disease. We have data for adults and seniors but not for teen or child because CHIS does not ask. Also has variable for physical activity and BMI. What you'll notice is that BMI has demographic built environment and physical activity in it and is taking those variables into account. The activity models tend to have transportation walking in it so takeaway is that you always have demographics and built environment in there. According to modeling chain, might also have physical activity and body mass.
- Here is modeling chain:
  - Start off in group 1 for walking and biking transportation minutes. Once we have that information, we use group 2 inputs of moderate physical activity and minutes of vigorous activity. Walking gets placed into moderate. From that, we model BMI which has physical activity minutes in it. We take those minutes and weight into metabolic equivalents. Then we model group 4, obesity model, diabetes model, high blood pressure, heart disease. Has body mass index, and all demographic covariates.

*One of the meeting participants asked:* Is the built environment in the physical activity model?

- Dr. Iroz-Elardo: Yes, the built environment and demographic models are in each of these coefficients. In each block group, we know built environment and type of people that live there. We can predict their type of activity and report that out, then we use that to reflect built environment to predict BMI and then use average BMI to predict diabetes rate and high blood pressure.

*Miguel asked:* does this equation take into consideration dietary intake?

- Dr. Iroz-Elardo: No, however it is picked up in obesity and access to retail measurements. Carries through into metabolism and how much you eat versus how much you burn.

*Cynthia asked:* You start out with built environment that is one 1 km grid, but how are you connecting these two? Are you using physical activity to predict or weight the built environment as it stands low, high, moderate and then attribute results to 150 meter grid?

- Dr. Iroz-Elardo: 1 km is about what is in the physical activity space. In each of those numbers, discusses how many numbers from the center of the grid which represents how many stores to get in the grid which is then used to predict minutes of activity, BMI and diabetes. Once we have equations they are applied to every grid because sample of grids is wide variation and demonstrates what you most often see in CA. This is then extrapolated to every in state in NPHAM.

*Meredith asked:* When doing these person level models, is that based on where a person lives?

- Dr. Iroz-Elardo: Yes, we have their address and can put their point on a grid. We also have their demographics and can make assumptions about residence.

Dr. Iroz-Elardo then continued her presentation:

- Expanded model outcome chain
  - In our model, Type 2 diabetes is a nested model situation which is an easier way to think about for some people.

*Meredith asked:* Why do we use model BMI when you know the person's BMI?

- Dr. Iroz-Elardo: We want to be able to predict BMI for everyone or, rather, the average person living in the average grid.

Dr. Iroz-Elardo then continued her presentation:

- Model results: Our advisory committee spent a lot of time looking at models, and all the coefficients for adult income models can sent out to today's meeting participants.
- Sometimes, since we have already accounted for physical activity in BMI, some weird things happen as you go down the modeling chain.
  - CHIS model chain- transport and leisure walking. Think of this as a two-step model: separate participation (binary) and duration (minutes). CHIS has physical activity outcomes for adults between 18-64,
  - Ran through covariates social and demographic. Transportation walking participation, duration and leisure walking participation and duration. It turns out that you're less likely to walk for transport if you're female, and more likely to walk for leisure. As you get older less likely to walk for transport. It is also interesting to note that leisure walking is predictive and has a lot to do with educational status. The more education you have, the more likely you are to recreate. Note, though, how education drops out in duration because it didn't add predictive power as a variable.
    - However, income stayed in because they were likely fighting for explanatory power. This makes sense as education and income are related: income really matters for if you walk and, if you are walking for transport, how long you walk. Different activity patterns for income strata.

- What we see if you live in walkable place, you are more likely to walk for transportation. If you live near bus stop/rail line, you're more likely to walk for transportation. We see major roads as inhibitors for transport walking. Helpful if you can access employment and other data points regionally for our model.
- After we know transport walking statistics, we ask about physical activity in general which is supposed to keep track of the substitution affect. Two step model, participation and duration.
  - You'll see broad swaths that are important—if one is unemployed, more likely to have time to do physical activity. As you get more and more education, more likely to go to the gym.
  - Directions in overall physical activity are being modeled above and beyond transport models.
  - And there are other things here and there of quasi-interest: Whether or not you're a renter says a lot about you. You're less likely to walk for transportation. An adult with a child has less time, so is not as physically active.
  - We have gone through these all with fine tooth comb and reviewed relationships to make sure that it matched the literature about provable relationships. We are highly confident that most of these are plausible.
- If you live in high walkable neighborhood, you actually might have less moderate activity
- We combined all of these into metabolic equivalents to match the physical activity. Walking is given a weight of 3.5, moderate activity is 4, biking is 4, and vigorous is 8.
  - BMI is continuous
  - In the columns on the screen, the first column is group 3 body mass index, which is the first variable. You see high blood pressure, type 2 diabetes and heart disease. But, as we know, the more education you have, the less likely you are to have high BMI. Obviously there are some racial components to that as well.
  - We see heart disease as having a strong association with education: more education=less likely to have it.

