An Outcome Evaluation of a Medically Tailored Meal Intervention for Older Adults with Diabetes

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Author Note

We have no known conflicts of interest to disclose.

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Abstract

Background: Due to social conditions, older adults in Solano County have been affected by high rates of chronic conditions such as type 2 diabetes (T2D) and have found it challenging to manage their conditions effectively. The Medically Tailored Meal (MTM) intervention was developed to evaluate whether a nutrition-focused intervention would help to control diabetes.

Method: The intervention involved 50 older adults living in Solano County. To improve T2D control in this population, participants received 12 weeks of 10 prepared meals, a weekly grocery bag, health education, and exercise classes.

Results: Data were collected using pre- and post-surveys, an intervention satisfaction survey, and recorded health data. Almost all participants reported improved blood sugar and glucose levels, among other health factors.

Discussion: These findings underscore the potential of the MTM interventions to improve the health outcomes of older adults with T2D and the need for further implementation and support for other social health conditions.

Keywords: Older Adults, Medically Tailored Meals, Food as Medicine, Diabetes Prevention, Trauma-informed Nutrition Education.

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In Solano County, the top three leading causes of death are cancer, heart disease, and stroke, with diabetes being sixth (Solano Public Health, 2006). Older adults with chronic conditions have been historically marginalized. Solano County conducted a needs assessment, and the community identified nutrition as an area for improvement, which included expanding culturally appropriate meals, offering more food resources such as emergency meals and snacks, and increasing the number of congregate and home-delivery meals (Solano County, 2020).

Medically Tailored Meals (MTM) are nutrition-focused meals approved by Registered Dietitians, designed to support individuals in achieving their health goals, especially during critical recovery periods (Roots Food Group, n.d.). These meals are part of community support initiatives to manage chronic conditions, particularly for those recently discharged from hospitals or nursing facilities. MTM interventions coordinate care and help reduce healthcare costs associated with chronic illness management. The Ecosystem of Care model enhances this approach by integrating multiple networks to tackle the root causes of poor health among individuals with unique health and social needs, fostering a sustainable food ecosystem for individuals and communities (Camden Coalition, n.d.).

In Solano County, thirteen percent (13.7%) of the population experience food insecurity (Solano County, 2020). Addressing these barriers can further support the community's efforts in preventing and managing chronic illness (Solano County, 2020). Numerous studies have shown that MTM interventions effectively improve health outcomes in managing chronic conditions, including a 50% adherence to treatment, a 17% improvement in diabetes control, and a 23% higher likelihood of being discharged home after hospitalization (FIM Coalition, n.d.; Berkowitz

et al., 2018; Berkowitz et al., 2019; Berkowitz et al., 2019; Gurvey et al., 2013; Henstenburg et al., 2019; Seligman et al., 2018). A study found that a 1% reduction in HbA1c (glucose levels) led to a 2% decrease in total healthcare costs and a 13% decrease in diabetes-related expenses, resulting in annual savings of $429 and $736, respectively (Lage & Boyce, 2020). For patients with an HbA1c of 7% or higher, a 1% reduction correlated with a 1.7% reduction in all-cause costs and a 6.9% reduction in diabetes-related costs, with annual savings of $545 and $555 (Lage & Boyce, 2020). This community impact project evaluated an MTM intervention and demonstrated that food can be used holistically as medicine to manage chronic conditions.

Method

In 2023, Innovative Health Solutions (IHS) received American Rescue Plan Act funding from the Napa/Solano Area Agency on Aging (N/S AAA) to implement an MTM intervention in Solano County. The target population for intervention was older adults with Type 2 diabetes (T2D) in Solano County, who were La Clínica de la Raza-Vallejo patients. This intervention assessed health outcomes for adults 50 and older with T2D living in Solano County. Over 12 weeks, the MTM intervention provided services to 50 T2D patients, including 10 prepared meals, a weekly grocery bag, T2D education, and "Bingocize" classes to provide physical activity. The "Bingocize" exercise classes were conducted simultaneously with the diabetes classes and food pick-up. Bingocize is an evidence-based curriculum to help older adults improve and/or maintain mobility and independence, learn about fall reduction, improve nutrition and other health-related behaviors, and engage older adults in social settings.

