

FINDING WORKERS, OFFENDERS, OR STUDENTS MOST AT-RISK FOR VIOLENCE: ACTUARIAL TESTS SAVE LIVES AND RESOURCES^{1,2}

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Summary.—147 adults (107 men, 40 women) and 89 adolescents (61 boys, 28 girls), selected randomly from referrals and volunteers, were given the Ammons Quick Test (QT), the Beck Suicide Scale (BSS), the Minnesota Multiphasic Personality Inventory Second (MMPI-2) or Adolescent Versions (MMPI-A), the Raven's

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Advanced Progressive Matrices, and the Standard Predictor (SP) of Violence Potential Adult or Adolescent Versions. The goals were to: (a) demonstrate computer and paper-and-pencil tests correlated; (b) validate tests to identify at-risk for violence; (c) show that identifying at-risk saves lives and resources; and (d) find which industries benefited from testing at-risk. Paper-and-pencil vs. computer test correlations (.83-.99), sensitivity (.97-.98), and specificity (.50-.97) were computed. Testing at-risk saves lives and resources. Critical industries for testing at-risk individuals may include airlines, energy generating industries, insurance, military, nonprofit-religious, prisoners, trucking or port workers, and veterans.

Globally, violence is a costly challenge for society. Over the last century in the United States (U.S.) and in the European Union (E.U.), homicides jumped from 1 to 6 per 100,000. Within the U.S. in 2012, there were 12,000 homicides and 17,000 suicides; there are twice that many in the E.U., due to its larger population. Among U.S. youth, the murder rate is even higher at 7.5 per 100,000 (Hellmich, 2013). Victimization by homicide and suicide is rampant. Homicide is one of the three leading causes of death among adolescents. Each day, one soldier and 22 veterans commit suicide (Basi, 2013; Zaroya, 2013). Every 17 hours, a public safety officer commits suicide (Fields & Jones, 1999; Cowan, 2008). It is statistically more dangerous in some U.S. cities than the Afghanistan or Iraq battlefields. In fact, more U.S. individuals have died from homicide than U.S. soldiers have died on battlefields since the Revolutionary War (Zagar, Busch, Grove, & Hughes, 2009a). Yearly in the U.S., for two decades, there are approximately 600 workplace homicides, and 12 to 24 murders on university campuses (Zagar, Zagar, Bartikowski, Busch, & Stark, 2009). These figures only include killings on site, at the workplace or on the campus; more homicides occur nearby, in transit to or from work or campus. This doubles or triples these officially reported rates (Bowen, Bowen, & Reichman, 1998; Sampson, Rauden, & Earls, 1997). Despite more stringent gun control laws in Europe relative to the U.S., 2012 E.U. homicides are just as prevalent (6.2 vs. 4.7 per 100,000) and are decreasing slightly in frequency in both the European and U.S. cultures (1992, U.S. vs. E.U., 9.3 vs. 7.0 per 100,000; 2002, 5.6 vs. 6.5 per 100,000; 2012, 4.7 vs. 6.2 per 100,000).

The 26 children killed at the Sandy Hook Elementary School in Connecticut during the fall of 2012 remind us of the tragic consequences of murder. Such senseless events occur because the most at-risk individuals are often not diagnosed, treated, or monitored. Often these at-risk persons land up in jail and some have psychiatric disorders (Torrey, 2013). During the 1950s through the 1970s, the availability of psychotropic medication, the community mental health movement, and the moving of funding for mental illness to federal sources (1965 amendments to Social Security) resulted in the release of large numbers of mentally ill from psychiatric institutions (Stroman, 2003). In 1955, there were 370 psychiatric hospital beds for every

100,000. Recently in 2005, that number diminished to 17 per 100,000. Researchers have noted that jails have become the institutions for the mentally ill (MacDonald, 1999; Domino, Norton, Morrissey, & Thakur, 2004). On 29 September 2013, in a *Sixty Minutes* broadcast, the Cook County Sheriff asserted that 2,500 mentally ill were housed in the adult jail, arguably the largest asylum in the U.S. There is a naïve notion that family members or social workers could comprehensively care and monitor the mentally ill.

The Four Goals of This Study

The first question of this study is whether computer and paper-and-pencil tests are equivalent. This is important because computer tests are brief, inexpensive and easy to use. The second purpose of this study is how to identify individuals for risk of violence, physical abuse, mental illness, substance abuse, and other risks. Next, the goal is to use the available data to show that identifying those at-risk saves lives and resources. The final goal is to determine which industries might benefit from computer testing.

Monetary Costs of Violent Crime

Placing a monetary value on suffering from violent crime is impersonal. However, without an objective measure, it is difficult to assess and evaluate the costs of violence. Expenses related to criminal victimization are derived from the National Crime Victimization Survey. In this survey, people over 12 years of age are polled regarding their personal experiences of rape, robbery, theft, burglary, and/or motor vehicle theft. Estimates of the costs and the consequences of the victimization are extrapolated from the Uniform Crime Reports, the National Crime Victimization Survey, and the National Incidence and Prevalence Survey of Child Abuse and Neglect (Sedlak, 1991).