*One of the audience members asked:* Can I get clarity on the race association with the health outcomes in your model? Because of systemic issues related to access and equity, why wouldn't a future scenario include race? Are we just assuming that in this model that you would have the same risk factors now that you will in 20 years?

- Dr. Iroz-Elardo: Yes, we are assuming that same risk factors will exist for people of color in 20 years that do now. We do not know which areas will gentrify 20 years from now. While land use modelers predict income well into 20 years, most modelers are not even trying to get racial component predicted out into the future.

Dr. Iroz-Elardo then continued her presentation:

- We see that income does not really influence BMI/Blood pressure but it does for diabetes. If you have an ambulatory disability, obviously you would have a higher rate of health challenges.
- In this model, we look at BMI and outcomes in terms of built environment. Starting with group three, we know that you have a lower BMI if you live in a walkable place. The presence of a major road is a contributor to BMI, but unclear if that is because of physical activity. It could be a factor of design pollution that comes with major roads having influence on systematic inflammation and BMI. Maybe it is showing dietary influences along major roads that tend to be unhealthy. So we do not necessarily have all of the causes in the model.

*Irene asked:* Did transit access also drop out of previous chains? If it drops out in a lot of them, you're not going to see impact for most other chains.

- Dr. Iroz-Elardo: You do have rail presence being more predictive, along with the notion of a small walk to the bus stop being predictive. The more physical activity, the higher the prevalence rate.

Dr. Iroz-Elardo then concluded her presentation with:

- Comparing model coefficients by age:
  - Seniors track pretty well, being in TOD area powerful predictor. Seniors are sensitive to different built environment characteristics than adults are. Teens and children have different sensitivities as well. We feel that it is good that different age groups are acting in different ways in our model as it more accurately mimics real life.

After describing what SCAG is, Rye Baerg then detailed a use example of outcomes from 2016 RTP/SCS:

- This was the 2<sup>nd</sup> RTP/SCS done through bottom-up process that respects city control. SCAG staff started caring about public health because the message was brought to our leaders that SCAG needed to model impacts of plans.
  - 2016 RTP/SCS—plan goal: protect the environment and health of SCAG's residents by improving air quality and encouraging active transportation.
  - Policy direction: provide robust data on how to invest in infrastructure to achieve these goals.
  - In the plan SCAG tried to take a holistic look as to how plan would impact the public.
  - Wanted to encourage land use growth that facilitated transit and non-motorized transportation.
  - This is breaking out what we are trying to model in UF and transportation demand model for infrastructure that could compliment SCAG's built environment/transportation goals.
  - Modeling framework: each one of the blue boxes is a major modeling activity across our region. We do a lot of economic growth modeling for

trade/transportation, and use CHPAM used as scenario planning model. Develop four scenarios that we then take to our policy committee to see what they like best. We also engage the public around these options. Essentially, we showed a picture of development as normal trends versus planned growth TOD. Our example was in South Glendale, where high quality transportation lines are represented in red, and blue represents high quality transit areas where focusing growth. Have current land use based on zoning and show what would happen to development in areas in terms of densification. Can show effect on minutes walking per-day as you start adding transit and active transportation lines.