La Clínica provided patient case management, facilitated weekly T2D education and support groups, and assisted during meal and food pick-up. La Clinica selected patients for the MTM program who had uncontrolled diabetes and were dealing with other chronic health issues,

mobility challenges, food insecurity, housing instability, limited English proficiency, and lack of connection to a primary care provider. These factors complicated their ability to manage diabetes effectively. The impact of the MTM intervention on these individuals was significant, highlighting the importance of the program.

In collaboration with Aliados Health Plan, IHS developed and coordinated the activities and partnerships to implement the program. Aliados Health provided IHS with in-kind staff and administrative support to guide a contractual agreement with La Clínica de La Raza Vallejo. La Clínica, a federally qualified health center, played an indispensable role in the program, providing accessible, culturally appropriate, and high-quality healthcare services to all individuals.

As part of planning and implementing the MTM intervention, we secured a contract with Partnership HealthPlan of California to provide MTM as part of their CalAIM Community Supports initiative. This contract ensures that MTM will be offered as an ongoing benefit to the community for Medi-Cal clients who need it. Collaborating with community partners is crucial to establishing a viable, fair, and sustainable Ecosystem of Care in Solano County. A functional Ecosystem of Care involves interconnected programs and services designed to holistically address community members' complex health and social needs. To ensure this, IHS contracted Provisions by League of Chefs in Vallejo to serve as the food vendor for the MTM program. Provisions was selected for its proximity to La Clínica in Vallejo, convenience, commitment to procuring local ingredients, and dedication to supporting local businesses, demonstrating our careful consideration of all aspects of the program. The role of community partners like Provisions is invaluable, and we sincerely appreciate their contribution to the success of the MTM program.

Another local organization, Food is Free Bay Area, was selected because of its willingness to accommodate patients' needs. This organization not only prepared the weekly grocery boxes and picked up the prepared meals from Provisions but also went the extra mile by delivering meals to the La Clínica site and participants' homes when they could not attend in-person groups.

Stakeholders for the MTM Intervention, who are also essential partners, included individuals and service providers already working with this population, such as medical providers, social workers, IHS staff, Aliados Health staff, La Clínica Vallejo staff, Solano Public Health staff, Senior and community centers, food providers and transporters, and others. However, it is crucial to note that older adults with chronic conditions are a vital stakeholder group since they are most impacted by the implementation, success, and modifications made to this program.

Participant behavioral and medical data was collected and analyzed to evaluate if the intervention achieved the expected outcome. This data was collected at the beginning and end of the intervention period. A process evaluation was conducted to make intervention design and delivery improvements. The intervention evaluation sought to answer the following three evaluation questions: Do participants of the Medically Tailored Meals Program show objective improvements in their health after participation in the program? Have participants in the Medically Tailored Meals intervention improved their food/nutrition practices after participating? Does MTM improve food security for those enrolled?

Outcome indicators used to assess participant's food behavior and health included the percent change in participant Hg A1C, blood glucose, blood pressure, and Body Mass Index (BMI) measurement pre- and post-intervention; the average change participants report in healthy

and unhealthy eating behaviors, and the average change participants report in the level of food insecurity. The change process was evaluated based on three indicators: the number of participants who referred to the intervention program who participated in the meal services, meals distributed to participants, and the percentage of participants who completed pre- and post-surveys.

The IHS program staff trained clinicians at La Clínica to identify individuals who meet the intervention criteria, are not currently receiving Meals on Wheels, and are interested in participating in an MTM program. Once the eligible individuals were screened, the La Clínica staff notified IHS of their eligibility, and the individuals were enrolled in the program. The IHS staff tracked participant attendance to ensure that designated meals were delivered to their homes or skipped for that week if attendees could not attend their appointments. After discovering that some participants had difficulties with transportation, a change was made to deliver meals to participants' homes and provide health education via phone calls.

