

Design and evaluation of a park prescription program for stress reduction and health promotion in low-income families: The Stay Healthy in Nature Everyday (SHINE) study protocol

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ABSTRACT

Background: Contact with nature improves human health; stress reduction is a mediating pathway. Stay Healthy in Nature Everyday (SHINE) is a stress reduction and health promotion intervention for low-income families at an urban Federally Qualified Health Center. We plan to evaluate two service-delivery models for SHINE and present here the intervention design and evaluation protocol.

Methods: Behavioral change theory and environmental education literature informed the intervention. Outcomes were selected after review of the literature and field tested procedures to determine what was feasible and ethical in a busy clinic serving vulnerable populations.

Design: We designed a randomized controlled trial to examine two levels of intensity in behavioral counseling about the health benefits of nature. Dyads consisting of a caregiver and a child aged 4 to 18 who access our pediatric primary care center are eligible. All dyads receive a pediatrician's recommendation to visit parks to experience nature and written resources (a "park prescription"). The intervention group receives added case management and an invitation to three group outings into nature with transportation, meals and activities provided. Primary outcomes measured at baseline, one month and three months post-enrollment are caregiver stress measured by PSS-10 score and salivary α -amylase; secondary outcomes are park prescriptions adherence, physical activity recorded by pedometer and journaling, loneliness, family cohesion and affinity to nature as measured by a validated scales. Both groups receive incentives to participation.

Discussion: Our intervention represents a feasible integration of recent research findings on the health benefits of nature and primary care practice.

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1. Introduction

Nature (defined here as "physical features and processes of nonhuman origin, including the 'living nature' of flora and fauna, together with still and running water, qualities of air and weather, and the landscapes" [1]) has the potential to be used for health promotion [2,3]. Nature has been associated with better health outcomes and less health inequity. In a population-based study of more than 40 million people in the United Kingdom, as an example, the incidence rate ratio for all-cause mortality in the lowest socioeconomic quartile compared to the highest socioeconomic quartile was 1.93 in the least green living

environment and 1.43 in the greenest. Similarly, the incidence rate ratio of heart disease was 2.19 in the least green living environments and 1.43 in the greenest [4].

Among the plausible mediating pathways between nature and improved health outcomes is stress reduction [1,4,5]. Nature improves recovery from stressful events acutely by eliciting parasympathetic responses, decreasing heart rate, muscle tension, skin conductance, blood pressure, inflammatory markers and increased self-reported mood [6,7]. Green environments may buffer the negative effects of stress on health [8], and the effect is higher for more stressed populations [5]. Caregivers of children living in poverty experience increased stress [9] and may benefit from nature. Moreover, exposure to nature seems to bolster children's resilience to adversity by promoting adult-child relationships and by enhancing cognitive functioning [10,11]. The association between nature and health in both children and adults may also be mediated by increased physical activity [12,13], improved

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attention and cognitive functioning [14,15] and increased social interactions [16,17].

Clinicians have been called upon to intervene and to develop community partnerships to minimize the impact of stress on poor health outcomes. Because parks provide the readiest access to nature for many individuals living in urban areas [18], we propose to refer patients to local nature using our clinic's partnerships with our local park district. We present the methodology of our proposed intervention and the design of the trial we will use to evaluate it.

2. Materials and methods

2.1. Setting

In 2012 our pediatric primary care clinic (PCC) partnered with our local park agency to design a park prescription program. Our PCC is a Federally Qualified Health Center (FQHC) that serves a linguistically, racially and culturally diverse group of pediatric patients living near the federal poverty level. This population has higher rates of chronic illness than the national pediatric population [19].

2.2. Intervention design

We hypothesize that just as sustained lifestyle changes for obesity prevention such as changes in diet require intense behavioral counseling [20], lifestyle changes related to nature will require supports for sustained change. Low-income populations of color and populations with special needs encounter multiple barriers to experiencing nature: lack of access [21], lack of leisure time, competing priorities, lack of familiarity, and discrimination faced in parks [22]. Alleviating a single barrier, such as waiving a park entry fee, has not lead to increased park visitation in underserved populations [23]. In contrast, across a diversity of respondents, memories of and a history of positive experiences in

nature, especially those with friends and family, are associated with park visits [24]. We therefore hypothesize that a physician recommendation to be in nature will be more effective if accompanied by supportive and culturally appropriate reinforcements for creating behavior change.