Generally, costs to victims comprise out-of-pocket expenses for medical bills, property loss, reduced productivity at work, home, and school, and non-monetary losses (fear, pain, suffering, and lost quality of life). Of course, the intangible loss of quality of life is often much greater than the tangible or out-of-pocket expenses. Intangible losses are assigned by jury award and are not predictable. Economists place monetary values on intangible losses in the following categories: productivity; medical care and ambulance; police and fire services; mental health care; social victim service; and property loss and damage (Miller, Cohen, & Wiersema, 1996). For example, the average pedophilia crime costs \$120,681 in 2012 U.S. dollars. On average, a robbery costs \$9,752. A fatal crime with assault costs \$3,239,964. These expenses do not include punitive damages, but only the portion of awards meant to compensate the victim's pain, suffering, and lost quality of life. These examples demonstrate how experts quantify

costs of violence. With such figures, one can more fully understand incidents like the Sandy Hook Elementary School murders in Connecticut. The aggregate cost for the 26 murdered children, their families, and the community is just over \$2 billion in 2012 U.S. dollars.

Non-profit and religious organizations have paid over \$6.5 billion U.S. dollars (Paulson, 2002) in compensation for child abuse over the past two decades. Recently, Penn State University paid out \$59.7M to 26 victims for pedophilia, an average award of \$1.6M to each victim, which exceeds the highest payout to Roman Catholic Church clergy victims who received \$800K (Bacon, 2013). Physical abuse, substance abuse, and violence have resulted in an estimated \$110 billion to \$250 billion in yearly losses, including living expenses, direct and indirect costs of victimization, and criminal justice system expenditures. In the E.U., the costs are approximately double these figures (Zagar, Zagar, Bartikowski, & Busch, 2009; Zagar, Busch, Grove, & Hughes, 2009a, 2009b, 2009c; Federal Bureau of Investigation, 2012; Miller, 2012; United Nations Office of Drugs and Crime, 2012).

Predicting Violent Behavior

There are multiple methods to identify those with tendencies toward violence and abuse. One can develop a predictive regression equation or use actuarial statistical tests. For the first method, one uses information such as demographics, life history, academic records, and standardized tests to create a valid predictive regression equation with static, unchanging descriptors as the predictors. Since this option was already discussed in Zagar, Kovach, Basile, Grove, Busch, and Hughes (2013) and Zagar, Busch, and Grove (2013), it will not be further mentioned here.

The other identification method is a statistical approach with actuarial tests. The approach recommended and described in this paper is to screen proactively, in a cost-efficient manner, only the most at-risk persons. A description is provided of appropriate actuarial tests, with evidence-based research about the sensitivity and specificity of these assessments. As a case study in this article, such a test battery was applied to a random sample of adult or adolescent workers, offenders, and students.

In addition to this objective empirical approach, a discussion is added of the costs of violent crime, potential savings, and Return on Investment (ROI) of using specifically selected tests with good psychometric quality to detect and treat individuals most at-risk for violence. Pairing empirical study with estimates of economic consequences is crucial. Decision makers require scientific evidence and information about costs, savings, and return on investment to make full use of the case study approach. Finally, a real-world case study is presented, in which nonviolent adult or adolescent prisoners were moved from Cook County prison to electronic surveillance, saving considerable resources.

Actuarial Testing to Detect Persons with Violent Tendencies

Burgess (1928) created the first test of “return to court” and/or “dangerousness.” Burgess followed released offenders for three years after their release from jail, to see who returned to an Illinois prison. Detainee candidates up for parole were administered his checklist, which comprised 21 historical descriptors (coded ‘present’ or ‘absent’) which were summed for a total score. This test was intentionally made simple, so that anyone with a minimal education could fill it out.³ The higher the score on these descriptors or the greater number of risks, the more likely a costly “return to court” would occur. Costs avoided by using such an actuarial test include the expense of detecting, apprehending, convicting, and imprisoning the repeat offender.

For 80 years these assessments for violence potential and other risks have been used in clinics, workplaces, and universities (Zagar, Busch, Grove, & Hughes, 2009c). Interestingly, these risk evaluations have content similar to the tests employed five millennia ago in ancient China for civil service job applicants (Salkind, 2006). The tests are accepted in the courts within the British Commonwealth, the E.U., the U.S., and elsewhere. Risk can be measured for people of both genders, many racial and ethnic groups, and lower or middle socioeconomic class. It is possible to evaluate other risks such as abuse, mental health, substance abuse, low IQ, and problem solving, to obtain results for decision making.