This comprehensive approach to participant care was reinforced by monthly meetings to discuss the program's progress and make any necessary changes. Provisions (the food provider) and Food is Free implemented Food Safety Plans to ensure food was handled correctly and safely. The menus were approved by an Area Agency on Aging Registered Dietitian and meet California Code Title IIIC Menu requirements for essential nutrients. There were no cultural considerations for the focus population; meals were not culturally appropriate but focused more on being medically tailored.

Once La Clínica staff had identified interested participants, their team worked with the participants to complete the (PRE) survey before receiving any MTM intervention components. The La Clínica support team was on hand to support participants with survey completion,

ensuring that each participant felt personally supported throughout the process by welcoming them to the program, explaining the program, explaining the purpose of the survey, answering questions, and reading the survey to participants who could not read. The pre-and post-surveys included general assessment questions related to health outcomes, including two questions adapted from the gold standard USDA Adult 18-item Food Insecurity Survey (U.S. Department of Agriculture, Economic Research Service, n.d.) and general questions about physical activity and eating habits. The survey also included demographics, eligibility, general nutrition, physical activity, medical information, and administrative questions to ensure a holistic understanding of each participant. La Clínica delivered the completed surveys to the IHS team that entered the records into the Apricot 360 tracking system.

Approximately halfway through the program, the IHS internal evaluation team surveyed the La Clínica team members to assess how they felt the participants were managing their diabetes, discuss any challenges they were facing, and share anything participants wanted to learn more about during T2D and support group sessions. These surveys involved open-ended responses completed by La Clínica staff and were not part of the pre-and post-evaluation analysis.

At the end of the intervention, La Clínica staff completed a post-intervention survey with each participant. This post-survey included the same core components and questions as the pre-survey (general nutrition and physical activity, medical information, and administrative questions) and intervention satisfaction to evaluate changes.

Results

This intervention sought to determine if MTM intervention impacted health outcomes in T2D and improved their nutrition practices and food security. This research evaluated the

effectiveness of an intervention by examining both outcome and process indicators of success. The findings will inform future implementation cycles and assessments.

Quantitative data was gathered from matched pairs (pre- and post-tests) and analyzed using t-tests to identify significant differences. Additionally, qualitative data was thematically coded to identify patterns in participant feedback, allowing for a comparative summary of the responses.

Forty-nine individuals participated in at least one of the 12 classes, with 404 attendance records, and 73.5% of participants attended more than six sessions. Fifty-one participants completed a pre-survey, 34 completed a post-intervention survey, and 33 completed both. Of the individuals who completed the pre- and post-surveys (n=33), 54.5% identified gender as female, and 45.5% identified gender as male. 63.6% identified as Hispanic, 15.2% as Asian, 9.1% as Black or African American, 9.1% as White, and 3% as Native Hawaiian or Other Pacific Islander.