The Stay Healthy in Nature Everyday (SHINE) study examines two levels of intensity in behavioral counseling. One group of participants will receive a park prescription in the form of a physician recommendation with written resources. The other group will receive the same park prescription, plus assistance in planning park outings and invitations to three successive Saturday afternoon nature outings of four hour duration each with free transportation and meals provided. The research team, in collaboration with clinic providers, deemed it was unethical to include a study arm that received no intervention.

The SHINE intervention design has been guided by the Precaution Adoption Process Model (PAPM) described by Weinstein and Sandman [25], summarized as a logic model in Fig. 1. PAPM proposes healthy behavior change occurs in stages: not being aware, not being engaged, considering action, deciding whether to act or not to act, acting and maintaining the choice to act. An individual may progress or regress through the stages. The park prescription provided to both arms of the study is intended to bring awareness to participants of the health benefits and location of local nature (steps 1, 2). SHINE intervention activities are designed to encourage families to decide to participate (steps 3, 4, 5), act (step 6) and, through positive experiences in nature, maintain the behavior of park visitation (step 7).

2.3. Study objectives

- To evaluate the impact of a park prescription alone versus park prescription with extensive support on caregiver stress and other secondary health outcomes in caregivers and children at a pediatric PCC serving low-income patients.

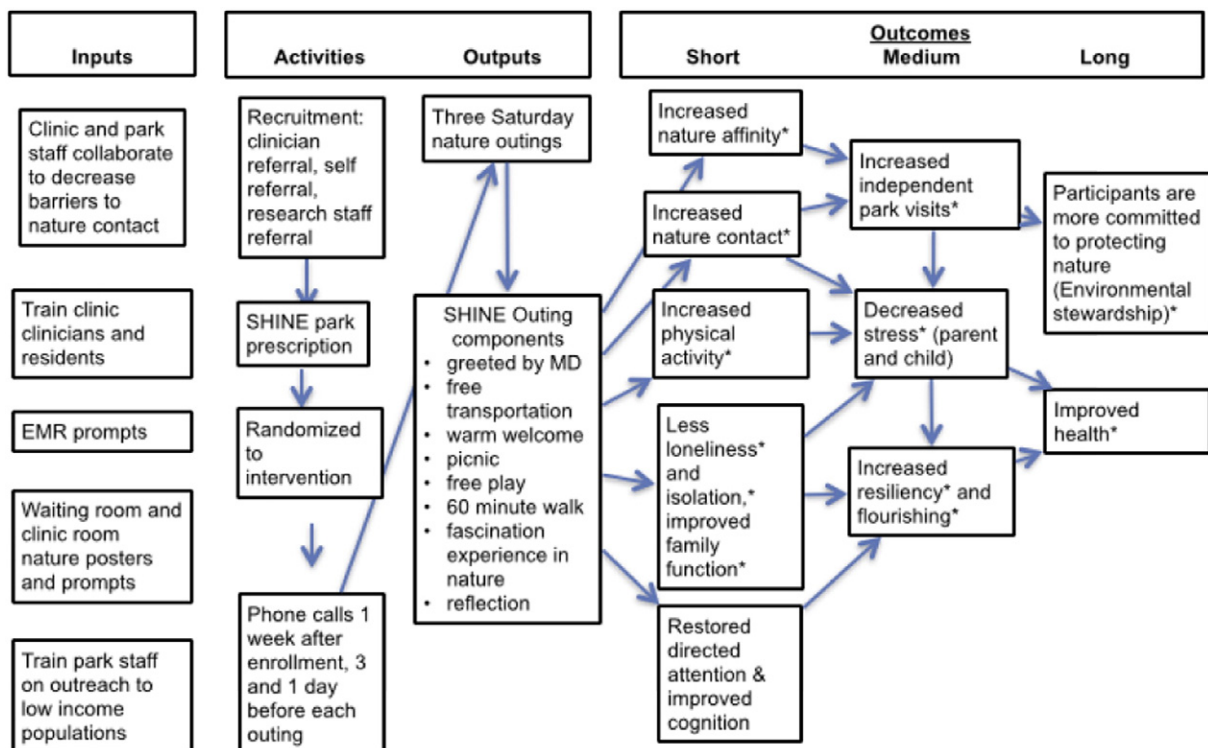


Fig. 1. Logic model for SHINE intervention's short, medium, and long term outcomes. Asterisk indicates measured outcome.

