

Addiction research centres and the nurturing of creativity: University of Michigan Addiction Research Center (UMARC) - development, evolution, and direction

Robert A. Zucker

University of Michigan, Department of Psychiatry, Addiction Research Center, Ann Arbor, MI, USA

ABSTRACT

A historical summary is provided of the evolution of the University of Michigan Addiction Research Center (UMARC) since its origins in 1988. Begun as a National Institutes of Health (NIH) research center within a Department of Psychiatry and focused solely upon alcohol and aging, early work emphasized treatment efficacy, differential outcome studies and characterization of the neurophysiological and behavioral manifestations of chronic alcoholism. Over the last 15 years, UMARC has extended its research focus along a number of dimensions: its developmental reach has been extended etiologically by studies of risk early in the life span, and by way of work on earlier screening and the development of early, brief treatment interventions. The addiction focus has expanded to include other drugs of abuse. Levels of analysis have also broadened, with work on the molecular genetics and brain neurophysiology underlying addictive processes, on one hand, and examination of the role of the social environment in long-term course of disorder on the other hand. Activities have been facilitated by several research training programs and by collaborative relationships with other universities around the United States and in Poland. Since 2002, a program for research infrastructure development and collaboration has been ongoing, initially with Poland and more recently with Ukraine, Latvia and Slovakia. A blueprint for the future includes expanded characterization of the neurobiology and genetics of addictive processes, the developmental environment, as well as programmatic work to address the public health implications of our ability to identify risk for disorder very early in life.

Keywords Addiction research, collaboration, international relationships, research training.

Correspondence to: Robert A. Zucker, University of Michigan, Department of Psychiatry, Addiction Research Center, 4250 Plymouth Road, Ann Arbor, MI 48109-2700, USA. E-mail: zuckerra@umich.edu

Submitted 21 July 2009; initial review completed 10 September 2009; final version accepted 24 November 2009

INTRODUCTION AND EVOLUTION OF THE CENTER

In the 1980s, under the impetus of Senator Claude Pepper of Rhode Island, the oldest member of the US Senate, the US National Institutes of Health (NIH) National Institute on Alcohol Abuse and Alcoholism (NIAAA) issued a call for applications for national research centers focused upon the interactions between alcohol use and aging. Under the leadership of Thomas Beresford, a psychiatrist with an interest in substance abuse and aging, Edith Lisansky Gomberg, a clinical psychologist and one of the earliest researchers in the field of geriatric substance abuse, and Frederic Blow, a younger colleague with training in human development and aging, a subgroup of the

University of Michigan Department of Psychiatry faculty submitted a proposal for a National Alcohol Research Center on Alcohol and Aging. In 1988, it was funded, and with that came the formal birth of the University of Michigan Alcohol (*sic*) Research Center (UMARC). Its director was the department chair, John Greden, and Beresford was Scientific Director, with major research components directed by faculty from both Psychiatry and Neurology. Research focused upon two themes: (i) how alcohol interacts with the aging process to produce behavioral and neurophysiological impairment across a variety of systems; and (ii) treatment issues with the aging and elderly focused upon earlier diagnosis and screening, impairments to treatment entry and development of new methods for brief intervention.

In its second 5 years of operation, research expanded to include a collaboration with the University's Transportation Research Institute (UMTRI) to examine the relationship of alcohol consumption to driving impairment. Research operations were, from the outset, interdisciplinary, both in training of investigators (psychiatry, psychology, neurophysiology, neurology) and in cross-department collaborations. Noteworthy output included the now widely used Geriatric Michigan Alcohol Screening Test (G-MAST) [1] and Beresford & Gomberg's volume: *Alcohol and Aging* [2]. Also noteworthy was the beginning research relationship of the Center to the Chelsea Arbor Treatment Center, an out-patient substance abuse treatment program operated as a joint venture by the University and the nearby Chelsea Community Hospital. Frederic Glaser was the original program director, followed by Kirk Brower in 1991. Brower, an addiction psychiatrist on the faculty, began systematically to change the clinic's culture to encompass both treatment and outcomes research. The clinic also began to serve as a patient resource for experimental studies. In 2006, the relationship with Chelsea Hospital ended and the program formally joined the Department of Psychiatry's Substance Abuse Section as its out-patient substance abuse treatment facility. It also became located physically in the same building as the center.