This actuarial testing approach was suggested 60 years ago (Meehl, 1954). It was shown to be superior to clinical judgment in 126 of 131 studies (Grove & Meehl, 1996; for more detail see Grove, Zald, Lebow, Snitz, & Nelson, 2000). For a variety of reasons, including lack of awareness, actuarial tests are not universally employed. When actuarial evaluations are used, the benefits in the workplace include reduced cost of employee assistance, dismissal, retraining, and better safety and productivity. Among criminal offenders, prison expenses can be avoided when nonviolent adults or adolescents already in jail are moved to less costly electronic surveillance. Additional savings could be realized using a test that can be administered and scored via computer over the internet.

A Set of Tests to Measure Most At-risk via the Internet

Several tests were chosen, after an exhaustive review of the research on the sensitivity and the specificity of actuarial evaluations for “return-to-court” or fitness-for-duty uses. Tests with higher reliability and validity were chosen. A longer list of questions was thought to be required to achieve both sensitivity and specificity. There is considerable empirical

³Burgess’ assessment had a test-retest reliability of .6 to .7.

literature attesting to the test-retest reliability of these tests in a variety of populations over time. A brief description of the selected tests follows.

Ammons Quick Test (QT) is a brief, norm-referenced assessment of receptive vocabulary in a four-choice picture format with three alternate forms, which takes five to 15 minutes to administer (Ammons & Ammons, 1962). The Ammons QT was developed before the Peabody Picture Vocabulary Test (Dunn & Dunn, 1959; Vance & Singer, 1979; Dunn & Dunn, 1997), and is commonly utilized to screen in prisons for intellectual or learning disabilities. The Ammons QT can be employed with children through adults and has been used with patients, students, and employees (Mednick, 1969; Advokat, Eustis, & Pickering, 2005; Zagar, Kovach, Busch, Zablocki, Osnowitz, Neuhengen, Liu, & Zagar, 2013).

Beck Suicide Scale (BSS) is a 21-item test with three-choice format that requires five minutes to complete. The BSS is intended to assess potential for suicide. Dealing with depression and suicidal thoughts, the BSS uses self-descriptive statements like crying, failure, fatigue, guilt, insomnia, and irritability. The assessment also deals with pessimism, punishment, sadness, weight loss, and withdrawal and has a reliability and validity from .7 to .9 (Beck, 1978, 1991).

Minnesota Multiphasic Personality Inventory Second Edition (MMPI-2) or the Adolescent Edition (MMPI-A) evaluates mental health and personality. Across the three editions with item duplication, the computerized test takes less than 60 minutes to complete. The MMPI-2 for adults has 567 true-false format questions, while the MMPI-A for adolescents has 478 true-false items. Administration via the internet allows for instantaneous scoring and report generation with a precision that exceeds 90% in detecting mental illness. Over 19,000 empirical studies and 250 appellate court cases attest to the usefulness of this assessment that originated in the 1930s. The MMPI and other tests in this study can assess employees in airlines, military, nonprofits/religious organizations, power generation industries, police and fire public safety, trucking and ports, veterans, worker compensation and personal injury insurance clients, and also prisoners (Butcher & Pancheri, 1976; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989; Butcher, Williams, Graham, Archer, Tellegen, Yossef, & Kaemmer, 1992; Butcher, 1996; Pope, Butcher, & Seelen, 2004; Butcher, Gucher, & Hellervik, 2009). The MMPI-RF was not included.

Raven's Advanced Progressive Matrices ('Raven's test': Raven, 1965, 1990) is a norm-referenced measure of visual, nonverbal problem solving that has been normed in more than 54 countries (Flynn, 1984, 1987). The 48 challenging problems are presented in a multiple-choice format of 6 or 8 and computer administration and scoring takes 25 minutes (Shultz, Kaye, & Hoyers, 1980; Dillon, Pohlman, & Lohmen, 1981; Pietariu, 1986).

Standard Predictor (SP) is an assessment of violence potential for adults, with 98 true-false or multiple-choice format items and an Area under the Curve (AUC) = .99. The Standard Predictor for Adolescents has 123 items with AUC = .91. The Standard Predictor evaluates specific, historical self-descriptions and requires 15 min. to complete. The SP has no items from any of the other tests and is a free standing instrument with 98 or 123 independent items distinct from the other tests. This measure was successful in discriminating randomly selected violent offenders (1,595 adults and 1,127 adolescents) from matched controls with AUC = .96 in a combined adult and adolescent version based on a sample of 2,722 (Zagar & Grove, 2010). This AUC is noteworthy because most tests in the literature attempting to predict criminal recidivism or "return to court" have AUC s from .7 to .8 (Moosman, 2013).

This carefully selected set of tests was administered either by paper-and-pencil or over the internet with a total test time of 110 min. for 823 items. In the internet format, tests with automated reports cost 70 to 80% less than current paper-and-pencil versions. Also, percentiles, raw and T scores, and cut-offs were available instantaneously, except for MMPI clinical interpretative report, which does not provide percentiles.