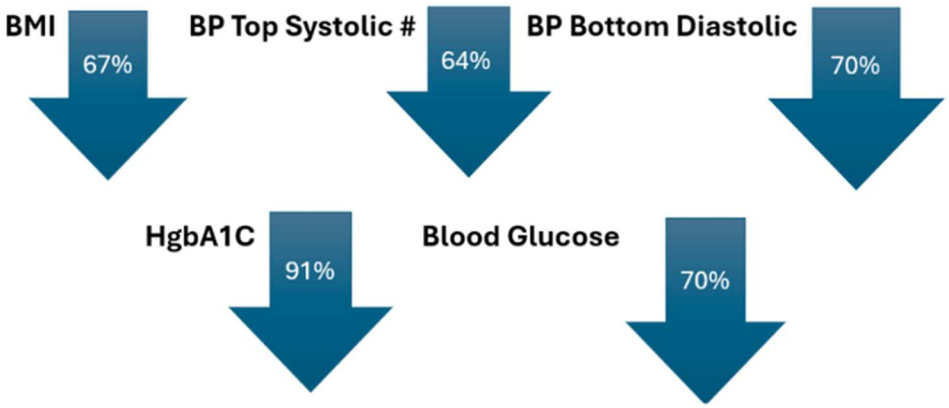
Clinical Health Measures

La Clínica staff recorded participants' health data at the intervention period's beginning and end. Key indicators all showed improvement (Figure 1), with HbA1C and blood glucose improvements being statistically significant (90.9% of participants had improved (lower) HgbA1C, and 69.7% had improved (lower) blood glucose measurements, Table 1). A similar percentage of participants had lower BMI and blood pressure values. At the end of the study, controlled versus uncontrolled T2D was tracked using HbA1C results. Before the intervention, 12% (4 out of 33 participants) had their T2D in control with an overall average HbA1C of 9.118. After participating in the MTM program, 33% (11 out of 33 participants) were in control with an

overall average HbA1C of 7.615. According to research, any reduction in HbA1C is associated with health benefits for patients and a decrease in healthcare costs (Lage & Boye, 2020).

Figure 1

Percentage of Change by Clinical Health Measures



Note. This figure shows the percentage (%) of participants who improved from pre- to post-intervention in five clinical health measures (BMI, BP systolic, BP diastolic, HgbA1c, and Blood Glucose) associated with diabetes status (controlled versus uncontrolled) and diabetes outcomes.

Table 1

Clinical Health Measures: Pre- and Post-Survey Averages

Questions	Pre-Average	Post-Average	Difference	P-Value	Percent with Improvement
BMI	29.35	28.85	-0.5	0.754	66.7%
BP Top Systolic# (mmHg)	133.12	125.15	-7.97	0.1021	63.6%
BP Bottom Diastolic# (mmHg)	75.67	70.19	53.70	0.0813	69.7%
HgbA1C (mmol/mol)	9.12	7.61	-1.5	0.0001	90.9%
Blood Glucose (mg/dl)	197.64	155.42	-34.97	0.0179	69.7%

Note. This survey shows Pre- and Post-survey averages, Differences, P-Values, and Percent with Improvement values for Clinical Health Measures (BMI, BP, HgbA1C, Blood Glucose) for participants of the MTM program.

Table 2 displays the changes in HbA1C and BMI by gender. HbA1C and BMI decreased for the controlled and uncontrolled values for T2D groups, on average, for both genders by the end of the MTM intervention. Males with controlled T2D showed a more considerable change compared to females with controlled diabetes. In contrast, females with uncontrolled T2D had a larger change than males with uncontrolled T2D. The group with the most significant change was males with controlled diabetes.

