MICROCLINIC INTERNATIONAL

Research Evidence for the Microclinic Program
List of Publications by Program Site
June 2014

Kentucky

Multiple Conditions: Diabetes, Heart Disease and Obesity

I. Results of the RCT in Bell County, Kentucky with 16-month follow up published in the American Heart Association journal *Circulation*:

http://circ.ahajournals.org/content/128/24/2704.full

Randomized Trial of Social Network Lifestyle Intervention for Obesity: MICROCLINIC Intervention Results and 16-Month Follow-up

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BACKGROUND: Obesity has been suggested to propagate within social networks. A social network program was engineered to contagiously propagate healthy lifestyles and leverage pre-existing social networks to decrease obesity. We expand upon a 9- to 10-month intervention program with 16 month followup to investigate the power of social networks in the first ever long-term randomized trial. METHODS: Based in rural Appalachian region of Kentucky, we investigate the Microclinic Social Network Behavioral Health Intervention (MSN) lifestyle intervention in a resource-limited but socially cohesive area with high obesity prevalence. Social clusters of 2-8 individuals who participated together in a program with weekly physical activity, nutrition, health education and social activity sessions led by health-educators; controls had access to standard care from local county health department. Body weight and waist circumference were collected in followup waves during intervention, plus at 16 months after baseline in a 52% sample subcohort. Longitudinal analyses utilized multilevel repeated-measures mixed models, with multilevels of neighborhood center, classroom, and social cluster (i.e. microclinic) to examine the change in health outcomes in program participants vs. controls.

RESULTS: Study enrolled 552 participants, comprised of 242 social clusters, among 27 classroom clusters, and from 5 neighborhood cohorts. Participants were 85.8% women, mean age 50.9 years (13.8), mean BMI 36.2 (7.6). From baseline to end of intervention period, MSN intervention group showed decreased body weight of -6.52 lbs (95% CI: -8.57 to -4.47; P<0.001), and improved central adiposity with decreased waist circumference of -1.24 inches (-1.85 to -0.63; P<0.001), relative to controls. In subcohort at 16 months, decreases in weight (-4.70 lbs, -7.56 to -1.84) and waist circumference (-0.99 inches, -1.81 to -0.17) were maintained.

CONCLUSIONS: Expanded and long-term findings demonstrate the effectiveness of Microclinic Social Network Behavioral Health Intervention for obesity control in resource limited settings. Results hold promise for socially engineering and leveraging the power of social networks interventions to propagate healthy lifestyle behaviors.

II. Results of the RCT in Bell County, Kentucky published in the American Heart Association journal *Circulation*:

http://circ.ahajournals.org/cgi/content/meeting_abstract/127/12_MeetingAbstracts/A009

Abstract 009: Microclinic Social Network Lifestyle Intervention for Weight Loss and Obesity Management: A 10-Month Randomized Controlled Trial

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BACKGROUND: Lifestyle behaviors and health conditions, such as obesity, smoking, and alcohol use, are observed to contagiously propagate in social networks. However, to date, such effects have only been evaluated in observational studies; evidence from socially-engineered health programs to directly harness the power of social networks have yet to exist. The *Microclinic Social Network* program was developed to leverage social network effects, to socially propagate healthy lifestyles for improving disease prevention and management.
METHODS: In a 10-month randomized controlled trial in Bell County, Kentucky, we evaluated the *Microclinic Social Network* intervention, harnessing pre-existing social cluster connections to influence and propagate change in lifestyle factors for improving obesity in a resource-limited rural area. Microclinics consisted of social clusters of 2-6 individuals who participated together in nutrition, physical activity, health education and social activity sessions weekly with health-educators; controls had access to standard care from local county health department. Body weight, waist circumference, and blood pressure were collected in 4 followup waves. Longitudinal analyses utilized multi-level repeated measures mixed models, with multi-levels of community center and social cluster, with AR1 autoregressive covariance by time, and heteroskedastic variances by intervention group.

RESULTS: Among 265 participants at baseline, 91.5% were women, mean age=51.5 years (SD=13.5), mean BMI=36.2 (7.55), mean baseline waist circumference=43.6 inches (5.77), and mean social cluster size= 4.1 individuals/microclinic. After 10-month program, MSN intervention group showed decreased body weight of -5.32 lbs (95% CI: -8.36 to -2.29) compared to controls (P<0.001). The absolute BMI net change was -0.95 (-1.48 to -0.42), with corresponding percent BMI net change being -2.44% (P<0.001). Furthermore, central adiposity improved substantially, with a waist circumference net change of -1.54 inches (-2.39 to -0.69; P<0.001). Among morbidly obese (BMI>=35) participants at start of study, the MSN program decreased the likelihood of remaining morbidly obese by the end of the program by -13% (Relative Risk=0.87, 95% CI: 0.76-0.99; P=0.04). Furthermore, MSN participants notably lowered systolic blood pressure by -6.59 mm Hg (-12.7 to -0.48; P=0.03). Multi-level models also revealed network effect of microclinic social clusters to explain 26% of correlated BMI trajectories among intervention participants, versus just 13.1% among social clusters in controls.