Beresford left Michigan in 1994 and Robert Zucker, the current director and a long-time alcohol researcher, was recruited to direct the Center's operations and also to direct the Substance Abuse Section, the overarching departmental administrative structure responsible for the conduct of substance abuse research, clinical services and education. Zucker, a psychologist, brought long-standing relationships to the alcohol research community, including early work at the Rutgers Center of Alcohol Studies. The Rutgers Center had begun its existence at Yale in the late 1930s under the direction of Howard Haggard, followed thereafter by E. M. Jellinek, then by Selden Bacon. At Yale, alcohol research had always been regarded as too applied, and largely irrelevant to the missions of a major research university. Continually lacking institutional support, Bacon, along with several of his Yale colleagues, moved the operation to the more welcoming environment of Rutgers University in 1962. Edith Gomberg, another Yale Center researcher, had moved to Michigan but continued her relationships to the Center when it moved to Rutgers. Zucker's early connections to the Michigan operation were through his relationship with Gomberg. His emphasis on a life-span perspective, as well as the longitudinal research studies he brought with him, expanded the Center's mission to a broader, developmentally focused agenda that included aging, but also focused upon earlier portions of the life span—even as far back as early childhood. The Center

also began to examine the etiology of abuse with drugs other than alcohol. This perspective was articulated in several publications of that period [3,4]. UMARC's research portfolio also expanded to include studies of the relationships of alcohol use to prescription drug use, some clinical pharmacotherapy trials were started under NIH and industry sponsorship, and small nodes of clinical outcomes research and studies on the genetics of risk for substance use disorder were initiated. Much of this work was summarized in a national meeting held at UMARC in 1996, and in an NIAAA monograph derived from that meeting [5].

UMARC's NIH Center funding ended in 1999. By that time a substantial group of other grants, an addiction psychiatry fellowship program developed and run by Kirk Brower and an NIAAA-funded post-doctoral training program sustained its operations; it has grown steadily in breadth and depth since then. Also in 1999, to reflect a broader substantive focus upon other drugs as well as alcohol, and to open the possibility for future work on other addictions, the Center underwent a name change and became the Addiction Research Center. These operations, with NIH funding from both NIAAA and the National Institute on Drug Abuse (NIDA), internal funding from the Department of Psychiatry for administrative operations and grants management and an expanding envelope of research programs, continue to the present.

MISSION

The Center's mission, as a unit within one of the major research universities in the United States, is the development of new knowledge about the causes, course and consequences of substance use disorders and the training of the next generation of researchers to continue this work [6]. Given this emphasis, a focus upon policy is not an institutional priority, although the still marginalized nature of the substance abuse field as well as the great public health costs of the problem provide a strong stimulus for individual faculty to become involved in policy issues. More about this below.

Although UMARC operates cohesively as a research center, as noted earlier, it is also structurally the research arm of a larger operation, the Department of Psychiatry's Substance Abuse Section, which includes a clinical operation (the University of Michigan Addiction Treatment Services), and an educational operation for training of medical students, psychiatric residents, addiction fellows, nursing students and social work interns. All operations are under the same administrative leadership, which insures integration across functions and facilitates initiation of new clinical research as well as patient recruitment for ongoing studies.

CORE OPERATIONS

The Center carries out biomedical and behavioral research that probes the neurophysiological underpinnings of substance abuse and the substance use disorders as well as the behavioral and contextual factors that contribute to development, maintenance and recovery. Ongoing research involves 24 different projects. Current Center faculty and staff (both research and administrative) number approximately 150; the majority of staff are located at Center headquarters on the University's East Medical Campus, but UMARC also has two project-specific offsite locations in other Michigan cities (East Lansing and Flint). The satellites were set up as the most effective way to implement field-based and clinical studies whose design required that they be carried out in locations at some distance from Ann Arbor. The satellite arrangement minimizes travel costs and allows us to hire local staff more easily to conduct the research.