- To evaluate the feasibility of a park prescription in a low-income setting by examining prescription adherence.

2.4. Study hypotheses

Decrease in caregiver stress as measured by the PSS-10 and salivary α -amylase levels and in secondary outcomes at one and three months after the SHINE intervention will be greater in the intervention group receiving extensive support in addition to the park prescription. These outcomes will be measured in children, using instruments validated for the specific age group. (Table 2).

2.5. Study design

We propose to conduct a randomized controlled trial to evaluate the difference in change in stress level one month after enrollment and three months after enrollment between participants who receive a park prescription with extensive support versus those who receive a park prescription alone.

2.6. Study population

The target population is low-income families living in urban areas. The accessible populations are family dyads consisting of a caregiver and a child age 4 through 18 who is a patient at UBCHO PCC. Potential participants will be excluded if either member of the dyad is enrolled in a weight loss or exercise program, or if either family member is unable to walk or be otherwise physically active, attend the intervention park outings or complete two follow-up visits over three months.

2.7. Recruitment

Eligible dyads will be recruited by providers during patient visits or through self-referral. The principal investigator will train clinic physicians, nurse practitioners, social workers, case managers, and therapists by giving presentations at staff meetings on the health benefits of nature, the locations of local parks, and patient eligibility. The training is based on a curriculum previously developed by the research team [26]. Training consistency will be ensured by using the same presenting materials, and by having presenters review with the principal investigator. Large posters of local nature sites posted in the clinic waiting area and exam rooms and a prompt for health care providers will be integrated into participants' electronic medical records for use during well-child visits.

SHINE staff will determine eligibility and consent and obtain baseline measures. All participants will be given a \$20 gift card for completing the baseline survey, \$40 for completing the first post-program survey and \$40 for completing the final post-program survey. Upon enrollment, parents and children will each receive a SHINE pin and a pedometer to keep. Compensation will not depend on group assignment and participants may withdraw at any time.

Once baseline data are gathered, enrolled families receive a park prescription from the enrolling physician who will state, "We recommend that you are outside, in nature, three times a week, for at least one hour at a time, and here are some local parks where you can find nature." Four health benefits of nature listed on a postcard and a map with bus routes will be reviewed prior to patients receiving a journal and pedometer (Fig. 2 and Supplement Appendix A).

2.8. Assignment of interventions

Participants will then be randomized to one of two treatment groups using REDCap electronic data capture tools hosted at University of California, San Francisco (Research Electronic Data Capture Consortium, Bethesda, Maryland, USA) [27]. Randomization will be blocked (using random permuted blocks) to ensure that the groups are balanced with regard to child gender. Analysis of the data will be blinded to group assignment, but study subjects cannot be blinded.

Intervention-group dyads will receive an invitation to three successive Saturday afternoon nature outings, will be encouraged to bring family members, and will be asked to brainstorm potential barriers to outings into nature, such as transportation and work or family obligations, and to make a personalized plan for potential barriers.

On the appointed Saturdays, intervention-group participants and their families will meet the principal investigator and a research assistant at the clinic. A bus will transport patients to one of three local parks: a bayfront park with a beach, a lake with woodlands and a redwood forest. Each park is located within 15 min of the clinic by vehicle, is easily accessible by public transportation and is highlighted in the SHINE park prescription postcard.

Park activities based on Cornell's environmental education curriculum for urban children visiting nature [28] include: (1) a park staff's welcome including a set of lively games intended to serve as ice breakers and as a bridge to nature with exercises challenging participants to focus their attention through their senses of touch, hearing, and sight, (2) unstructured time and (3) a picnic. (4) The group will then have a brisk 60-minute walk. (5) Midway through the program, children will have an opportunity for a nature fascination experience such as: exploring tide pools, holding crabs, a small waterfall, fort building.



Fig. 2. Front and back of park prescriptions postcard for Stay Healthy in Nature Everyday (SHINE) participants.

(6) Outings conclude with quiet reflection and an opportunity to share experiences. Safety will be monitored by trained park volunteers.