- Our outcomes means that we expect walking/biking to increase across SCAG region. Health outcomes show decrease in diabetes, obese, heart disease, high blood pressure. With this model, you're not changing diet, only transportation land use and you still are making positive influence in right direction.
- Modeling process: next step would monetizing those effects for the decision makers. We find figure of \$12.8 billion in costs from diabetes, heart disease and hypertension in region which is drain on the SCAG region's economy. Estimate small reductions in chronic disease which can create quite a bit of estimated savings. Using this tool, we are able to show that, by 2040, investments and land use changing results in savings.
- Part of RTP is economic analysis, and we traditionally use REMI. For our next study, our hope is to do the economic modelling in tandem with CPHAM modelling in UF to show additional economic output. Economic impact also accounts for less sick days which creates more productivity. Even with small reductions in diseases, we have proven a huge impact.
- We have experienced some challenges during the first time running model and it is very technical.
  - In UF, you assign population to areas. Those new people take on the demographics of the people in that area. One needs to be careful, because you can actually find worse health outcomes because of population taking on negative health characteristics. We had to create a synthetic population based on regional averages.
- Right now we are collecting sidewalk layers to better inform pedestrian modeling.
- Opportunities with CPHAM/UF:
  - Corridor or smaller area level planning estimates like GP or specific plan update
  - Can incorporate cost benefit analysis of active transportation in terms of health and economics
  - Using base year data in active transportation plans, general plan and specific plans. Create index, but only available data was the county level but now can provide more localized data

*Chanda asked:* In the Glendale example, when looking at average number of increased active transportation, does that include the new population or just on average?

- Rye: These are just multiplying effects. Changes in population are localized, but economic benefits can spread out regionally.

*Will asked:* When you do these reports, I assume there are targets you are supposed to hit? Are there any of those connected to health factors?

- Rye: We are not there yet. The feds are requiring targets to be set on a number of factors but those do not include health right now. SCAG just created state of region report and have crash data for region safety analysis.

*Meredith asked:* Can you talk a little more about what you're saying when you say that you provide "base year" data?

- Rye: If you go to the CHIS website, you can only provide city wide level of data which is not helpful for city or other local areas. Base canvas uses CPHAM without adding people to model, can provide that to cities at block or tract levels.

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Lunch Break

Use Case Examples

### Neighborhood-level investigation in an RTP Context San Diego and Sacramento Applications

Dr. Frank provided an introduction of himself and then began his presentation:

- Scenario planning tools are unique in their scalability. The variation in data is important in environmental justice to see where we can leverage funding to increase equity.
- In this particular San Diego use case example, SANDAG received Stimulus package funding for a project in Palomar to influence tramway. This led to the first model of CPHAM using parcel data. Palomar wanted to build TOD with tramway, densify, multi-family focus. Using CPHAM, they modeled results and calculated urban foreign predictors for a given place. The results showed a 68% increase in minutes of active transportation, along with reductions in high blood pressure, diabetes. While this was also related to diet, it showed behavioral physical activity was significant.
  - All adult health metrics improved in the change scenario but child/teen results were mixed. Physical activity predicted to increase, but so did obesity and asthma. Collision risk factor also increased. Need to be careful about impacting sensitive population with investments.
- SACOG did a RTP in 2016 and investigated the 2012 baseline and 2040 preferred alternative with 2012 demographics used for both analyses.
  - Wanted to focus in on 19 areas for an in-depth look which is shown on the map in dark grey. Built environmental variables to change: FAR 5.8% increase, proxy for pedestrian environment which is a good predictor for active transportation. Keep in mind that you can have a mixed-use environment that is auto-oriented.



- Other Built Environment changes: distance to education, restaurants, retail, increasing dwelling unit counts, and accessibility; employment accessibility; residential access and commercial access; regional access and walkability index assuming build-out of transit.
  - Variables:
    - For transit: count of stops/ stations, distance to nearest transit, transit access and any rail .
    - Road: local street density, major street density, major road with 1 km, network connectivity index, major road exposure index.
    - Park: acreage of park, distance to nearest park, park access index
  - Decision makers assume that looking at large geography like the entire state means that you are not do a deep dive which is not the case. CPHAM produces 150m grid-level health results and aggregate grid-level model results to regional total or one of the 19 sub area totals with population weighted. Buffered in crow-flying radial way. Was a functionality issue of UF but is currently being fixed.
  - 2012 Adult Obesity percentages showed where things that got better and worst. Typically, obesity map is the inverse of a walkability map.
  - Outcome changes from 2012-2040 in the mean results of the 19 subareas. Showed that even small change in chronic disease can have a huge economic impact on a region.
  - Important to note that this is all scalable, and can be replicated.
- Predicting Spatial Variation of Disease—Madison, Wisconsin
    - Can I use CPHAM/NPHAM outside CA?
      - Both models are based in CA data
        - CPHAM original data more restricted to populated areas, equations based on grid-level built environment characteristics
        - With NPHAM, a broader dataset used, based on block group level requirements
        - California has broad variation, so it should cover what we see elsewhere. Came within 95% confidence of replicability.
    - We were asked to put Madison Dane County 2050 RTP to validate outside of CA usage
      - How do local conditions compare with data upon which CPHAM was built?
      - Built environment; demographic; activity patterns; disease outcomes. Had to get rid of college areas because of demographic skews
    - Some calibration required between the national travel survey and BURFIS. We made sure the mean predication matched up and moved it where it didn't match up. We did struggle a little bit with diabetes but, once we shifted normal curves to be on top of the calibrated curves, the measurement was spot on.
    - Type 2 diabetes predications: exurban rural areas are more likely to have higher diabetes rates. Validated at block group space after calibration, about ½ a