Table 2

Changes in HbA1C and BMI Pre- and Post-Intervention

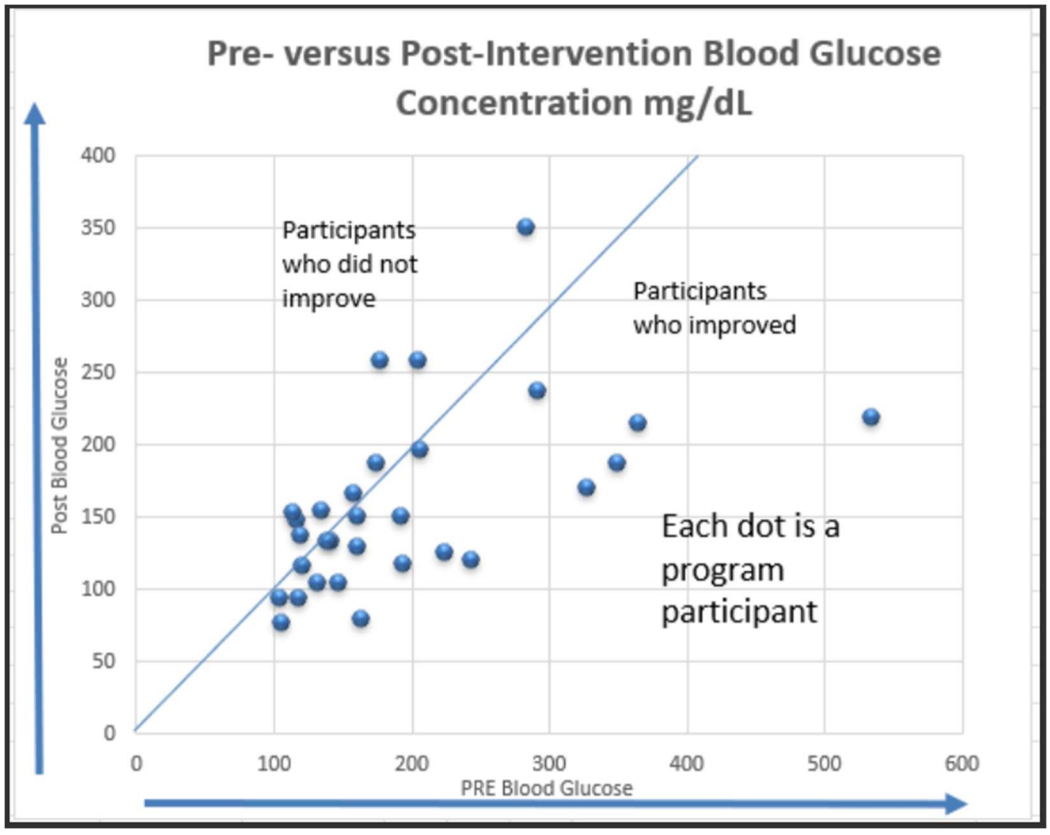
Diabetes Status by Gender	Average of Final HgbA1C (%)	Min. of Final HgbA1C (%)	Max. of Final HgbA1C (%)	Average of Change from pre- to post: HgbA1C (%)	Average of Final BMI	Min. of Final BMI	Max. of Final BMI	Average of Change from pre- to post: BMI
Controlled	6.21	5.20	6.80	-1.72	30.45	22.11	45.91	-1.06
Female	6.4	5.80	6.80	-1.10	33.03	26.30	45.91	-0.69
Male	5.98	5.20	6.50	-2.46	27.36	22.11	32.04	-1.50
Uncontrolled	8.32	6.60	13.20	-1.40	28.05	20.12	38.86	-0.22
Female	7.73	6.60	8.60	-1.46	27.82	20.12	38.86	-0.49
Male	9.03	7.10	13.20	-1.32	28.32	23.58	38.26	0.10
Total	7.62	5.20	13.20	-1.50	28.85	20.12	45.91	-0.50

Note. This table shows the Average, Minimum, and Maximum Final Values, and the average change from pre-post-intervention in HbA1C and BMI for MTM program participants.

The pre- and post-blood glucose values were included to compare against a constant line (Figure 2). The constant line indicates where the pre- and post-values would be identical. Data to the left of the line indicates actual individuals who did not improve, and data to the right indicates those who did improve. This visual shows more of the participants' detailed results. Each dot represents a participant in the program. Those to the left and above the line (9 participants or 30%) had higher blood glucose values in the post-assessment, whereas those to the right and below the line (21 participants or 70%) showed improved, lower values. Some participants improved more than others, with one participant improving significantly from the pre- to the post-survey, from approximately 540 mg/dL to approximately 240 mg/dL blood glucose concentration.

Figure 2

Pre and Post Intervention Blood Glucose Concentration



Note. This table shows the results from *the pre-and post-survey blood glucose concentrations for participants compared to those with no change (constant line).*

Eating, Nutrition, and Physical Activity Habits

Participants were asked to rate their eating habits pre- and post-intervention, with 1 being "poor" and 10 being "excellent." The average eating habits rating increased, which indicated that participants had an improvement in how they rated their eating habits. In addition to an overall statistically significant improvement, it is valuable to note that 76% of participants showed an improvement, so the intervention positively impacted most participants.

Physical Activity

Participants were asked about their overall physical activity level; 48% indicated an improvement in their activity level from pre- to post-MTM intervention.

Food Insecurity

Participants made modest improvements in their sense of food security. In the pre-survey approximately 30% of participants answered, "Sometimes True" or "Often True" to "In the last six months, I worried whether our food would run out before we got money to buy more." This number decreased in the post-survey. About 30% of participants whose food did not last and who did not have money to buy more also decreased from the pre- to the post-survey. In summary, participants had improvements in their perception of food security.