CONCLUSIONS: Results indicate that the *Microclinic Social Network* lifestyle intervention may be effective for weight loss management. As the first randomized trial engineered to directly leverage effects of social networks, findings yield promise for the power of social networks to propagate healthy lifestyle behaviors for public health.

Jordan

Diabetes

I. Results from the second study for the Microclinic diabetes program in Jordan published in Lancet Global Health:
http://download.thelancet.com/flatcontentassets/pdfs/CUGH-2014/CUGH_abstracts_p3_50_Part17.pdf

Long-term bodyweight and glucose management effects of the Microclinic Social Network Health Behavioral Program in Amman, Jordan: 2-year results

Daniel E Zoughbie, Kathleen T Watson, Nancy Bui, Rami S Farraj, Marta R Prescott, Eric L Ding

Abstract

Background **Evidence shows that social network phenomena are major drivers of lifestyle risk factors that contribute to risks of obesity and diabetes. Since 2005, Microclinic International has pioneered the research and development of a novel social network "microclinic" model—a social network programme designed to propagate lifestyle change and leverage pre-existing social networks to improve health. We sought to assess the effectiveness of such a social network programme for sustaining long-term health.**

Methods **With the Microclinic Social Network Behavioral Health Program in Jordan, patients with diabetes or prediabetes were enrolled in the 4-month Microclinic International programme, with data collection at baseline, the end of the 4-month programme, 12 months, and 24 months after baseline (between March, 2010, and April, 2012). Social clusters of two to eight individuals participated together in a programme with weekly physical activity, nutrition, health education, and social activity sessions. Multi-level repeated measures regression estimated the long-term change in weight, body-mass index (BMI), and HbA_{1c} during programme and follow-up.**

Findings **Of 315 participants with a full 2-years of follow-up, 262 (83·2%) completed the 4-month programme, 283 (89·8%) returned for the 12-month follow-up, and 216 (69·6%) for the 24-month follow-up. At completion of the 4-month programme, participants lost an average of 2·89 kg (–3·84 to –1·93; p<0·0001). At 1 year, participants, on average, sustained a weight reduction of –1·84 kg (–2·77 to –0·91; p<0·0001) from baseline, a –0·69 (–1·03 to –0·36) reduction in BMI, and –0·46% (–0·60 to –0·32; p<0·0001) sustained absolute reduction in HbA_{1c}. 2 years from baseline, participants maintained an average weight loss of –1·60 kg (–2·67 to –0·54; p=0·003) from baseline, –0·43 (–0·82 to –0·05) reduction in BMI, and –0·97% (–1·12 to –0·81; p<0·0001) reduction in HbA_{1c}.**

Interpretation **Our results show that the Microclinic Social Network Behavioral Health Program was translated well into this cultural context and participants had long-term sustained benefits in bodyweight, BMI, and glucose control.**

Funding **BRIDGES.**

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Contributors

ELD and MP did the statistical analysis. ELD wrote the Abstract with input from DEZ. DEZ and KTW designed the project; KTW, NB, DEZ, and ELD collected data; and RSF contributed guidance to study implementation. Authors have seen and approved the final version of the Abstract for publication.

Declaration of interests

We declare that we have no competing interests.

Acknowledgments

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II. Results from the first study for the Microclinic diabetes program in Jordan published in the *American Journal of Epidemiology*.

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ASSOCIATION BETWEEN SERUM 25-HYDROXYVITAMIN D LEVEL AND INSULIN RESISTANCE IN AN ELDERLY KOREAN POPULATION. *Bo Mi Song, Hyeon Chang Kim, Yumie Rhee, Yoosik Youm, Chang Oh Kim (Department of Public Health, Yonsei University College of Medicine, Seoul Korea)

Introduction: A low serum vitamin D concentration has been reported to be associated with increased risk of diabetes mellitus. But the relationship with 25-hydroxyvitamin D [25(OH)D] level and insulin resistance has not been ascertained in the Korean elderly population. The purpose of this study was to investigate the association between 25(OH)D level and insulin resistance in community-living elderly Koreans. Methods: This study used data from the Korean Urban Rural Elderly (KURE) study. In 2011 study, 927 participants aged 65 years or older completed baseline health examinations. Participants were recruited from an urban and a rural communities. After excluding two individuals missing 25(OH)D value, cross-sectional analyses were conducted for 925 participants (302 men and 623 women). Plasma glucose and serum insulin levels were measured from overnight fasting blood samples and homeostasis model assessment for insulin resistance (HOMA-IR) was calculated using them. Fasting glucose, insulin and HOMA-IR were log-transformed for parametric tests. Results: In men, serum 25(OH)D level was significantly associated with HOMA-IR ($\beta = -0.01$, $p = 0.027$) even after adjustment for age, body mass index, smoking status, alcohol intake and regular exercise. However, there were significant differences in serum 25(OH)D level (18.68 vs. 26.39 ng/ml; $p < 0.001$) and HOMA-IR (1.58 vs. 1.04; $p < 0.001$) between urban and rural areas. After additional adjusting for residential area, the association was not significant ($\beta = -0.001$, $p = 0.767$). In women, the association between 25(OH)D and HOMA-IR was not significant before ($p = 0.238$) and after ($p = 0.929$) adjustment for residential area. Conclusion: Our findings suggest that serum 25(OH)D level is not independently associated with insulin resistance in elderly Koreans.