percentage point off. We have seen that when there is a significant underestimation in rural areas, there tends to be an overestimation in urban areas. The model still did really well when it predicted spatial patterns of disease.

- Questions that have come up: yes, you can use local data but it does require technical know-how.
- Modeling Challenges-Demographics
  - Appropriate accounting for forecasting limits. Race, income predictors are difficult to predict which has huge implications for disease and equity. It is sometimes difficult to determine if the result of your measurement is about demographics, or built environment.
  - Have some choices to mitigate this difficulty:
    - Hold demographics constant: population doesn't age or diversify with huge public health implications. Results are clearly built environment
    - Do sensitivity analyses
    - Create avatars (synthetic population like SCAG did) and assign all new people the average characteristics of 'X' area.
    - Ideally have conversation up front, to think about this need.
  - Challenging results that come up and what should you do when direction of effect is unexpected:
    - 1. Examine scenario design features. Is there a big institution there, or a big piece of open space that might throw results off?
    - 2. Demographic effects over time
    - 3. Context specific counter-intuitive results
    - Examples:
      - Increasing major road index has a small negative effect on transport walking
      - The largest changes come from increasing or decreasing population age by +/- age by 5 years. This is why we recommend that you think about holding population constant. If there is one area that looks super off, you might have senior center in the area or some other confounding variable.

*Chanda asked:* when are population changes over time incorporated into model? Are you assuming that in your base year you have the same mix over time?

- Dr. Frank: Base year means today, trend means business as usual.
- Rye: We do demographic modeling for our RTP but we need to make sure that we are using same mix of people to represent the data. What we are trying to represent here is the built environment and we need to keep demographics constant in order to represent that.
- Dr. Iroz-Elardo: My advice is to keep the population constant unless you have good reasons not to. As someone involved in health equity, I know why you would want to change that but it might skew your findings.

- Rye: It really depends on your research goals. For SCAG, we have 19 million dollars to invest in transportation land use infrastructure, and we need to keep variables constant to get that particular data.

*Will asked:* Is the issue that demographic predictions are not granular enough?

- Rye: We do demographic *forecasting* here and that gives us the overall mix that we use county wide. This includes aging, and age factors. One possibility is to use possible allocation of household size and income, but there are limits to how far this can go. What are you trying to accomplish is the fundamental question to identify when thinking about how to interact with your inputs. SCAG was trying to look at effect of changing built environment.
- Mike: Travel modelers are loath to do anything with race and ethnicity. This topic is brought up and dispersed in land use literature. The tension is to try to get to that demographic issue to address environmental justice/equity. Maybe the solution is to change base data to account for changes in population. Local jurisdictions are required to do sustainable community strategies that includes changes in housing.

*Chanda asked:* I am having a hard time getting a handle on how the built environment is only affecting transportation. It also has huge implications on the other factors. How do you account for this?

- Rye: If you have a good idea of who is in what area, you can add that into the tool. When focusing on a place, and if you know specific things about that place, you can use models to develop on different demographics. This is all relative to data that is available.
- Mike: Using urban micro-economic modeling could also give you some clues about this point. If you have building size and style in a place, this type of modeling would estimate demand and rent and then could predict the demographics that would be likely to move in to that area. This is another way to incorporate race.
- Rye: This is definitely something to follow up on because it can impact affordable housing investments.
- Dr. Frank: There might be some places that are demographically unique and that makes sense to incorporate that into our model.