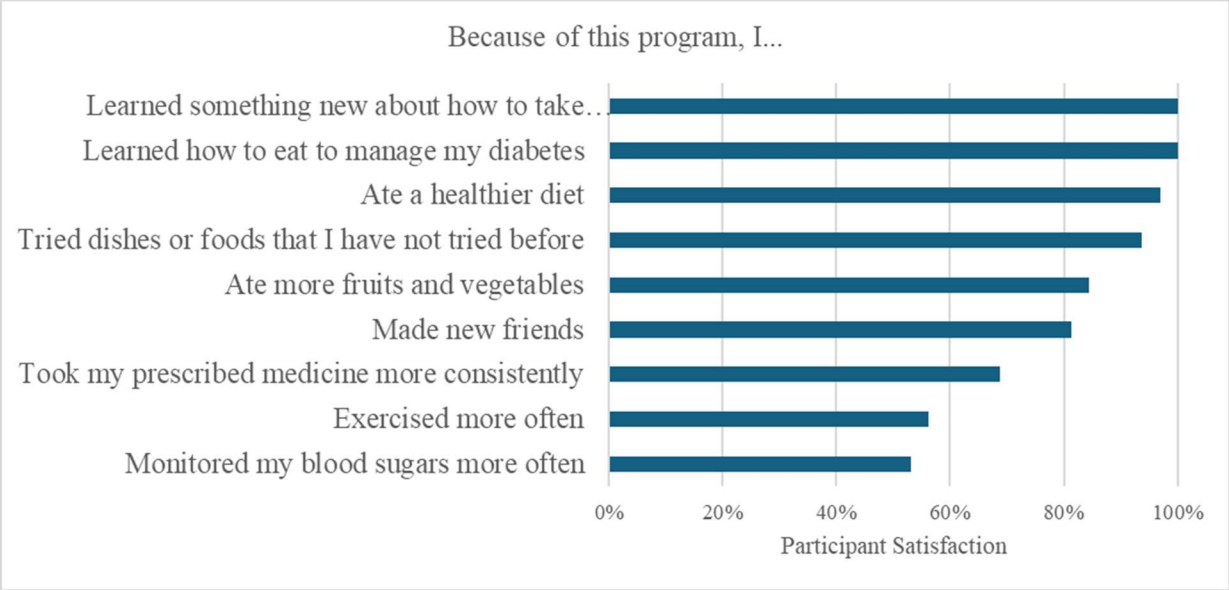
Participant Interim Survey and Final Participant Satisfaction

Participants were administered the interim assessment halfway through. They were asked how patients manage their diabetes, their challenges, changes made, and what they wanted to learn more about. Overall, participants were very satisfied with the program, with 100% of

respondents saying that because of it, they learned something new about managing their T2D and how to eat to manage it (Figure 3). Some individuals (12%) indicated they want more culturally relevant meals.

Figure 3

Count of Participants who had the Outcomes Specified



Note. This graph demonstrates the results of the participation satisfaction survey.

Discussion

Metabolic and diet-related illnesses are the leading risk factors for mortality in the U.S. Six in ten Americans have at least one chronic condition such as heart disease, cancer, stroke, or T2D (CDC, 2024). Additionally, four in ten adults have two or more chronic conditions (CDC, 2024). Although people with chronic illness represent 50% of the population, it contributes to more than 85% of healthcare costs (Holman, 2020). Chronic conditions are a concern nationally and on a community level. The need to effectively manage chronic conditions is critical for the health outcomes of older adults struggling to manage conditions. A healthy diet helps prevent chronic illnesses by providing essential nutrients that support bodily functions and boost the

immune system. A balanced diet rich in fruits, vegetables, whole grains, and lean proteins can help reduce the risk of heart disease, diabetes, and certain cancers (Cena & Calder, 2020). Additionally, avoiding processed foods and limiting sugar and salt intake are vital strategies for maintaining overall health and managing existing conditions.