Research is funded primarily by NIH grants from NIAAA and NIDA, and to a small degree by private foundations and internal university grants. The Department of Psychiatry sustains the infrastructure of the Center as a vital part of the Section's operations. This includes provision of space and an administrative and grants management staff. To give some sense of the size of the footprint, substance abuse funding managed by UMARC of almost 9 million dollars annually is 45% of the Department's total federal research budget.

There are currently 15 faculty on permanent staff (Kirk Brower, Yu-Pey Anne Buu, Theadia Carey, Stephen Chermack, Deirdre Conroy, James Cranford, Jennifer Glass, Ilana Hairston, Mary Heitzeg, Brian Hicks, Jennifer Jester, Leon Puttler, Elizabeth Robinson, Maureen Walton and the author), of whom three are tenure track faculty, two are clinical track and the remaining 10 are research track faculty. The large majority have full-time activity in grant-supported research; those with academic or clinical track appointments that require teaching or clinical involvement are able to forgo those assignments by buying out this effort. Two of the faculty are addiction psychiatrists (Brower, Carey); the others are psychologists with subspecializations in clinical, cognitive, cognitive neuroscience, developmental and social, a statistician who contributes scholarly work as well as statistical support and a faculty member with a background in both social work and psychology. Earlier in its history, sociologists and behavior geneticists have been part of the group, and undoubtedly will be again at some point.

The Center also has eight affiliate, faculty, primarily Psychiatry Department colleagues who have had long-term, collaborative relationships with the unit (Roseanne Armitage, J. Todd Arnedt, Fred Blow, Kristen Barry, Margit Burmeister, Rebecca Cunningham, Mark Ilgen,

Jon-Kar Zubieta), but their careers either never did, or do not currently have substance abuse as a primary focus. Two were former core staff (Blow) or post-doctoral fellows (Cunningham), all have research support from NIDA and/or NIAAA, and half administer their substance abuse research programs through the Center. UMARC also sustains an extended network of collaborators across the university and around the country, whose involvement varies from project to project. Current collaborations within the university involve researchers from the Departments of Emergency Medicine, Human Genetics, Nuclear Medicine, Neurology and Surgery in the Medical School, from Psychology and Statistics in the College of Literature, Science and the Arts, from the Schools of Social Work, Nursing and Public Health and the Molecular and Behavioral Neuroscience Institute (MBNI), the Institute for Social Research (Survey Research Center and Research Center for Group Dynamics), UMTRI and the Institute for Research on Women and Gender. An extensive network of collaborations (currently numbering 14) also exists with colleagues at other universities around the United States and in eastern Europe.

UMARC carries out research in six thematic areas, although it has become increasingly common for work in one area to connect to another. Themes are: (i) developmental psychopathology and genetics [7–12]; (ii) brain function and the neurophysiology of addiction (this relatively new program of research is carried out in collaboration with investigators from MBNI and from the university's Functional MRI Laboratory) [13,14]; (iii) treatment [15–17]; (iv) health services research [18–22]; (v) prevention and early intervention [23–26]; and (f) sleep disturbance (pharmacotherapy, mechanisms and relationship to substance use disorders) [27–29].

THE CORE ROLE OF EDUCATIONAL ACTIVITY IN SUSTAINING AND EXTENDING RESEARCH OPERATIONS AND RESEARCH INFRASTRUCTURE

Several research training activities over the years have been important stimuli to Center research. In 1990, Center leadership obtained a post-doctoral research training grant from NIAAA, and the continuity of that program has allowed a steady stream of creative and productive young substance abuse researchers to join the staff and facilitate ongoing work. For many years the program supported only post-doctoral training: post-residency physicians (primarily psychiatrists, but including surgeons and emergency medicine physicians on occasion) and fellows from a broad range of specialties in the behavioral and biomedical sciences. In 2002, two pre-doctoral positions were added. Although the program is nominally for 2 years, given the time necessary to gear up

for a new program of research and launch it, it has not been uncommon for trainees to remain for 3 years. Until now, the program has trained eight physicians, 22 post-doctoral fellows and supported three pre-doctoral students; six other trainees are currently in process. Program graduates have been quite successful in obtaining federal funding of their own to continue substance abuse research. In addition, more than 75% have gone on to research and/or academic careers at other universities and institutes. Equally important, about a third have gone on to research faculty positions within the Center or in affiliated university departments and institutes.