Overall Goal

The overall goal is to show that actuarial testing can be used to increase safety in organizations and communities with sensitive and specific identification of the most at-risk adults and teens. A second purpose is to show how use of an actuarial test battery could reduce costs associated with violent crime by proactively identifying those most at-risk. The application of an actuarial test battery is discussed for various at-risk groups as examples of how to save lives and resources. Finally, a real-world case study in which nonviolent adult or adolescent prisoners were moved from Cook County prison to electronic surveillance is presented as an example of the demonstrated return on the investment of testing.

METHOD

Participants and Population

Using a random number table from a convenience sample of 4,987 people referred for assessment⁴ by courts, industry, hospitals, schools, and universities, a sample of volunteer adults ($N = 147$; M age = 36.2 yr., $SD = 15.3$; 107 men, 40 women) and adolescents ($N = 89$; M age = 14.7 yr., SD

⁴The referrals were for: competence to stand trial, developmental disability, hearing problems, learning disabilities, motor problems, physical or personal injury, parole or probation hearings, pre-sentencing, pre-trial, seminary or school entrance, speech disorder, employ-

TABLE 1
 DEMOGRAPHICS FOR ADULT, ADOLESCENT, AND COMBINED GROUPS OF WORKERS,
 CRIMINAL OFFENDERS, AND STUDENTS

Demographic Variable	Adults (<i>n</i> = 147)		Adolescents (<i>n</i> = 89)		Combined (<i>N</i> = 236)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Sex: Males	107	73	61	69	168	71
Females	40	27	28	31	68	29
Race: African American	11	7	50	56	61	26
Asian American	4	3	3	4	7	2
Euro-American	126	86	24	27	150	64
Hispanic American	6	4	12	13	18	8
Socio-economic Status (SES):						
Low	35	24	56	38	91	39
Middle	112	76	33	62	145	61
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age, yr.	36.2	15.3	14.6	2.1	28.1	16.0
Education, yr.	15.3	2.6	8.6	1.7	12.7	3.9

= 8.6; 61 boys, 28 girls) (Table 1) was selected. The sample came from a Midwestern city with approximately 2,000,000 workers and students. This sample was independent of those reported in prior research (Zagar, Arbit, Hughes, Bussell, & Busch, 1989; Busch, Zagar, Arbit, Hughes, & Bussell, 1990; Zagar, Arbit, Busch, Hughes, & Sylvies, 1990; Zagar, Zagar, Busch, Grove, Hughes, Arbit, Bartikowski, Isbell, & Stark, 2009; Zagar & Grove, 2010). Of the participants, 20 traveled in for the examinations from adjoining states of Indiana, Michigan, Minnesota, Wisconsin, and New Jersey, referred from airlines, courts, energy production industries, insurance firms, trucking companies, and lawyers. This sample included some people most at-risk for violence, including those with issues related to abuse, alcoholism, substance addiction, assault, career delinquency-criminality, school dropout, lack of work skills, homicidal or rapist tendencies, mental illness, pedophilia, suicide, or credibility issues such as malingering, feigning, and somatoform disorders.

ment termination, visual disorder, workers compensation issues. The selection of referrals is not much different from the selection of the standardization samples for the MMPI, which are basically convenience samples from clinical and school psychologists, recruited by the testing corporations, who along with volunteer test subjects are chosen to meet certain age, gender, race, SES, and specialized population characteristics, and are given a small stipend to test and to take the test. This is not much different than general referrals who pay (or whose insurance pays) for the examination and report.

Data Collection

Testing of these individuals was done to assess current functioning and address the hypotheses, as well as the more immediate issues of offering interventions, assessing fitness for duty, schooling, screening, and/or medical or psychological treatment. Then records for these individuals were obtained from court, industry, hospital, school, and/or universities. The records were checked and accepted as accurate with regard to convictions and illnesses. Records were examined for previous court contacts for neglect, substance dependency, physical and sexual abuse, delinquent and criminal offenses such as truancy, disorderly conduct, solicitation, phone harassment, forgery, mob action, violating a court order, drug possession or sales, property damage, auto theft, theft, burglary, robbery, unlawful weapon possession [firearm(s)], arson, assault or battery, aggravated criminal sexual assault, and homicide (same procedure as used in Zagar, Busch, Grove, & Hughes, 2009b).

Demographics.—For these adults or adolescents, demographic data include sex, race (African, Asian, Euro-, or Hispanic American), years of education completed, income or socioeconomic class (SES), occupation, criminal offense(s), and illnesses. Among adults, the 107 males represented 73% of the group, while the 40 females made up the remaining 27%. There were 11 African Americans (7%), four Asian Americans (3%), 126 Euro-Americans (86%), and 6 Hispanic Americans (4%). There were 35 with low (24%) and 112 with middle (76%) socioeconomic status (SES). Ages ranged from 19 to 88 years. Completed years of schooling ranged from 3 to 22. Among the adolescents, the 61 boys represented 69%, while 28 girls made up the remaining 31%. There were 50 African Americans (56%), 3 Asian Americans (4%), 24 Euro-Americans (27%) and 12 Hispanic Americans (13%). There were 56 with low (38%) and 33 with middle (62%) socioeconomic status (SES). Ages ranged from 9 to 18 years. Completed years of schooling ranged from 3 to 12. The combined group comprised both the adults and adolescents.