Chronic conditions disproportionately affect people who have less access to resources to prevent and manage those conditions. Access to food can reduce barriers to healthy eating, improve patient outcomes, and assist the overly burdened medical system with solutions for chronic condition management while saving healthcare spending. Knowing that social determinants of health contribute to 80% of health outcomes, providing support within the built environment is critical in preventing and managing those conditions (Robert et al. Foundation, 2019). Studies have found that food security status strongly predicts chronic illness (Cai & Bidulescu, 2023; Gregory & Coleman-Jensen, 2017; Robert et al., 2019). Improving food security is critical in managing diet-related illnesses (Food Research & Action Center, n.d.; Ziso et al., 2022). Our holistic study aimed to contribute to food security and use food as medicine to manage chronic conditions through MTM intervention.

The MTM intervention had very favorable results, with almost half (48%) of participants showing an improvement in their activity levels and more than three-fourths (76%) of participants reporting improvement in how they rated their eating habits. Almost all participants (91%) had decreased HbA1C (average blood sugar and glucose level over the past two to three months), and 70% had lower blood glucose measurements. A similar percentage of participants had lower BMI and blood pressure. Participants also demonstrated a slight improvement in their perception of food security. The results of this study were consistent with other MTM programs in terms of improved blood glucose levels in adults (Lage & Boye, 2020; Seligman et al., 2015;

Seligman et al., 2018). This study built upon prior research on MTM programs focused on all adults to see if the findings would be replicated in older adults with T2D in Solano County. The findings suggest that medically tailored meals, increased access to fruit and vegetables, health education, and physical exercise can improve T2D control in this population. Eating the right foods, controlling portions, and exercising regularly can reduce blood glucose levels and improve health outcomes through direct services.

When services are provided to the community by the community, there is a greater chance of adherence (Haldane et al., 2019). Community involvement increases adherence because people feel more responsibility and accountability to their peers (Haldane et al., 2019). Additionally, services tailored to the specific needs and values of the community are more likely to be accepted and utilized (Granicus, n.d.; Haldane et al., 2019). This collective effort fosters trust and cooperation among community members (Haldane et al., 2019). Cultural relevance is crucial in ensuring that community services are effective and well-received (National Association of Social Workers, n.d.). When services are designed with an understanding of the community's cultural norms and values, they are more likely to resonate with the people they aim to serve (Penn State Extension, n.d.). This alignment with cultural expectations can lead to higher engagement and better outcomes (Administration for Children and Families, 2023).

As previously stated, holistic community-led approaches to chronic condition management, especially diabetes, can contribute to lowered health costs for the individual and system. This form of care constables decreases medical costs while providing critical care for disease management. For Solano County older adults with diabetes, being able to manage their health condition with any extra pocket cost is crucial for intervention adherence. Therefore, effective ways to manage chronic conditions are needed. The annual cost of T2D care was 413

billion dollars in 2022, making it one of the most expensive chronic diseases. (Centers for Disease Control and Prevention., n.d.; Food Research & Action Center, n.d.). Since 2022, about $307 billion has been spent yearly on the direct medical costs associated with the disease (American T2DAssociation, 2023; Parker et al., 2022). This is a costly burden for both the healthcare system and the individual. Uncontrolled T2D can contribute to a large portion, 48 to 64%, of the medical costs due to complications such as heart disease and stroke (King et al.,1999). For those with T2D and less access to health insurance, substantial financial difficulties may arise due to paying out of pocket for treatment.

We discovered that carrying the grocery boxes and food was challenging for this intervention. Delivering food to participants' places of residence is best for MTM interventions, where possible. Scheduling challenges made it difficult for some participants to attend classes and receive the food. It is recommended to be clear about this requirement initially with participants to ensure a smooth enrollment and implementation process. When we offered alternate options for implementation, it helped to increase participation, suggesting that flexibility, when possible, may produce higher adherence.