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PERINATAL OXIDATIVE STRESS AFFECTS FETAL GHRELIN LEVELS. *Zhong-Cheng Luo, Jean-Francois Bilodeau, Anne-Monique Nuyt, William Fraser, Francois Audibert, Jin-Ping Zhao, Lin Xiao, Pierre Julien, Emile Levy (Sainte-Justine Hospital Research Center, University of Montreal, Montreal QC Canada)

The prenatal period is considered a critical developmental window in "programming" the vulnerability to obesity and "metabolic syndrome"related disorders. The mechanisms remain unclear. Perinatal oxidative stress may affect the expression of certain redox-sensitive gene products and "program" such susceptibility. This study investigated (for the first time) whether perinatal oxidative stress may affect fetal circulating levels of ghrelin - an important hormone regulating appetite and energy balance . Indices of oxidative stress (F2-isoprostanes, malondialdehyde (MDA)) were measured in maternal (24-28 weeks gestation) and cord blood in 255 singleton pregnancies. Plasma ghrelin concentrations were significantly higher in cord versus maternal blood (median: 392 versus 132 pg/ml), and were strongly correlated ($r = 0.50$, $p < 0.0001$). Indices of oxidative stress were highly correlated in maternal versus fetal cord blood ($r = 0.35$ for MDA, $r = 0.57$ for F2-isoprostanes, all $p < 0.0001$). Adjusting for gestational age at blood sampling and cord blood glucose concentration, consistent negative correlations were observed in cord plasma ghrelin levels with indices of oxidative stress in both maternal blood ($r = -0.37$, $p < 0.0001$ for MDA; $r = -0.17$, $p = 0.01$ for F2-isoprostanes) and cord blood ($r = -0.15$, $p = 0.02$ for MDA; $r = -0.28$, $p < 0.0001$ for F2-isoprostanes). Most observed associations remain significant after adjusting for maternal and pregnancy characteristics. The data consistently suggest that perinatal oxidative stress may suppress ghrelin expression during fetal life in humans, which may be a mechanistic link in programming the susceptibility to obesity and metabolic syndrome related disorders.

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ALL-CAUSE, CARDIOVASCULAR, AND CANCER MORTALITY IN POSTMENOPAUSAL WHITE, BLACK, HISPANIC, AND ASIAN WOMEN WITH AND WITHOUT DIABETES IN THE U.S.: THE WOMEN'S HEALTH INITIATIVE 1993-2009. *Yunsheng Ma, James Hébert, Jo Ann Manson (University of Massachusetts Medical School, Worcester MA 01545)

Objective: Using data from the Women's Health Initiative (WHI), we compared all-cause, cardiovascular (CVD), and cancer mortality in White, Black, Hispanic, and Asian postmenopausal women with and without diabetes. Research Design and Methods: Race/ethnicity, diabetes status, total and specific mortalities were obtained from 158,833 postmenopausal women recruited from 1993-1998 and followed up until August 2009. Comparisons of all-cause, CVD, and cancer mortality by self-reported diabetes status and by race/ethnicity were made using Cox proportional hazard models from which hazard ratios (HRs) and 95% confidence intervals (CI) were computed. Results: With an average age of 63 at baseline, WHI participants included 84.1% White, 9.2% Black, 4.1% Hispanic, and 2.6% Asian. The percentages of women with prevalent or incident diabetes from study enrollment to August 2009 were, in decreasing frequency: 27.1% for Blacks, 20.8% for Hispanics, 15.9% for Asians and 11.7% for Whites. Within each racial/ethnic subgroup, women with diabetes had approximately 2 to 3 times higher risk of all-cause, CVD and cancer mortality as compared to those without diabetes. However, the HRs for mortality outcomes were not significantly different between race/ethnic subgroups according to diabetes status. Population attributable risk percentages (PARP), which take into account both the prevalence of diabetes and HRs associated with the disease, indicated that for all-cause mortality, Whites had the lowest PARP [11.1 (95% CI: 10.1-12.1)] versus Blacks [19.4 (15.0-23.7)] and Hispanics [23.2 (14.8-31.2)], while the PARP was 12.9 (4.7 – 20.9) for Asians. Conclusions: Postmenopausal women with diabetes had a higher risk of all-cause, CVD, and cancer mortality when compared with postmenopausal women without diabetes. Both Black and Hispanic women are at higher-than-average risk of developing diabetes and have higher proportions of all-cause mortality attributable to diabetes compared to Whites. Because of "amplifying" effect of diabetes prevalence, efforts should focus on prevention of type 2 diabetes.