Occupations.—From the U.S. Department of Labor Dictionary of Occupational Titles, for the combined group (adults plus adolescents) of 236 workers and offenders, the 120 different occupations or jobs (collapsed into these general categories) included: accountants (3), bakers (3), billing clerks (3), chief executive officers (3), janitors (3), consultants (3), deliverymen (3), district managers (3), executive directors (3), college and high school football coaches (3), nuclear controllers-workers (3), nurses (3), painters (3), policemen (3), store managers (3), telecommunication technicians (3), and truck drivers (3), administrative assistants (4), roofers (4), cashiers (4), engineers (4), farmers (4), executives (4), military (4), night shift guards (4), personal security (4), nuclear power guards (4), school, university, and

store security guards (4), bankers (5), cooks (5), factory workers (5), financial planners (5), and realtors (5), programmers (6), claim clerks (7), teachers (7), housekeepers (8), bank, financial, government, insurance, non-profit, police, or store managers (10), babysitters (12), waiters-waitresses (12), youth group workers (12), ministers, monks, priests, rabbis, or sheiks (13), construction workers (14), Air Force, Army, Coast Guard Marine, Navy currently enlisted and officer military (18), sales persons (24), Buddhist, Hindu, Jewish, Muslim, Protestant, and Roman Catholic seminarian and/or religious studies college or graduate level students (29), high school students (89), undergraduate and graduate, private and public university, business, college, dental, engineering, law, and/or medical students (39), adolescent and adult students (127), and Air Force, Army, Coast Guard, Marine, Navy enlisted and officer veterans (25). There were 236 participants who held 1 of 120 different occupations making up 492 positions held at some point in their career. (In this enumeration, a single participant could have 1 or more occupations, military or student statuses.)

Offenses.—As defined in Illinois statute, the number of violent offenses that had been committed by the participants in the five years (± 1.5 , see “Records” below) before testing included: 27 physical and sexual abuse cases; 9 robberies; 12 unlawful possession of firearms; 7 arsons; 28 assaults; 9 pedophilic molestations; 4 rapes; 4 homicides; and 2 completed suicidal events. There were also nonviolent offenses: 31 cases of neglect; 3 minors considered for dependency (not able to care for themselves); 24 of disorderly conduct, solicitation, phone harassment, forgery, or mob action; 2 of violating court orders; 11 drug possession or sales; 5 property damage; 6 auto theft; and 17 thefts, 7 burglaries, and one truancy (see Table 4).

Measures

Psychological examinations.—According to the published test manual instructions, two psychologists administered the Ammons Quick Test (QT), the Beck Suicide Scale (BSS), the Minnesota Multiphasic Personality Inventory–2 (MMPI–2) or the MMPI–A, Raven’s Advanced Progressive Matrices, and the Standard Predictor Violence Potential Adult or Adolescent Version (SP). The order of test administration was randomized. For the hand scoring of the raw test data, the two independent psychologists had excellent inter-observer agreement (Pearson $r_s = .91-.94$). All of the MMPI data were scored using the Pearson Assessment and University of Minnesota Press Computerized Interpretative and/or Extended Report.

Records.—After physical and psychological examinations, current medical and other records were coded using the International Classification of Diseases (ICD–9; World Health Organization, 1977) and the Diagnostic Statistical Manual IV–TR (American Psychiatric Association, 2000). Records

were searched backward for a minimum of 5 years ($M = 5.3$ yr., $SD = 1.5$). All diagnoses were established by pediatricians, physicians, psychiatrists, psychologists, nurses, and therapists for (a) a history of problems with central nervous system neurological, respiratory, renal, hepatic, musculoskeletal, endocrine, circulatory, gastrointestinal, and genitourinary systems (ICD-9), (b) visual, hearing, speech disorders, headaches, blackouts, tremors, epilepsy, head neck injuries, skull fractures, cerebral palsy, and hydrocephalus, (d) complications of anoxia, pre-maturity, fetal alcohol, cocaine, heroin, nicotine, or marijuana exposure, transient neonatal diabetes, apnea, jaundice, and breech or Caesarian delivery, (e) psychiatric hospitalization, enuresis, Attention Deficit Hyperactivity Disorder (ADHD), developmental delay, overdose, post-traumatic-stress, and adult or adolescent substance abuse (weekly use of one or more: alcohol, marijuana, cocaine, hallucinogens, heroin, amphetamines, and/or aromatics, e.g., paint or glue), (f) organic brain syndrome, malingering, brief reactive psychosis, major affective, schizoaffective, or paranoid disorders, and schizophrenia, (g) infant, child, adolescent, parent, relative, and guardian mental status, child's developmental, medical, and family history if a court case involved abuse, (h) fainting, blackouts, seizures, paralysis, local weakness, numbness, tingling, tremors, memory loss, nervousness, tension, mood, depression, education, housing, employment, finances, future, insurance, medications, habits, routine, allergies, exercise, substance use, health of family, number and type of hallucinations, overdoses, and hospitalizations, and (j) offenses and convictions either from the abuse, delinquency or adult court.