Furthermore, staffing was challenging during the program. Sometimes, staff had illnesses or were overwhelmed with other tasks and ongoing programming at the clinic. It is recommended that one person be dedicated not only to being a point person for the intervention but also to dedicate one to two backup persons if the point person is unavailable.

Additionally, we found that the coordination of food requires careful consideration. The menu must be appropriate to the medical status of the individuals and meet California Code standards. Sometimes, food vendors need to become more familiar with specific T2D requirements or how to meet them and need to realize the work involved when initially

becoming involved. Educating potential food vendors where necessary and working collaboratively on medically tailored menus is essential.

Ensuring the food menu is culturally appropriate for the participants is also recommended. Many participants were accustomed to eating Mexican cuisine and noted that the menu was new, which they only sometimes liked. According to the participant satisfaction survey, 12% of participants indicated that they would have preferred culturally appropriate meals. A consistent menu with culturally appropriate foods could greatly influence the participation and results of the study.

It is also essential to foresee the languages spoken by potential participants and plan for this in advance. Splitting participants into two separate groups, English and Spanish-speaking, greatly improved the feasibility and effectiveness of the classes.

For future programs, it is recommended that an increased emphasis be placed on connecting individuals to ongoing food programs, such as CalFresh and Food Pantries, after participating in the intervention so that they can continue improving their health by participating in an MTM intervention. Generally, it is recommended that MTM be considered for adults with chronic illnesses, such as diabetes, especially in the setting of existing wrap-around services, such as support groups, regular check-ups, or similar repeating touch points in their managed care. Effective partnerships across multiple sectors are critical to these efforts.

Conclusion

The implementation of the MTM intervention resulted in positive improvements at both the individual and community levels. At the individual level, the findings indicated a promising outcome, with participants reporting increased physical activity levels and healthier eating habits. Most participants significantly reduced their HgbA1C levels and experienced

improvement in their perception of food security. Additionally, participants had a positive experience during the intervention, learned new things about managing their diabetes, made new friends, and expressed eagerness to maintain engagement with their primary care provider. Participants requested that the weekly T2D education and support groups continue. La Clinica has implemented this continuation and now offers ongoing support groups.

At the community level, the intervention fostered valuable community partnerships and established a strong foundation for future collaborative efforts. This collaboration has strengthened connections with participants and streamlined recruitment processes. Moreover, IHS gained vital insights into the health needs of participants with diabetes, allowing for the development of future targeted interventions.

Reflection

This project takes a trauma-informed approach because it acknowledges that a community-based participatory intervention is needed to change behaviors in a community. This includes bringing together various community partners and stakeholders to work towards a solution. The MTM interventions focused on creating community-based solutions for a social issue. IHS used coordinated efforts of multiple community-focused organizations to assist in facilitating services and providing an intervention tailored to the needs of the focus community. Using La Clínica as an implementing agency was critical for participation; it was selected based on its connection with the local community. IHS adopted a person-centered approach, ensuring that participants' needs were recognized and addressed. La Clínica gathered feedback from participants throughout the intervention, providing valuable insights that enabled IHS to adjust effectively to the community needs. IHS provided quality control surveys to La Clínica to assess how the participants adapted to the intervention. In addition, La Clínica was flexible with the

participants; for example, when a participant could not make it to the in-person health education class, they offered a phone option to avoid missing any valuable information, and selecting La Clínica to implement the intervention allowed for more adherence. This demonstrates the commitment by both organizations to provide a high-quality intervention.

The MTM intervention has the potential to significantly increase health equity in three ways: food delivery, scheduling of health education classes, and the promotion of culturally appropriate meals. Developing a food box and meal transportation system makes it easier for all to access their meals, thereby improving health equity. This approach also alleviates the burden of carrying heavy food boxes for older adults. Offering health education classes in person, by telephone, and online makes the intervention more equitable and potentially increases participation and retention. Lastly, by adapting the menu to reflect culturally appropriate meals, we can further improve equity. This adaption would help the population understand how their culture's food can be healthy and allow them to feel more familiar with the foods provided. The MTM intervention is a beacon of hope, demonstrating that health outcomes can be significantly improved when communities work together.

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