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THE MICROCLINIC HEALTH PROGRAM: A SOCIAL NETWORK-BASED INTERVENTION FOR WEIGHT LOSS AND DIABETES RISK MANAGEMENT. ***Marta Prescott, Daniel Zoughbie, Katie Watson, Nancy Bui, Rami Farraj, Nadia Elkarra (Mailman School of Public Health, Columbia University, New York NY 10032)**

Obesity and behavioral risk factors have been shown to aggregate and propagate via social networks. We aimed to examine the ability of a program, the Microclinic Health Program, to harness organic social structures by determining the extent to which change in clinical markers that occurred during the program was clustered within social layers. The program was conducted among 720 individuals who participated in the 4-month type-2 diabetes education program in Amman, Jordan. All subjects participated with 2-8 friends or family members (a microclinic) and had diabetes, were at-risk for diabetes, or had a loved one with diabetes. Clinical markers (weight, Body Mass Index [BMI], and Hemoglobin A1c [HbA1c]) were measured at baseline and at the end of the program. We used multivariable multi-level linear regression to examine the change in clinical markers as well as examine the clustering of change within social layers (microclinics, classes, or cohorts). At the end of the program, results indicated decreased weight (Beta [B]:-1.38 kg; 95% confidence interval [CI]: -1.73, -1.04), BMI (B:-0.55 kg/m2; 95% CI -0.69, -0.41), and HbA1c (B:-0.48%; 95% CI -0.61, -0.34). Additionally, the trajectories of change in these risk factors were clustered in the social layer within microclinic groups (Intraclass correlation [ICC] = 57.7% weight loss, ICC = 52.5% for BMI decrease, and ICC = 35.3% for HbA1c). Based on the clustering of change, our results suggest that the program successfully harness an organic social-network to promote improvements in diabetes management. Such a social network-based intervention may be a promising tool to propagate healthy behaviors for diabetes and obesity prevention throughout a community.

III. Preliminary results from the 3-arm randomized controlled trial published in the American Diabetes Association journal *Diabetes.*

MICROCLINIC Social Network Interventions for Obesity and Diabetes in Jordan: a 3-Armed Cluster Randomized Controlled Trial

Control/Tracking Number: 2014-LBA-5852-Diabetes

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BACKGROUND: Diabetes and obesity are suggested to propagate within social networks, with diabetes a concern in the Middle East. Leveraging pre-existing social networks to propagate healthy behaviors, we conducted the first ever social-network randomized trial to improve obesity and diabetes in a developing country.

METHODS: Based in community health clinics in Amman, Jordan, we tested the effects of various Microclinic Social Network (MSN) behavioral interventions in collaboration with the Jordanian Ministry of Health and Royal Health Awareness Society. A 3-armed 28-week cluster randomized trial was designed: Arm A) enhanced MSN social network program in weekly interactive sessions led by health-educators; Arm B) basic MSN social network program but without extensive class interactions; Arm C) controls with standard care. Weight, waist circumference, HbA1c, and blood pressure were collected. Longitudinal multilevel mixed models levels of community, classrooms, and microclinic social clusters were used.

RESULTS: The trial enrolled 911 participants, comprised of 9 community-cohorts, 45 classroom clusters, and 523 social clusters. Participants were 66% women, mean age 55.1 years (10.2), mean BMI 33.6 (3.2). After 12 weeks, Arm B reduced weight vs C (-0.99 kg, 95% CI: -1.93 to -.06; P=0.037), while A yielded borderline weight change vs C (-0.59 kg, P=0.096). However, by end of 28-weeks of intervention, Arm A showed strongest sustained weight reduction versus control (-1.11 kg, -1.87 to -0.35; P=0.004), while B did not (-0.64, -1.69 to 0.41, P=0.23), with over P for program*time interaction=0.019. HbA1c showed borderline significant drop at 28 weeks for A vs. control (-0.20, P=0.08), but not B vs. control (-0.15, P=0.27). Waist circumference and blood pressure were not significant.

CONCLUSIONS: Results demonstrate the effectiveness of MSN health interventions in a resource-limited, high chronic disease burdened, developing-country setting.