Work records searched included incidents of injury, physical, psychiatric, or psychological examinations, safety, test data, and licenses. School and university records searches included course transcripts, behavioral incidents, national, local, achievement, group, and individualized test scores, suspension, expulsion, truancy, tardiness, and multidisciplinary individualized education plans. Federal, state, county and city laws guarantee and protect individual's anonymity, civil rights, and privacy, especially court wards and minors. Ethical guidelines in the handling of records were followed in the coding of data to maintain anonymity. Records were provided by the referral source: clinic, court, hospital, industry, insurance company, military, public safety organization, school, or university. No names were attached to any data files.

Decision-making Algorithm

For adults or adolescents, using the record and test data, two independent psychologists classified individuals with the following algorithm to assess mental health including substance abuse, or abuse or violence potential. (a) Ammons Quick Test score below 70 is consistent with cognitively delayed functioning, as was (b) Raven's Advanced Progressive Matrices with a score below 70. (c) A Beck Suicide Scale (BSS) score of 10-20

or more, in the moderate to severe range of major depression with suicidal ideation. (d) The Minnesota Multiphasic Personality Inventory–2 (MMPI–2) or the MMPI–A with significantly ($p < .01$) elevated validity and/or basic clinical scales consistent with a T score of 65 or above. Finally, (e) the Standard Predictor of Violence Potential (SP) Adult version cutoff was 70.6%, the lowest score of convicted violent offenders⁵; the SP Adolescent version cutoff was 82.9%, the lowest score of convicted adolescent violent offenders (Zagar & Grove, 2010). With this decision-making algorithm, for the two independent psychologists, Pearson product moment coefficients of inter-observer agreement were .92–.96 ($p < .01$). The results of this algorithm were compared with records of the individuals' actual histories.

Statistics and Experimental Design

For adults, adolescents, and the combined group (adults plus adolescents), the means and standard deviations were computed for age, sex, race, SES, years of education completed, occupation, and offenses. For adults, adolescents, and the combined group, the test scale means and standard deviations were normally distributed according to the Komolgorov-Smirnov Test and met the assumptions of homogeneity of variance on Bartlett's test. In simple terms, the data was normally distributed and homogenous. For the domains and tests employed, the sample size was sufficient (Kirk, 1982).

To compare the paper-and-pencil with the computer administration and scoring, the test scales were subjected to Pearson product moment correlation analyses. Next, for the combined group, the sensitivity and specificity of the algorithm were computed for mental health including substance abuse, abuse and violence potential, or their combination. The criterion for mental health including substance abuse, and for abuse and violence potential was the individuals' actual records. These included court or health records of mental illness, substance abuse, violence, and/or abuse. For example, if the records showed a finding of mental illness, it was assumed that the individual had mental illness, and so forth for the various criteria, substance abuse, violence, and/or abuse.

Real-world Example of Actuarial Statistical Tests Used Proactively

As an example of the possible outcomes of screening with the algorithm, an analysis was run assuming that those screened as at-risk were diverted from nonviolent and violent offenses at the rate of 52%, which was the average diversion (32% less homicides, 46% fewer shootings, 77% decreased assaults) in a large-scale project entitled the "Culture of Calm," funded by a \$76.6 million U.S. Department of Justice grant providing an-

⁵Violent offenses are robbery, sex offenses, assault, battery, arson, illegal gun possession, or homicide.

ger management training, jobs, and mentors to 4,850 most at-risk adolescents⁶ in 38 Chicago high schools for the academic years 2009–2012; 104 lives and \$492 million were saved with a $ROI = 6.42$ for every dollar spent. Thus, in the current study, the 52% diversion rate has good face validity when applied to offenders. Current offense costs and treatment expenses were used to assess the savings in resources and the ROI assuming a 52% diversion from offending if testing and treatments had been used *before* the offenses in these same participants.

It was expected that cost savings using a computerized test battery could be achieved in such critical industries as airlines, energy generating industries, insurance, military, nonprofit-religious, prisoners, trucking or port workers, and veterans. To more fully understand the potential, the current size of certain example populations, the annual costs within each population, the savings by using testing, and the return on investment were collected and computed. (which will be explained in more detail in Table 5 later).