2.9. Outcomes and measures

Outcomes were carefully selected after a review of literature encompassing medicine, psychology, landscape architecture, recreation and leisure sciences and environmental education (Fig. 1). In addition to health outcomes, we plan to measure affinity for nature because it is associated with increased desire to visit nature and future environmental stewardship, a long-term outcome of interest to park partners. A scale for childhood adversity was included as research shows that nature serves as a buffer in decreasing the negative impacts of major adverse events on pediatric stress and health [5]. To examine childhood adversity, we will use a modified version of the well-established and validated Adverse Childhood Experiences Study (ACE Study) questions, a scale shown to have a dose-response relationship with adverse health outcomes [29]. The National Survey of Child Health (NSCH), a national survey conducted by the Centers for Disease Control and Prevention (CDC), supplied the exact modified ACE questions, as well as measures of childhood resilience and family cohesion, neighborhood characteristics, general mental and physical health measures, and demographic measures. NSCH survey questions are formulated through a rigorous literature review, review by a National Technical Expert Panel; they have been field tested numerous times by the CDC; using these questions also allows our findings to be comparable to the NSCH national data [29].

Outcomes assessed via questionnaire for parents and children are detailed in Table 1 for adult outcomes and Table 2 for child outcomes, with measurement timing summarized on Table 3.

Measures were finalized after piloting with clinic patients; the caregiver questionnaire is 20 min in duration when self-administered, and the child questionnaire is 15 min in duration when administered by a research assistant. Spanish, Arabic and Amharic translation are available.

Non-questionnaire assessments are as follows:

- Physiological stress— α -amylase, a salivary biomarker for stress, will be measured because it is less susceptible to diurnal variation than salivary cortisol [39], and as such, spot measurements can be made. During the pilot phase, we determined that compliance was low when patients

were asked to bring salivary samples in from home, and, as a result, study staff will obtain the specimens during clinic visits. Salivate (Sarstedt, Rommelsdorf, Germany) collection devices will be used.

- Park prescription adherence—Research staff will measure attendance at prescribed park outings. Thereafter, parents will be asked to journal daily physical activity and daily park visits for themselves and their child for one month using the SHINE journal (Supplemental Figure).
- Physical Activity—Participants will monitor their pedometry in the week prior to their first outing, in the week prior to each follow up appointment. They will be asked to wear Accusplit Eagle 170 DigiWalker 2 pedometers (Accusplit, Inc., Livermore, California, USA) at all times except when sleeping, bathing, or swimming, as well as to complete a brief activity log for two weekdays and one weekend day per week. Baseline pedometer and activity log readings will be obtained by telephone one week after enrolment. DigiWalker pedometers are valid instruments for measuring activity [40].
- Body mass index (BMI)—BMI be measured in clinic at baseline, one month, and three months out by using weight and an average of three measurements of height.

2.10. Statistical methods

2.10.1. Sample size

The study is powered for our primary outcome, caregiver stress as measured by the 10-item perceived stress score (PSS10). Normative data from population samples show a mean PSS10 score of 13.2 points with a standard deviation on 6.35 points [30] and a within-subject correlation coefficient of 0.77 over two weeks. Surveys repeated in 2006 and 2009 show similar distributions of stress across the U.S. population [30,31]. Accounting for the within-subject correlation, the standard deviation of the change in PSS score is approximately 4.0 points. We powered the study to detect a three point difference in the change of the PSS10. This is 50% of the standard deviation in the PSS10 at baseline and 75% of the expected standard deviation in the change score. This effect size is consistent with other estimates of a clinically significant change [31]. We plan a 2:1 randomization ratio of intervention to control. With a type I error of 0.05, a power of 0.8 and a two-tailed statistical test [41], we require 60 parent-child dyads (40 for the intervention

Table 1

SHINE study outcomes as measured by parent questionnaire, scale used, and timing. Objective measures listed in the text.