IV. Results from first pilot study in the West Bank published in the World Health Organization *Eastern Mediterranean Health Journal*.
http://applications.emro.who.int/emhj/1504/15_4_2009_1021_1026.pdf

Report

Community-based diabetes programme: the micro-clinic project

D.E. Zoughbie[1]

برنامج السكري المجتمعي المرتكز: مشروع العيادة المكروية

دانيال زغبي

الخلاصة: لقد أدى ازدياد التحضُّر في إقليم شرق المتوسط إلى ارتفاع ملحوظ في معدَّل انتشار السكري. وأصبح تقديم الرعاية للسكريين يمثِّل تحدياً كبيراً تحت ظروف التوطن للقلاقل والعنف والفقر. ويرسخ نموذج العيادة المكروية مجالاً عمومياً للتفاعل بين المجتمع العام والمجتمع المحلي، وينخرط فيه الأسر والأصدقاء والجيران بمجموعهم في التثقيف وتقديم المعالجة والدعم الجماعي والحصول على نصيب مما هو متاح من التكنولوجيا الملائمة، إلى جانب نشر السلوكيات الإيجابية، حيث يشعر المساهمون في مشروع العيادة المكروية بأنهم متمكنون من رعاية أنفسهم ورعاية غيرهم. كما يقدم هذا النموذج آفاقاً رحبة لأسلوب تقديم للرعاية الصحية مضمون الاستمرار على الصعيد السياسي والاجتماعي والاقتصادي.

ABSTRACT Increased urbanization in the Eastern Mediterranean Region has led to a significant rise in the prevalence of diabetes. Caring for diabetes under conditions of endemic uncertainty, violence and poverty is a great challenge. The micro-clinic model establishes a public domain of social and community interaction whereby friends, families and neighbours can collectively engage in education, treatment and group support, obtain shared access to appropriate technology and spread positive behaviours. Participants who are active in micro-clinics feel empowered to care for themselves and others. The micro-clinic model offers the prospect of an economically, socially and politically sustainable approach to health care.

Programme de lutte contre le diabète à l'échelon local : le projet de microclinique

RÉSUMÉ L'urbanisation croissante dans la Région de la Méditerranée orientale a entraîné une augmentation significative de la prévalence du diabète. La prise en charge de cette maladie dans des conditions d'incertitude, de violence et de pauvreté endémiques est extrêmement difficile. Le modèle de la microclinique permet d'instaurer un espace public d'échanges sociaux et communautaires au sein duquel les amis, la famille et les voisins peuvent participer tous ensemble à l'éducation, au traitement et aux séances de groupe, accéder avec d'autres à la technologie appropriée et encourager les comportements sains. Les participants qui s'investissent dans des microcliniques se sentent qualifiés pour prendre soin d'eux-mêmes et des autres. Le modèle de la microclinique offre la perspective d'une démarche durable du point de vue économique, social et politique en matière de soins de santé.

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Introduction

Chronic diseases are a leading cause of death and disability in the world today. Noncommunicable conditions, including obesity and diabetes, account for 59% of the 57 million deaths annually. Around 177 million people are affected by diabetes, two-thirds of whom live in the developing world [*1,2*]. The growing prevalence of diabetes and obesity threatens to undermine struggling economies [*3*].

Although there is a strong economic and humanitarian argument to be made for the prevention and management of chronic diseases, poverty alleviation programmes such as the Millennium Development Goals have failed to list chronic diseases as a major priority. Thus, they are being ignored and underfunded [*4*].

Burden of chronic disease in Palestine

Increased urbanization, socioeconomic development and behavioural changes in the Eastern Mediterranean Region have led to a rise in chronic diseases such as diabetes. These trends have serious implications for the future growth of chronic noncommunicable diseases, and constitute a major public health problem [*5,6*]. In the context of endemic uncertainty, poverty, persistent violence and restricted movement, the burden of diabetes in the Occupied Palestinian Territory is great. A 2001 study found impaired glucose tolerance in 5.9% of an urban survey population (492 men and women) and diabetes in 12.0% of the same population [*7*].

There is evidence that preventive measures in high-risk individuals, including proper self-management of diabetes, can reduce its prevalence and complications. The American Diabetes Association suggests that self-monitoring of blood glucose is an important part of diabetes management that allows individuals to evaluate their response to therapy and to achieve desirable blood glucose levels. Self-monitoring of blood glucose enables diabetic individuals to interpret data and to adjust medication and behaviour accordingly [*8*]. A healthy diet and appropriate physical activity are other important components of effective therapy as they can contribute to improved blood glucose control, prevent diabetes mellitus in high-risk individuals and improve overall bodily health [*8*].

Because individuals are connected to other individuals, their health is also connected to the health of those around them. Both negative and positive behaviours have the potential to be spread via social networks [*9*]. While medication can also be an important part of therapy, in places such as the Occupied Palestinian Territory, there are often severe shortages of medication due to closures, curfews, violence and economic hardship. General health and lifestyle information is provided hastily and superficially, if at all [*10*]. The prevention and management of diabetes in underserved regions requires effective social solidarity programmes that compliment existing services and bring together all available technical and human resources to solve significant public health problems.

The diabetes micro-clinic study

The existing Palestinian health care system continues to be undermined by geo-politics and pervasive conditions of uncertainty. In the D'heisheh refugee camp, for instance, it has been reported that a United Nations employed doctor sees about 170 patients a day [*11*]. With economic restrictions imposed

in 2006, the World Health Organization warned of a growing financial and humanitarian crisis, which has resulted in high rates of unemployment, restricted access to services, unpaid health workers and severe shortages of medicines [*12*].