RESULTS

Paper-and-pencil Versus Computerized Test Versions

For the adult, the adolescent, and the combined group, the means and standard deviations of the total and scale scores are presented in Table 2 for all measures. The significant ($p < .01$) Pearson product-moment coefficients of inter-observer agreement for two independent observers coding the records ranged from $r = .91$ to $.95$ for mental health issues including substance abuse, and abuse and violence, including convictions. For the adult, adolescent, and the combined groups, on the paper-and-pencil versus computer test scales, Pearson product-moment coefficients of inter-observer agreement ($p < .01$) ranged from $.83$ to $.99$: for the Ammons Quick Test (QT) $r = .96$ – $.99$, for the Beck Suicide Scale (BSS) from $r = .99$ – $.99$; for the MMPI-2 various scales from $r = .96$ – $.99$, for the MMPI-A various scales from $r = .99$ – $.999$, for the Raven's, $r = .99$ – $.99$; and for the Standard Predictor of Violence Potential Adult or Adolescent Versions (SP), $r = .94$ – $.998$.

Sensitivity and Specificity of Tests

In the combined group of adolescents and adults, for suicide potential as measured with the BSS, the true positives were 2 of 2 (100% sensitivity) and the true negatives were 229 of 236 (98% specificity). In the combined group, for mental illness, including suicide and substance, as measured by the MMPI-2 or MMPI-A, the true positives were 162 of 167 (97% sensitivity) and the true negatives were 65 of 69 (97% specificity). In the combined group for abuse and violence potential, including homicide, as evaluated with the

⁶Participants were prospectively identified with a logistic regression as detailed by Chandler, Levitt, and List (2011); Zagar, Kovach, Ferrari, Grove, Busch, Hughes, and Zagar (2013).

TABLE 2
 DESCRIPTIVE STATISTICS ON ALL MEASURES FOR ADOLESCENTS, ADULTS, AND THE COMBINED GROUP
 OF WORKERS, OFFENDERS, OR STUDENTS

Test and Scale	Adults (<i>n</i> = 147)		Adolescents (<i>n</i> = 89)		Combined (<i>N</i> = 236)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Ammons Quick Test						
Raw	39.14	4.71	40.51	3.42	39.76	4.02
Percentile (%)	41.14	11.01	43.14	12.13	42.14	11.46
IQ	95.14	16.32	97.89	15.12	96.52	15.53
Beck Suicide Scale						
Raw	2.5	4.83	3.65	4.27	2.36	2.93
MMPI-2/MMPI-A						
Lie (Raw)	4.87	3.69	4.85	2.91		
F (Faking)	6.83	5.71	13.29	7.07		
K (Defensiveness)	16.06	5.24	14.10	4.63		
Hs (Hypochondriasis)	9.42	14.10	13.85	6.45		
D (Depression)	23.80	8.80	29.79	7.49		
Hy (Hysteria)	25.71	6.34	28.85	10.31		
Pd (Psychopathic Deviate)	18.77	6.12	27.92	7.02		
Mf (Masculinity / Femininity)	27.60	6.47	23.08	5.02		
Pa (Paranoia)	12.24	4.21	19.22	6.89		
Pt (Psychasthenia)	15.71	11.42	24.38	9.30		
Sc (Schizophrenia)	16.48	12.29	31.82	12.37		
Ma (Hypomania)	17.12	4.54	24.38	5.71		
Si (Social Introversion)	26.16	10.29	29.52	7.45		
Raven's Progressive Matrices						
Raw	22.95	7.60	11.20	6.51	17.72	7.48
Percentile (%)	62.50	27.20	35.42	27.40	49.75	27.38
IQ	106.46	14.62	93.27	13.64	100.06	14.84
Standard Predictor of Violence Potential						
Raw	12.88	4.45	12.60	17.42		
Risk Percentile (%)	58.11	10.12	44.51	9.89		

Note.—The MMPI-2 and MMPI-A have different items, sets, and length, i.e. 567 vs. 468 items, although they have the same 13 basic clinical and validity scales; scores cannot be added.

Standard Predictor of Violence Potential Adult or Adolescent Versions (SP), the true positives were 71 of 73 (97% sensitivity) and true negatives were 159 of 163 (97% specificity). The full set of tests—Beck Suicide Scale (BSS), the Minnesota Multiphasic Personality Inventory (MMPI-2 or MMPI-A), and the Standard Predictor of Violence Potential (SP)—the true positives were

TABLE 3
 PREDICTING VIOLENCE AND MENTAL ILLNESS FROM A BATTERY OF TESTS WITH WORKERS, OFFENDERS, OR STUDENTS' ACTUAL HISTORY FROM RECORDS AS THE CRITERION (N = 236)

Overall Battery^a		
True Positive	False Negative	Predictive Performance
245	9	Sensitivity 97%
False Positive	True Negative	Specificity 97%
15	449	
Beck Suicide Scale (BSS)^b		
True Positive	False Negative	Predictive Performance
2	0	Sensitivity 100%
False Positive	True Negative	Specificity 97%
7	227	
MMPI: Mental Illness including Substance Abuse		
True Positive	False Negative	Predictive Performance
162	5	Sensitivity 97%
False Positive	True Negative	Specificity 94%
4	65	
Standard Predictor		
True Positive	False Negative	Predictive Performance
71	2	Sensitivity 97%
False Positive	True Negative	Specificity 98%
4	159	