There are several aspects of the program's operation that have insured its success and also made it one of the centerpieces of our infrastructure. One is the policy to only admit trainees whose research interests map onto current work, either of Center faculty or of other collaborating colleagues who would be the primary mentor. This insures that candidate and mentor are ready to engage rapidly, even at the start of the program, and build incrementally thereafter. Secondly, the collaborator mentorships serve to strengthen the ties of affiliate programs and faculty with the Center in ways that would not take place when collegial interactions are more casual and not content-focused. These collaborations have involved research in behavioral pharmacology, statistics, developmental epidemiology, personality psychology, etc. Thirdly, the grant-funded trainee activity serves as a subsidy to the ongoing work, as it provides a post (pre)-doctoral researcher on the project at no additional cost to the research. This has been experienced uniformly as a 'stimulus package' by the program where the trainee is placed.

A second key training activity involves undergraduates who participate in a Psychology Department-listed research practicum which engages them in entry-level research assistant activity in ongoing projects. The program runs year-round and serves as an effective identifier for post-graduation, permanent research assistant positions. Equally importantly, it provides exposure to the realities of empirical (primarily psychosocial) research, and to the seriousness of substance abuse as a public health problem. Although not all participants go on to substance abuse research careers, the program has served a public education function to hundreds of individuals who go on to careers in medicine, public health, law and other helping professions. Because of the caliber of the student body, many of these can be expected to go on to leadership positions in their fields.

INTERNATIONAL OUTREACH

In a serendipitous parallel to the Center's experience with these domestic training programs, in 2000 a Psychiatry

Department colleague and native of Poland approached the director about the possibility of taking part in a new NIH Fogarty International Center initiative to develop research infrastructure in middle- and lower-income countries. One component of that program, co-funded by NIDA, was for the development of infrastructure for substance abuse research. With our colleague's help, we were able to compete successfully for one of those grants, and began a 5-year program in collaboration with the Institute of Psychiatry and Neurology (IPN) in Warsaw. The program co-director was a clinical psychologist, Czeslaw Czabala, who was Deputy Director of IPN and department head of one of its operating departments. Other early relationships were with Boguslaw Habrat, a leading addiction psychiatrist and Marcin Wojnar, a younger addiction psychiatrist who was already a nationally visible substance abuse researcher.

A three-tiered program was put into place to increase research skills among biomedical and behavioral scientists. The first tier brings fellows to Ann Arbor for a year of mentored research training, followed by a second year of program-supported pilot research at the fellow's home institution. The second tier involves a series of shorter-term fellowships for mid-career and senior scientists to spend 2–3 months in the United States for focused training, protected writing time and the development of collaborative relationships with American colleagues. The third tier, a yearly workshop series held in different cities throughout Poland, is open to all levels of substance abuse scientists, from graduate students to more advanced and senior researchers. The curriculum involves short-term research training on specialized research issues, as well as sessions where attendees present their ongoing work. The intent for all these activities is the development and extension of research programs for evaluation of existing treatment and prevention programming, conduct of new clinical trials in these areas, conduct of more basic research on etiology and clinical course and development of increased educational programming to sustain the learning that is initiated by training program exposure. A secondary goal, already accomplished successfully, was to foster research collaborations between program graduates and US scientists.

In its first 5 years, the collaboration involved only the United States and Poland. In 2006 it was extended to include collaborations with the Institute and Centre for Treatment of Drug Dependencies, Bratislava, Slovak Republic, the Department of Psychiatry and Narcology, Riga Stradins University in Riga, Latvia, the Clinical and Social Narcology Department, Ukrainian Scientific Research Institute of Social, Forensic Psychiatry and Narcology, Kiev and the Department for Prevention and Treatment of Drug Addictions, Institute of Neurology,

Psychiatry and Narcology of the Academy of Medical Sciences of the Ukraine in Kharkov.