In 2005, a pilot micro-clinic project was established in the Bethlehem area and the D'heisheh refugee camp. Working with volunteer doctors, nurses and students, we created 50 diabetes "micro-clinics" composed of small groups of patients meeting in designated houses or business premises for the purpose of diabetes education, screening, treatment, monitoring and social solidarity [*11*]. Micro-clinics bring together human, technological and information resources within a given community to address a significant public health problem. They facilitate shared access to general education, specialist services and technologies such as personal blood glucose monitoring devices. Using lectures, workshops and group activities, the diabetes micro-clinics are vehicles of self-empowerment that encourage informed interaction with health care professionals. The micro-clinics create an infrastructure that is owned and operated by the participants. Ultimately, micro-clinics are the people.

The micro-clinic model establishes a public domain of community interaction whereby people who know each other as family, friends and neighbours can collectively access education, treatment and psychosocial support. The idea emerged from ethnographic observations showing that many Palestinians are not properly educated about diabetes. Family members and close friends heavily influence the perception of serious health problems. Moreover, people do not have the resources or information to purchase important technologies such as personal glucose monitoring systems, widely used in the United States and Europe [*11*]. Therefore, each micro-clinic (a group of approximately 3 to 6 individuals) voluntarily completes an educational programme, participates in structured and unstructured group activities, and shares the cost of maintaining a glucose meter. These machines are important as they allow for more intensive blood glucose control that is cost-effective and can significantly reduce diabetes-related complications [*13*]. The machines, educational materials, and social activities create an interesting focal point for groups as they positively engage in improving the health and well-being of the community.

The micro-clinic project was implemented in 4 steps:

Step 1: Assessment and planning efforts were undertaken to identify existing resources, social networks and local volunteer leadership. This stage included planning and training sessions with volunteer doctors, nurses and students from the Bethlehem area and from the D'heisheh refugee camp.

Step 2: Although the Ministry of Health did not have any official involvement with this project, volunteer nurses, doctors and university faculty members from the Bethlehem area provided large educational lectures open to the community. These volunteers distributed supplemental educational booklets obtained from the United Nations Relief Works Agency (UNRWA). The lecture topics included the causes of diabetes, complications, prevention, management, diet and exercise [*11*]. These lectures were facilitated using local community centres, health committees and academic staff.

Step 3: The large lecture groups were then divided into smaller groups of about 20 individuals. Each person was able to ask personal questions and was tested by a

doctor or registered nurse using a personal glucose monitoring system (MediSense Precision QID systems were used because they do not require batteries and are locally available). Those who registered high readings or previously knew that they had diabetes moved on to the next step. These individuals were also referred to local doctors and nurses from the UNRWA, private clinics and Ministry of Health doctors or nurses when possible. In the Bethlehem area, existing services are either limited or expensive, and therefore many diabetic patients were not able to obtain regular access to such facilities.

Step 4: Individuals who registered high readings, and who were evaluated by health care professionals, were divided into "micro-clinics"—organically formed, self-selected groups of close friends, family and neighbours. Each micro-clinic was given a glucose monitor to share. During this phase, members of the micro-clinics were trained by a doctor or registered nurse in the use of the glucose monitors. This training included following relevant guidelines concerning the proper sterilization and waste disposal procedures for insulin needles, lancets and other sources of contamination [*14*].

As support groups, the micro-clinics are led by a volunteer leader—usually a family member—responsible for assisting in documenting readings, administering tests and promoting education and behavioural change. These micro-clinic groups participate in social activities together and receive ongoing education and follow-up visits from a registered nurse who serves as a local micro-clinic coordinator for approximately 1 year. The micro-clinic coordinator checks to make sure that the machines are working, being utilized properly and sterilization and waste disposal procedures are being adhered to. The coordinator also discusses behavioural changes, monitoring results and overall progress in the management of diabetes. This process helps diabetes patients interact with health care professionals in a more informed and empowered way. Working with local entrepreneurs, a cooperative system of purchasing replacement supplies was established to secure discounted prices for micro-clinic members.

Evaluation

Continuous evaluation takes place of what is and is not working at the local level. Several important observations were made during ethnographic fieldwork, focus groups and through individual discussions with 25 micro-clinic representatives.

Micro-clinics facilitate community awareness and outreach

The micro-clinics not only serve participants, but also impact on their immediate communities. Friends and neighbours mingle with micro-clinic participants and often ask about the programme and glucose meters. Some have subsequently asked to be screened for diabetes. As outreach centres, the micro-clinics are also functioning in emergencies. One undiagnosed woman who was feeling ill was rushed to the local doctor after her daughter, a micro-clinic participant, tested her and found an extremely high glucose level.

Micro-clinics involve friends and family

In most micro-clinics, both participants and volunteers (a son, daughter, grandson, etc.) were shown how to use the machines. These youth volunteers, family members, and caregivers act as "staff" leaders of the micro-clinics and are vital to their effectiveness. The micro-clinics work from within the space of the home, encouraging prevention and management of a disease which is

so greatly affected by domestic behaviour patterns.