Dr. Frank then continued his presentation:

- Data resources for CPHAM v2 are not insignificant: current conditions depend on parcel level knowledge, GIS capacity, etc. The future may be challenging as well: and scenario tools like Urbanfootprint may help translate the future. National public health assessment model has a data ease advantage with a block group instead of a grid with current conditions available with NPHAM model within the entire U.S.
- NPHAM is still being built with funding from U.S. EPA. We must use census data, because it is extremely difficult to get parcel data for entire U.S.
  - Goal: develop a nationally applicable health impact tool that empowers communities and developers to quantify localized health impacts of alternative land use and transportation investment scenarios.
  - Key elements:

- Statistical regression models of built, natural and social environment effects on health with a direct connection to modeled land use, walkability and health outcomes.
  - Block group level analysis and model prediction with models developed from California statewide travel and healthy survey
- Paring data and tools: national environmental dataset and national tool to allow planners and public health officials to measure and optimize the impacts of transportation and land use investments.
- Two phases: NPHAM phase 1 to measure physical activity and sedentary time with related general health, obesity, and mental health. NPHAM has the same architecture as CPHAM so it will be familiar to previous users.
- What is unique about NPHAM is that it connects to scenario planning software via end user API and software specific plug-ins. Can be fully integrated with envision tomorrow, urban footprint and community viz. It is platform agnostic, but the platform can help with the data gap.

*Jason asked:* Will this tool be updated over time?

- Dr. Frank: Yes, we have a negotiated rate per year but that is contingent on EPA funding levels.

Dr. Frank then continued with his presentation:

- Modeling challenges-sourcing data
  - Scale difference in CPHAM vs. NPHAM
    - ANALYSIS scale: 150m grids vs. census block group
    - Output data for modeling: 5 major regions of CA versus the entire state of California
    - Input data: local parcel, transportation and destination data versus local employment, transportation, and destination data with national coverage.
    - Scenario Planning tool tie-in: only urban footprint versus the other three tools
- What is next for the tool?
  - Model updates and extensions:
  - Air quality
    - Poor air quality can degrade the cardiovascular and diabetes benefits of physical activity.
    - We need to investigate if negative physical activity coefficients are picking up near road air quality in the model.
    - We also need to explicitly add air quality through additional variables

Dr. Frank then asked the audience if that had any input about what they might need for the air quality model:

- Mike: I worry a lot about spatial extent of air quality data. Pollution is spread like peanut butter across large landscape so the level of specificity is difficult to predict. We need to think more about how to integrate model dispersion.
- Cynthia: I think that it is important to integrate long-term regulation and dispersion models, and the impact of physical activity.
  - Dr. Frank replied that: accuracy is difficult, but there is good information on transportation movements that can help identify particulate data. There is a 0.6 correlation between particulates and walkability. The fact that walkability is a model for exposure itself makes it significant to address.
- Will: This also matters because TOD leads to reduced pollution because of reduced vehicle.
  - Dr. Iroz-Elardo replied that: the measurement you just mentioned has a regional versus local element. Regional numbers may go down even as specific corridors degrade because of VMT reduction strategies. This is also difficult to measure because of collinearity. It is tough to unpack and model on both the exposure and health sides.
- Rye: From an explanatory purpose to our elected officials, do we need to expand the explanatory abilities of CPHAM. Is there a value to our decision makers to show the physical benefits of physical activity outweighing the negative benefits of pollutant exposure?
- Chanda: There are tradeoffs around building active transportation infrastructure or electrical vehicle infrastructure and what the effects of that will be.
- Dr. Frank: Even though UrbanFootprint has an air quality model, CPHAM is blind to those aspects. It is epidemiologically negative because of the chronic outcomes of air pollution exposure. Not having that fundamental exposure piece in the model seems problematic.

Dr. Baca asked the meeting participants: On the potential end user piece, are there specific things that you need to know more about?

- Rye: SCAG is rolling out UF as a data-added process, so building in CPHAM for SCAG jurisdictions to have access to this tool would be great.
- Jason: One thing that I would like to see is a measurement of the mental health benefits in this model.
  - Dr. Frank replied: We tested for depression but did not come up with statically significant built environment measures in the model. There is a mental health data component in CHIS and will be integrated into ITHAM. There is a well-documented pre-relationship between physical activity and mental health in the literature as well. We also have good data on safety in CA, with quality measurements for injuries on some age groups. We also want to try and get greenhouse gas emissions as part of the tool. NPHAM will have data on sidewalks and bike lanes and predictors of active transportation so that we can model it. Also predicating climate and how that impacts and is impacted by active transportation as well.

*Will stated a few comments:* Safety—when pedestrian and bike volume increase, you should see an increase in collisions. Are you able to account for specific measures in the data to reduce the outcome of pedestrian/biking collisions? Does the data account for greater exposure risk to those doing active transportation?