The program has already had substantial impact. Meetings have been held in five cities in Poland and, with the advent of the new program, multi-national meetings have been held in Slovakia and the Ukraine. A number of trainees have spent a year in the United States; several have already received external funding to extend projects begun during their fellowships, with support coming from the NIH, from the European Union and from agencies of the Polish government. Joint research projects have also been initiated with several UMARC faculty. More than 200 scientists and scientist-clinicians at different levels of training have attended the yearly workshops. A new curriculum on addiction medicine has been introduced at the Medical University of Warsaw, which exposes all medical students to substance abuse clinical and basic research content. In addition, a new multidisciplinary Polish Society for Research on Addictions (PSRA) [Polskie Towarzystwo Badań nad Uzależnieniami (PTBU)] was chartered formally, had its first meeting in Warsaw in 2007, and now has a membership of approximately 100.

Dr Blow's experience with this program also served as a template for another NIH/Fogarty Center/NIAAA initiative. Starting in 2007, he and his colleagues began a parallel program in Poland, the goal of which was the development of new training capability and research collaboration with emergency medicine and public health academic departments in medical schools and teaching hospitals in order to increase alcohol and injury research capacity across the country.

Finally, in the fall of 2009, as part of the same long-term program, UMARC hosted the directors of the Polish State Agency for the Prevention of Alcohol-Related Problems (PARPA) and the Polish National Bureau for Drug Prevention. UMARC faculty were able to serve as a conduit for meetings and for the establishment of collaborations between these programs and their sister agencies in the United States [NIDA, NIAAA, and the Substance Abuse and Mental Health Services Administration (SAMHSA)] as well as with other leading research universities here. These relationships have continued to develop thereafter.

DAY-TO-DAY OPERATIONS

As befits a research institution where the majority of staff are supported on grants, primary activities are writing, supervision of research staff, communicating one's work both internally and externally, writing grant applications, responding to requests from outside agencies, mentoring and gaining new knowledge. Faculty and senior research staff attend national and international addiction society

meetings regularly and senior members have also taken part in their governance structures, including having held office. As noted earlier, although policy-related work is not a Center focus, a number of faculty have been active in programs to raise public as well as legislator awareness about issues of problem use. These have included advocacy about the need for early identification of risk, the problem of unidentified problem drinking in the elderly and the use of performance-enhancing drugs in competitive sports, to name but a few. Center staff participate routinely in Federal grant review, advisory panels and editorial boards of addiction journals. Publication output numbers around 40 refereed journal articles a year. As is true of all university settings, publication is at the scientist's discretion, without control except to the extent that high output in first-rank addiction journals and in high-visibility discipline journals is a necessary factor in promotion. Surrounding all this is an ongoing program of scientific exchange and education, and an attentive and high-performing administrative staff.

Center programming includes a monthly faculty meeting/seminar series that brings in outside speakers as well as in-house faculty who utilize the meeting to update colleagues on their research. Seminar attendance is also open to others outside the Center and is advertised broadly. Lunch is provided so attendance and energy levels are high. The Center also runs a widely advertised, day-long endowed lectureship/research/evidence-based practice update program, the MacDonell Lectureship, which regular draws more than 100 attendees.

A conscious effort is made to sustain a non-hierarchical administrative structure and an attitude of respect for the individual at all levels of the organization. There are features of the Center that are reminiscent of a family, with people of all ages, from undergraduates to senior staff, walking the hallways. Food is sometimes provided by discretionary funds, but it is also common for staff to bring in some treat spontaneously and share it in the Center's common space. For the last 13 years, UMARC has also sponsored its own community softball team that has twice won the divisional championship! Humor is common in dialogue, and staff commonly describe the operation to applicants for new positions as 'a great place to work'. Given that dissatisfaction with job and work-setting is often expressed by 'voting with one's feet', it is noteworthy that median length of employment of Center faculty is 13 years.