Micro-clinics can be important in remote locations
Glucose monitors were also distributed to registered nurses, who were not previously equipped with basic medical technologies. They have used these resources for micro-clinic groups of patients in remote locations, enhancing their mobility and geographical health care capacity.

Micro-clinics can be used as emergency support systems
The micro-clinic model offers an emergency support system which can be implemented in various contexts including conflicts and natural disasters. For instance, during curfews in Bethlehem when it is prohibited to enter the streets, family, friends and neighbours can come together in the micro-clinic house and share food, medicine and services.

This testing and health awareness is of even greater importance during emergencies, given prolonged high stress levels and lack of supplies.

Micro-clinics spread positive behaviours and provide psychological support
People "feel secure" and empowered in their micro-clinics, and share resources such as test strips when they run out. The micro-clinics also encourage behavioural changes, as participants take medicine and exercise in response to elevated glucose levels detected on the monitors.

Micro-clinics empower participants to take responsibility for their own health
Because the micro-clinic participants are encouraged and prepared to take a more central role in the prevention and management of diabetes and its complications, they are able to interact with health care professionals in a participatory manner.

The micro-clinic model offers the potential of scalability as well as social, economic and political sustainability, especially in conflict-ravaged and impoverished areas. It creates a social network that can be used to spread positive behaviours throughout a community. Most importantly, the micro-clinic model advances the notion that health care cannot simply be provided from the top down—it must also be provided from the bottom up.

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More details of the Global Micro-Clinic Project are available at at: http://www.gmcp.org.

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Kenya
HIV/AIDS

I. Efficacy of the Microclinic Model and HIV care published in the *Journal of Acquired Immune Deficiency Syndromes* 1 Apr 2014 (epublished ahead of print)

"Antiretroviral concentrations in small hair samples as a feasible marker of adherence in rural Kenya."
Authors: Hickey MD, Salmen CR, Tessler RA, Omollo D, Bacchetti P, Magerenge R, Mattah B, Salmen MR, Zoughbie D, Fiorella KJ, Geng E, Njoroge B, Jin C, Huang Y,Bukusi EA, Cohen CR, Gandhi M.

Abstract:
Antiretroviral hair levels objectively quantify drug exposure over time and predict virologic responses. We assessed the acceptability and feasibility of collecting small hair samples in a rural Kenyan cohort. 95% of participants (354/373) donated hair. Although median self-reported adherence was 100% (IQR 96-100%), a wide range of hair concentrations likely indicates overestimation of self-reported adherence and the advantages of a pharmacologic adherence measure. Higher nevirapine (NVP) hair concentrations observed in women and older adults require further study to unravel behavioral versus pharmacokinetic contributors. In resource-limited settings, hair antiretroviral levels may serve as a low-cost quantitative biomarker of adherence.

II. Efficacy of Microclinic Model and Program for HIV (*in preparation*)

"We are together": lived experiences and proposed mechanisms of a novel social network approach to optimize community-based HIV care and treatment in rural Western Kenya.
Authors: Charles R. Salmen; Matthew D. Hickey; Kathryn J. Fiorella, Richard Magerenge; Daniel Zoughbie; Dan Omollo; Brian Mattah; Robert Tessler; Harold Campbell; Katie Watson; Nancy Bui; Marcus R. Salmen; Caroline Christian; Elvin Geng; Monica Gandhi; Elizabeth A. Bukusi; Craig R. Cohen.

Background: Along the remote shores of Lake Victoria, Kenya, where HIV prevalence approaches 30%, the effects of HIV/AIDS are not limited to sero-positive individuals; rather, they result in chronic biologic, socio-economic, and ecologic disorders that disrupt entire social networks. Despite collective health burdens, infected individuals are frequently prevented from accessing social network support by intense HIV stigma. We describe the social network phenomena of 'HIV risk induction' to suggest that social networks have a vested interest in improving engagement with HIV care among infected members. These concepts provide support for a novel unit of HIV/AIDS intervention at the community-level in sub-Saharan Africa: the HIV-affected social network.

Methods: In 2011, our group launched a mixed methods cohort study to evaluate a community-based intervention known as the "microclinic" model across 22-month of follow-up. This intervention was designed to provide longitudinal training and facilitated testing and disclosure

for patients on ART and members of their HIV-affected social networks on Mfangano Island, Lake Victoria, Kenya. He we report qualitative data from 18 focus group discussions that we conducted with microclinic participants (n=82), community health workers (n=40), and local program staff (n=39). Responses were coded based on themes identified by an interdisciplinary team of local Kenyan investigators, HIV/AIDS providers and medical anthropologists who participated in the intervention.