- Dr. Frank: Yes, all the safety features of active transportation infrastructure could be included if you had data to input into the model like signaled cross walks etc.
  - Will: What about information related to bike lanes and sidewalks?
  - RYE: Sidewalk data is notoriously tough to secure and the formatting is difficult.

*One of the meeting participants asked:* Have you considered water quality measurements alongside the air quality ones?

- Dr. Frank: We have looked at street runoff, and other similar measurements but water quality in terms of a driver of disease is fairly low when compared with other variables here.

*Miguel offered:* As a potential user, this is all quite complex and I'd like to have a sense of the next steps in terms of accessing the tool and how to promote and introduce it to planners, health officials, elected officials, and planning commissioners. Can you give us a brief overview of tomorrow's policy briefing?

- Jung: SCAG built customized version of UF with the plan to release it to SCAG jurisdictions in November. The feature includes access to all data sets which will let you get most accurate local data. Next step is to work on public health feature for local use during the upcoming RTP. Hoping to have this available to the locals in November.
- Mike: SGC continues to work towards training consulting firms to use the models because cities will probably want to engage consults in process of applying tools.
- Dr. Baca: One of challenges to this tool is that it is so technically difficult. At tomorrow's policy briefing in Sacramento, we will have introductions, will lay out a policy framework for the relationship between the built environment and health, will identify what scenario planning tools are out there, will give overview of what tools are in the landscapes of healthy planning end then will engage in a policy discussion on these types of questions include who, how and when should folks be getting involved.

*Dr. Iroz-Elardo then asked the meeting participants what training or resource would be most helpful in spreading the user group for this tool.*

- Cynthia: Documentation to understand and break down the full tool would be very helpful. Complexities are fairly large, and there are tradeoffs in the measurements. I want a more in-the-weeds explanation of how the tool works because I need to answer what is vigorous/moderate activity is, how the parcel data works, and other details to help explain use.
  - It would be helpful to format a training similar to today's where SCAG is the organizer for use cases, and data access. Having training for consultants is great, but it limits access.

- Will: The web tool that SCAG is building for its local jurisdictions includes CPHAM and I would love to have a webinar on that as soon as possible about what it would do.
  - RYE: We are building that out as part of RTP public outreach plan so I could do that in about a year.
    - Will: Even a demonstration about what the tool might look like would be helpful. It doesn't have to be fully developed.

*Dr. Iroz-Elardo then asked the meeting participants about what would help communicate the viability of this tool to local leaders.*

- Meeting participant: Put together a profile on who an average user would be that lists needed skill sets.
- Chanda: Documentation or tie-in to other tools out there. Use-case templates that can be easily distrusted would also be helpful. I need to be able to say why I would spend time to learn this particular tool when there are so many tools out there. Would be helpful to know from you when this tool would be the most helpful or compelling to use. I also think the addition of an air quality measurement would go a long way in spreading users in LA.
  - Nicole: LA in particular has sunk a ton of money into facilities, so of course they would want to see what the money is producing. It might not be this tool in terms of predicting disease, but are there toolkits to walk local jurisdictions through air quality things to help decide where to put next resource. A prioritization element for where to spend money is important.

*Jason offered:* Thinking about quality of built environment is very helpful. With regard to what is a quality walking environment, there seems to be a lot of different measures. When changes happen in the built environment, people might find them jarring and unwelcome. How can this tool introduce the narrative of those changes?

- Dr. Iroz-Elardo: It is not just any destinations that matter, it is access to culturally relevant destinations. Relevance certainly matters. One of the things we are finding is that we can take this tool out of California or the US and some things objectively seem more influential than others. I do not think that there is going to be a time where the tools replaces a community meeting where locals decide what it is that they need. It can augment but not replace this.
- Mike: Hopefully this model can eventually run at the speed of its predecessor so that it can work real time at a community meeting.
- Nicole: The state, SCAG, could help by identifying assistance tools that are available. It's not just about should I put in crosswalks but where should I? What is the significant destination?

Rye asked the meeting participants: Do we have all of the answers that we want from this tool to make land use and transportation decisions?

- Mike: There is a fully downloadable link on SGC's website that has test use data that can help users identify uses.

- Chanda: That cost benefit comparison is very compelling in my current job and would be a critical component to create visually compelling materials to leverage decision makers.
- Larry: You can start using health equations to decrease resistance to density development. It is a little more qualitative, but will help us understand how people can use software tools in real time during local meetings.