In reflecting on what aspects of the environment might be nurturing of that ephemeral characteristic known as creativity, a number of subtext principles are very much a part of the Center's culture: (i) insure that a substantial number of colleagues are young, and also were not trained in-house—they bring in new ideas and methodologies; (ii) make sure the collegial environment is

multi-disciplinary; (iii) insure that the operation has extensive ties to researchers outside the unit, and that collaboration is easy, without institutional boundaries; (iv) operate in a larger research environment that is productive and creative in its own right; the atmosphere will stimulate work, and snippets of ideas will rub off, even without one knowing it is happening; (v) provide an infrastructure that insures longer-term job security even in times of lost funding—the Center has created such a mechanism, called the Rainy Day Fund, which has tided over staff for as long as a year when they have lost their external funding; (vi) provide an infrastructure that has relatively easy access to modest amounts of internal funds to investigate new ideas without the large effort, formal hassle and delay of external peer review—here, too, with Departmental leadership help, UMARC has been able to create a Development Fund that can support new pilot work on very short notice and with minimal paperwork; and (vii) provide an infrastructure of humor and relational informality and make food available often.

BAD DAYS AND CHALLENGES

Within a largely supportive and nurturing organization some challenges, typically structural, are impossible to avoid. Most problems are, in one way or another, linked to the ‘soft money’ funding structure of the unit, which means that without relatively frequent application funding will dry up. Because even the best of investigators are rarely successful on their first try, for more of the year than not one group or another at the Center is in ‘grant submission mode’. This creates a high level of work intensity for both scientific and administrative staff, long work hours at nights and weekends, and a time pressure that is relentlessly present.

Although the unit has been growing slowly, even in a time of shrinking resources, sometimes continuity of funding cannot be sustained or a project simply ends. Although Rainy Day funds are available, this cushion is not available for everyone. The challenge then becomes one of placing staff about to be terminated into new positions. Because of the large research operation and the close communication across investigator groups, staff often can be hired by another project, either within the Center or within the Department. This is not always possible, however, and investigators must deal with the always painful outcome of lay-offs.

A problem far more desirable than staff termination, but still a challenge, is the one of finding new space as research funding grows. The ready solution of leasing off-site space solves the problem nominally, but it creates others that involve lack of staff contact and lack of structural cohesiveness.

LOOKING FORWARD: CHALLENGES AND OPPORTUNITIES

UMARC’s growth since its founding, in size, in scope of science and in geographical impact, has been relatively steady despite some bumps in the road. Grant activity is more than double what it was a decade ago. The operation has also become allied more closely with the neuroscience and molecular genetics agenda of the University and the NIH. At the same time, it has not sacrificed its continuing work on characterization of social environment, clinical course and the discovery of new brief interventions and treatments for people with addictive problems. It has also extended its reach to Central and eastern Europe, with a program of collaboration that is likely to continue to increase its scope over time.

Although existing programs are strong and are likely to continue with vigor, logical next steps for work are in four areas: (i) expansion of the Center’s genetics collaborations to allow more intense exploration of genetic influences on etiology, course and treatment of substance abuse and comorbid disorders—given our existing strengths, there should be a special focus on characterization of gene–environment interactions; (ii) a dedicated focus should be initiated on the manner in which psychiatric comorbidity changes course, and possibly also changes the core nature of the disorder; (iii) given what is increasingly known about the detectability of risk for addictive problems very early in life, as well as the magnitude of the substance abuse problem in the population, a logical next-step activity is to address programmatically the public health implications of these discoveries—in the development of new screening techniques, in the development of decision trees about where and when it is most appropriate to identify and intervene, and in the development of new interventions for prevention and early intervention; (iv) a new challenge, undoubtedly difficult but important to initiate, will be to understand how obesity is similar to, and also differs from, substance use disorder. In American society, the two are problems of epidemic proportion and share some apparent mechanistic similarities. Parsing the differences as well as similarities between them is likely to lead to insights about each that are not currently known.

Declarations of interest

None.