Results: Participants highlight four overlapping mechanisms through which the microclinic intervention impacted engagement in HIV care and treatment, namely enhanced treatment literacy, widespread stigma reduction, group testing and disclosure, and group support. Despite challenges, participants report an emerging sense of collective responsibility for care and treatment within intervention communities.

Discussion: The lived experiences and potential mechanisms highlighted by participants suggest important opportunities to transform the continuum of HIV care from a secretive individual journey into a network-oriented cycle of engagement.

III. Efficacy of Microclinic model and HIV care (9th International Conference on HIV Treatment and Prevention Adherence)

http://www.iapac.org/AdherenceConference/presentations/ADH9_OA482.pdf

Pulling the network together: a novel social network intervention for promoting engagement in HIV care on Mfangano Island, Kenya.

Authors: Matthew D Hickey, Charles R Salmen, Dan Omollo, Brian Mattah, Elvin H Geng, Peter Bacchetti, Cinthia Blat, Gor Benard Ouma, Kathryn J Fiorella, Daniel Zoughbie, Robert A Tessler, Marcus R Salmen, Monica Gandhi, Starley Shade, Elizabeth A Bukusi, Craig R Cohen.

Status: Presented as oral presentation at the 9th International Conference on HIV Treatment and Prevention Adherence in June 2014. Manuscript in preparation

Background: Despite progress in the global scale-up of antiretroviral therapy (ART), sustained engagement in HIV care remains challenging. Social capital has been identified as an important factor for sustained engagement, but interventions to harness this powerful social force are uncommon.

Methods: We conducted a quasi-experimental study evaluating the impact of a targeted social network intervention on engagement in HIV care at a rural health facility on Mfangano Island, Kenya. 369 (87%) of 426 eligible adult patients on ART were enrolled. The intervention was introduced into one of four similar communities served by this clinic, and comparisons were made between communities using intention-to-treat. Microclinics, composed of patient-defined support networks, participated in 10 bi-weekly discussion sessions covering topics ranging from HIV biology to group support. The curriculum also included voluntary participation in a group HIV status disclosure session. We report impact on disengagement from care, measured by the incidence of ≥90 day gaps in care following a missed clinic appointment, using Cox proportional hazards regression. The model was adjusted for potential clinical and demographic confounders and included robust standard errors to account for clustering.

Results: 113 (74%) intervention community participants joined a microclinic group, 86% of whom participated in group HIV status disclosure. Over 22-months of follow-up, incidence rates of 90-day disengagement were 6.8 per 100 person-years in the intervention group (95%CI 4.2-10.9) and 12.9 (95%CI 9.6-17.3) in control. In the adjusted Cox model, intervention community participants experienced one-half the rate of 90-day clinic absence as those in control communities (adjusted hazard ratio 0.48, 95%CI 0.25-0.92).

Conclusions: The microclinic intervention holds promise as a feasible community-based strategy to improve long-term engagement in HIV care. Reducing treatment interruptions using a social network approach has important implications for individual patient virologic suppression, morbidity and mortality, and for broader community empowerment and engagement in healthcare.

IV. Efficacy of Microclinic model and HIV care (in preparation)

Re-engagement in care for HIV infected Patients Who Leave their Original Clinic site.
Authors: Matthew D Hickey, Charles R Salmen, Dan Omollo, Brian Mattah, Cinthia Blat, Gor Benard Ouma, Kathryn J Fiorella, Betty Njoroge, Monica Gandhi, Elizabeth A Bukusi, Craig R Cohen, Elvin H Geng

Background: HIV treatment is life-long, but many patients in East Africa are engaged in livelihoods that require travel or migration. Understanding the timeliness and completeness of connection to care across facilities – through either official or unofficial "silent" transfers – is critical for understanding engagement. To date, however, analyses of retention are mostly from the perspective of clinics, and therefore the success of movement between sites is not well understood.

Methods: We evaluated outcomes among patients on antiretroviral therapy who ceased accessing care from a clinic on Mfangano Island, Kenya. We defined stopping care from the perspective of the clinic – either leaving with an official transfer to a nearby facility or missing a scheduled appointment by ≥90 days (i.e. leaving without an official transfer). We traced all patients to determine reason for non-return and conducted chart review at target facilities for those who transferred. We report cumulative incidence of return to care at any facility.
Results: Over two-years of follow-up, 15 patients made an official transfer and 89 left the clinic without making an official transfer. Among official transfers, 93% linked to their destination facility by 90 days (95%CI 74-100%). Among those without official transfers, 12% returned or linked to another facility by 90 days (95%CI 6-20%) and 57% by 180 days (95%CI 47-68%). By the end of follow-up, 77 (74%) had returned to care, 45% to another facility and 55% to the original clinic.

Conclusions: Patients who left with official transfers quickly and successfully linked to care at the new facility. Most patients who left without an official transfer eventually returned to care, either at the original clinic or another clinic. However, this process was slow, suggesting that treatment interruptions may have occurred. Increased efforts to coordinate transfers may reduce adverse patient outcomes during fragile transfer periods and improve overall clinical outcomes.