Outcome	Scale	Description	Measured at month		
			0	1	3
Primary outcome in parents					
Stress	Perceived Stress Scale [30,31,32]	10-item validated scale used to measure stress self-report	X	X	X
Secondary outcomes in parents					
Short-term outcomes					
Park visits	Personal recall	One-week recall, number of park visits per day	X	X	X
Intermediate-term outcomes					
Physical activity	Personal recall	One-week recall, average minutes per day in moderate and vigorous physical activity	X	X	X
Loneliness	Three-item loneliness scale [33]	One-month recall, three validated items regarding social isolation, feeling left out and lacking companionship	X	X	X
Family cohesion	National Survey of Child Health (NSCH) 2011 [29]	Seven-item validated scale regarding family function and parenting stress.	X	X	X
Affinity for nature	Love and Care for Nature Scale for adults [34]	Fifteen-item validated scale used to measure emotional connection to nature; this scale has stronger correlations to environmental stewardship behavior than other widely used scales measuring connection to nature	X	X	X
Long-term outcomes					
General well-being	NSCH 2011 [29]	Two validated items for general and mental well-being	X	X	X
Moderators					
Demo-graphics	NSCH 2011 [29]	Parent level of education, race, ethnicity, born in US, language at home, household income	X		
Access to nature	NSCH 2011 [29]	Four validated items regarding neighborhood physical and social environment.	X		
	Self-report	Ten items assessing parental knowledge, access, comfort in nature, how much time spent in nature as a child	X		

Table 2
SHINE study outcomes as measured by child questionnaire, scale used, and timing.

Outcome	Scale	Description	Measured at month		
			0	1	3
Primary outcome in children					
Stress	Perceived Stress Scale questionnaire 8–11 [30]	19 items validated in children ages 8–11; nine items measure psychological stress and 10 items measure physiological stress	X	X	X
Secondary outcomes in children					
Short-term outcomes					
Resilience	Parental report via NSCH 2011 [29]	Seven items for children ages 4–5, three items for children 6–17	X	X	X
	Brief Resilience Scale [35,36].	Six items validated in adults, used here for children 6–17.	X	X	X
Park visits per week	Parental report	One-week recall for number of times a park was visited in the last week.	X	X	X
Intermediate-term outcomes					
Physical activity	Parental report based on NSCH 2011 questions [29]	One-week recall, self-report average number of days with at least 20 min vigorous exercise.	X	X	X
Affinity to nature	Connection to Nature Index [37]	16-item validated scale developed and tested for children aged 8–12.	X	X	X
Long-term outcomes					
Attention-deficit hyperactivity disorder (ADHD) severity (child)	Parental report: ADHD - CGI-P [38]	Validated 10-item scale for parents to rate the severity of children's ADHD symptoms.	X	X	X
Moderators - see parental measures with the addition of Baseline adversity	Parental report: NSCH 2011 [29]	Modified adversity score. Nine items created by a representative group of experts in the field.	X		

arm and 20 for the control arm). When counting parents and children, a total of 120 participants will be needed to complete the study. Based on previous research conducted at our clinical site, a 20% attrition rate is expected in both groups. As such, we plan to enroll 75 dyads (50 intervention, 25 control).

2.10.2. Analysis

The primary analysis will be an intention-to-treat analysis, followed by per-protocol and as-treated analyses. Our primary outcome (caregiver stress) is measured by a continuous repeated measure (PSS10). We will use mixed effects models to compare the two treatment conditions over three time points. If PSS10 levels decline more among parents in the SHINE intervention arm more than they do among parents in the control arm, we will infer a functional relationship between the SHINE intervention and declining caregiver stress.

We will also compare secondary outcomes among caregivers — park prescription adherence and physical activity, loneliness and affinity for nature (Table 1). The children will be compared with regard to park visits and change in physical activity, resilience, affinity for nature, BMI and ADHD severity (in those with ADHD) (Table 2). Because of the small sample size, the data on ADHD will be used for hypothesis

generation. The impact of potential effect modifiers such as baseline caregiver mental health on caregiver stress, and childhood adversity score on child stress will be examined by stratification.

2.11. Ethics and dissemination

Institutional Review Board (IRB) approval was obtained. Initial surveys and behavioral counseling will be conducted by a physician. In the cases where mandatory reporting protocols such as suspected child or spousal abuse arise, social workers or Child Protective Services will be involved as per PCC protocol. All caregivers or children noted to report high levels of loneliness, stress or family dysfunction will be referred to existing services at the PCC.