Acknowledgements

Thanks and deep appreciation to my colleagues at UMARC for making it such an enlivening environment within which to learn and to work. Special thanks to Kirk

Brower for his review and Shauncie Skidmore for her help in the preparation of this report. Preparation of this report, and the activities documented within it was facilitated by support from the National Institute on Alcohol Abuse and Alcoholism Training Grant T32 AA07477, and from the NIH Fogarty International Center and the National Institute on Drug Abuse Training Grant D43 TW05818.

References

- Blow F., Brower K., Schulenberg J., Demo-Dananberg L., Young J., Beresford T. The Michigan Alcoholism Screening Test—Geriatric Version (MAST-G): a new elderly-specific screening instrument. *Alcohol Clin Exp Res* 1992; 16: 372.
- Beresford T., Gomberg E. *Alcohol and Aging*. New York: Oxford University Press; 1995.
- Zucker R. A. Developmental aspects of aging, alcohol involvement, and their interrelationship. In: Gomberg E. S. L., Hegedus A. M., Zucker R. A., editors. *Alcohol Problems and Aging* (NIAAA Research Monograph no. 33). Rockville, MD: US Department of Health and Human Services; 1998, p. 3–26.
- Zucker R. A. Alcohol involvement over the life course. In: National Institute on Alcohol Abuse and Alcoholism, editor. *Tenth Special Report to the U.S. Congress on Alcohol and Health: Highlights from Current Research*. Bethesda, MD: US Department of Health and Human Services; 2000, p. 28–53.
- Gomberg E. L., Hegedus A. M., Zucker R. A. *Alcohol Problems and Aging* (NIAAA Research Monograph no. 33. NIH Pub. no. 98-4163). Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism (NIAAA); 1998.
- University of Michigan, Department of Psychiatry. Substance Abuse Section, Addiction Research Center website. Available from: <http://www.med.umich.edu/psych/sub/research.htm> (accessed 12 January 2010).
- Jester J. M., Nigg J. T., Buu A., Puttler L. I., Glass J. M., Heitzeg M. M. *et al.* Trajectories of childhood aggression and inattention/hyperactivity: differential effects on substance abuse in adolescence. *J Am Acad Child Adolesc Psychiatry* 2008; 47: 158–1165.
- Nigg J. T., Wong M. M., Martel M. M., Jester J. M., Puttler L. I., Glass J. M. *et al.* Poor response inhibition as predictor of problem drinking and illicit drug use in adolescents at risk for alcoholism and other substance use disorders. *J Am Acad Child Adolesc Psychiatry* 2006; 45: 468–75.
- Nigg J., Nikolas M., Friderici K., Park L. Y., Zucker R. A. Genotype and neuropsychological response inhibition as resilience promoters for ADHD, ODD, and CD under conditions of psychosocial adversity. *Dev Psychopathol* 2007; 19: 767–86.
- Hill E. M., Stoltenberg S. F., Bullard K. H., Li S., Zucker R. A., Burmeister M. Antisocial alcoholism and serotonin-related polymorphisms: association tests. *Psychiatr Genet* 2002; 12: 143–53.
- Buu A., Mansour M., Wang J., Refior S. K., Fitzgerald H. E., Zucker R. A. Alcoholism effects on social migration and neighborhood effects on alcoholism over the course of 12 years. *Alcohol Clin Exp Res* 2007; 31: 1545–51.
- Zucker R. A. Alcohol use and the alcohol use disorders: a developmental–biopsychosocial systems formulation covering the life course. In: Cicchetti D., Cohen D. J., editors. *Developmental Psychopathology: vol. 3. Risk, Disorder and Adaptation*, 2nd edn. New Jersey: John Wiley & Sons, Inc.; 2006, p. 620–56.
- Heitzeg M. M., Nigg J. T., Yau W., Zubieta J. K., Zucker R. A. Affective circuitry and risk for alcoholism in late adolescence: differences in frontostriatal responses between vulnerable and resilient children of alcoholic parents. *Alcohol Clin Exp Res* 2008; 32: 414–26.