3. Discussion

Translational research about the clinical applications of visits to nature is lacking. The SHINE protocol is the first to coalesce varied disciplines into a replicable nature-based clinical intervention and evaluation. Research findings on the benefits of nature in stress relief,

Table 3
Example schedule showing enrollment, interventions and assessments for SHINE study intervention-group participants. Timeline is the same for children and adults. Some measures differ; those only obtained in children are asterisked.

Timepoint	Study period					
	Enrolment	Post-allocation				Close-out
	0	1 week	2 weeks	3 weeks	1 month	3 months
Enrollment						
Eligibility screen	X					
Informed consent	X					
Allocation	X					
Interventions						
Nature prescription by MD	X					
Baseline pedometry		X				
Case management phone call, reminder phone call		X	X	X		
Family nature outings		X	X	X		
Assessments						
Questionnaire	X				X	X
Child height and weight*	X				X	X
Saliva	X				X	X
Pedometry recordings		X			X	X

physical activity, and social cohesion, are translated into clinician screening and prescription, and measurement tools.

While others have looked at the application of parks for increasing physical activity, a review of the interdisciplinary research shows that nature's benefits may actually lie in stress reduction, cognitive benefits, and opportunities to be social, and that these benefits may resonate better than physical activity with patients [27]. Our work translates these outcomes into clinically relevant measures by using validated measures that are easily replicable, have been used in nationally comparable datasets, and are easily replicable in a clinical setting. Future research can further clarify the clinical implications of changes in these scales. Our study is powered to detect a 3 point effect size in the PSS10, a 40 point scale, a clinically significant change. Future work will help determine what the public health impact of such change means for an individual, and what the cumulative small changes in individual stress reduction could mean on a population level.

To our knowledge, this is also the first clinical survey instrument to include outcomes that span from psychological to biomedical to measures of nature affinity. As parks, health, and other disciplines come together to tackle complex public health challenges, future research should continue to explore how we can share measurements of impact. Other well recognized benefits of time in nature include improved cognition, improved empathy, and a variety of mental health improvements such as anxiety and depression.

This study is also intended to examine nature's role as a health intervention within the contexts of an imperfect and sometimes inequitable medical system. Our study design allows us to measure adherence with park prescriptions, to understand which patients benefit from a parks prescription, and which supports are needed to encourage outdoor time in nature for health. Because we are looking at two levels of behavioral counseling intensity, we will be able to examine how resource-intensive a park prescription program needs to be to work. This study was will not be able to compare a park prescription to a true placebo because the clinical providers felt it was not ethical to provide no intervention if a patient or family was screened for the presence of stress in their lives. Future research can navigate these ethical concerns by using a wait-list intervention control group. The impact of nature could also be assessed in isolation by providing the same indoor stress interventions to both groups, and including an outdoor component for one group only.

Study limitations include generalizability to other contexts, climates or populations. Using the gold standard for comparative trials, a randomized controlled trial, however, should account for weather, vacations and other potential confounders. The researchers predict that factors such as age, gender and medical conditions may moderate the benefit that program participants will receive. However, the study will likely have an insufficient sample size to conduct sub-group analyses. If an overall benefit to the target population is found, further study will be needed to determine which specific types of patients are most likely to benefit from the program. A threat to internal validity will be compliance and attrition. We will attempt to identify key predictors of attrition and test for differences between conditions.

Despite these limitations, this trial is an important first step in building an evidence-based path towards nature-based clinical interventions. The SHINE protocol is of use to clinics and parks looking for effective and feasible ways to engage patients in nature for of improved health.

4. Conclusions

Exposure to nature has been associated with better health outcomes and less health inequity. Among the plausible mediating pathways between nature and improved health outcomes is stress reduction. Clinicians have been called to develop community partnerships to minimize the impact of stress on poor health outcomes, but lack information on how basic science findings about nature's potential role may be relevant to clinical care.

This paper translates an interdisciplinary body of research about the health benefits of nature into two levels of clinical intervention. We detail the intervention design with the goal of establishing evidence-based behavioral counseling techniques aimed at increasing family time in nature. We then present the methodology of a randomized trial to evaluate the health impacts of the proposed health interventions. The primary outcome is parental stress, and other outcomes in parent and child are detailed. This work presents methodology and survey instruments that can be of use to public health departments and clinicians seeking partnership with parks departments.

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.cct.2016.09.007>.

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