- Heitzeg M. M., Nigg J. T., Yau W.-Y., Zucker R. A., Zubieta J. K. Striatal dysfunction marks preexisting risk and medial prefrontal dysfunction is related to problem drinking in children of alcoholics. *Biol Psychiatry* 2010; in press.
- Wojnar M., Brower K. J., Strobbe S., Ilgen M., Matsumoto H., Nowosad I. *et al.* Association between Val66Met brain-derived neurotrophic factor (BDNF) gene polymorphism and post-treatment relapse in alcohol dependence. *Alcohol Clin Exp Res* 2009; 33: 693–702.
- Brower K. J., Kim H. M., Strobbe S., Karam-Hage M. A., Consens E., Zucker R. A. A randomized double-blind pilot trial of gabapentin vs. placebo to treat alcohol dependence and comorbid insomnia. *Alcohol Clin Exp Res* 2008; 32: 1429–38.
- Robinson E. A. R., Cranford J. A., Webb J. R., Brower K. J. Six-month changes in spirituality, religiosity, and heavy drinking in a treatment-seeking sample. *J Stud Alcohol Drugs* 2007; 68: 282–90.
- Brower K. J., Carey T. L. Racially related health disparities and alcoholism treatment outcomes. *Alcohol Clin Exp Res* 2003; 27: 1365–7.
- Walton M. A., Cunningham R., Chermack S. T., Weber J. E., Maio R. F., Tripathi S. *et al.* Predictors of violence following emergency department visit for cocaine-related chest pain. *Drug Alcohol Depend* 2009; 99: 79–88.
- Resko S. M., Walton M. A., Chermack S. T., Zimmerman M. A., Bingham C. R., Shope J. T. *et al.* Alcohol availability and violence among inner-city adolescents: a multi-level analysis of the role of alcohol outlet density. *Am J Commun Psychol* 2010; in press.
- Ilgen M. A., Chermack S. T., Murray R., Walton M. A., Barry K. L., Wojnar M. *et al.* The association between partner and non-partner aggression and suicidal ideation in patients seeking substance use disorder treatment. *Addict Behav* 2009; 34: 180–6.
- Walton M. A., Goldstein A. L., Chermack S. T., McCammon R., Cunningham R. M., Barry K. L. *et al.* Brief alcohol intervention in the emergency department: moderators of effectiveness. *J Stud Alcohol Drugs* 2008; 69: 550–60.
- Flynn H. A., Walton M. A., Chermack S. T., Cunningham R. M., Marcus S. M. Brief detection and co-occurrence of violence, depression and alcohol risk in prenatal care settings. *Arch Women Ment Health* 2007; 10: 155–61.
- Kumpfer K. L., Olds D. L., Alexander J. F., Zucker R. A., Gary L. E. Family etiology of youth problems. In: Ashery S., Robertson E. B., Kumpfer K. L., editors. *Drug Abuse Prevention Through Family Intervention* (NIDA Research Monograph no. 176). Rockville, MD: US Department of Health and Human Services; 1998, p. 42–77.
- Ehrlich P. F., Maio R., Drongowski R., Wagaman M., Cunningham R., Walton M. A. Alcohol interventions for trauma patients are not just for adults. Justification for brief interventions for the injured adolescent at a pediatric trauma center. *J Trauma Injury Infect Crit Care* 2010; in press.

26. Zucker R. A., Donovan J. E., Masten A. S., Mattson M. E., Moss H. Early developmental processes and the continuity of risk for underage drinking and problem drinking. *Pediatrics* 2008; **121**: S252–72.
27. Brower K. J., Aldrich M. S., Hall J. Polysomnographic and subjective sleep predictors of alcoholic relapse. *Alcohol Clin Exp Res* 1998; **22**: 1864–71.
28. Brower K. J., Aldrich M. S., Robinson E. A. R., Zucker R. A., Greden J. F. Insomnia, self-medication, and relapse to alcoholism. *Am J Psychiatry* 2001; **158**: 399–404.
29. Wong M. M., Brower K. J., Fitzgerald H. E., Zucker R. A. Sleep problems in early childhood and early onset of alcohol and other drug use in adolescence. *Alcohol Clin Exp Res* 2004; **4**: 578–87.