Note.—^aEntries are the sum of numbers of individuals in the combined sample screened as positive on each test in the battery: True positives are 2 + 162 + 71; False positives are 7 + 4 + 4; True negatives are 227 + 65 + 159; and False negatives are 0 + 5 + 2. ^bEntries are the individuals in the combined sample screened on the BSS test: True Positives are 2 who had endorsed items scored 0, 1 or 2 totaling 20; False Positives were 7 who endorsed items with a score 15-19; Sensitivity, 100%; True Negatives are individuals who endorsed few of the 21 items on the BSS; False Negatives were 0 not identified on the BSS.

245 of 253 (97% sensitivity) and the true negatives were 449 of 464 (97% specificity). Given that most of the research on these tests have 90% to 95% reported sensitivity and specificity, these results are excellent. It is not surprising the combined tests have better precision (Table 3).⁷

⁷Originally two other tests were administered: (a) the Child Abuse Potential Questionnaire with 150 true-false items which require 20 min. to answer (Milner, 1980; 1986; 1990) with a cutoff set using signal detection theory that can detect abusive workers, parents, and caretakers and 90% accuracy in separating abusers from controls, employed in a variety of work, court, and other settings (Couron, 1982; Haddock & McQueen, 1983; Milner & Robertson, 1985); and (b) the Substance Abuse Subtle Screening Inventory for Adults (SASSI-1, SASSI-3) which consists of 67 true-false items, 12 items on alcohol use, and 12 items for drug use totaling 91 items or the SASSI-2 for Adolescents has 72 true-false items and 28 questions about substance misuse, totaling 100 items which take 15 min. to administer with a

Estimated Savings if This Sample's Most At-risk Had Been Diverted

In Table 4, the offenses for the combined group (adults plus adolescents) are presented in the first column, followed by 52% theoretically diverted with a program of anger management, jobs, and mentors in column 2. The treatment including testing cost of \$15,793.81 (derived from the \$76.6 million U.S. DOJ grant for the "Culture of Calm" divided by their 4,850 students) is multiplied times the number diverted (column 3). The costs of the nonviolent and violent offenses are given in column four (from Zagar, Zagar, Bartikowski, & Busch, 2009, with the regional Consumer Price Index in 2012, U.S. Bureau of Labor Statistics, 2012; U.S. Census Bureau, 2010; 2012; U.S. Department of Agriculture, 1994; Lino, 2007). In column 5 are the savings or losses in 2012 U.S. dollars, determined by subtracting the treatment costs from the offense cost. At the bottom right corner of Table 4 are listed the ROIs for violent offenses alone (17.14), and for the total offenses (nonviolent plus violent; 6.64), for every dollar spent in testing and treatment. The results presented in this table make a strong case for actuarial testing used proactively to identify the most at-risk, and then targeting the empirical treatments that are most likely effective (Lipsey, 1999, 2009), to save lives and resources. In this fictional but validly constructed scenario, two lives would have been saved and a savings of \$10 million expected.

Application to Populations of At-risk: Airlines, Energy, Military, Nonprofits, Public Safety, Jail

Six key populations or market niches, the airlines, energy production, military, nonprofits, public safety and prisoners, are briefly discussed in terms of how to extend the case study approach of actuarial screening tests described above. Within each population, rates of risk within the population, specific costs of risks for violence, mental illness, and abuse, estimates of testing, projected yearly savings, and ROIs are summarized.

Airlines.—U.S.-based commercial airlines employ approximately 2,000 pilots. There are also 613,000 private pilots. Suicides and homicides among pilots, as well as large-scale terror actions using airplanes, are reasons why regular actuarial testing of airline staff is paramount. Among Air Force pilots there are suicide attempts, depression, substance abuse/dependence and post-traumatic stress disorder (Otto & Webber, 2013). In Table 5, column 3, the annual costs for fitness-for-duty paper-and-pencil screening of 2,000 commercial and 613,000 private pilots to prevent disasters is \$1.22

sensitivity and specificity over 90% in detecting substance abuse (Miller, 1985, 1988, 1990, 1997; Miller & Lazowski, 1999, 2001; Miller, Roberts, Brooks, & Lazowski, 2003). However, adding 35 minutes and 231 items to measure abuse (already measured in the SP) and substance abuse (already assessed in the MMPI) seemed impractical, given that the sensitivity and the specificity remained .97 and .97 with or without these two tests. To spare the test-taker time and energy and the purchaser extra cost, these two tests were removed.

TABLE 4
 ESTIMATED SAVINGS IF THOSE IDENTIFIED AS MOST AT-RISK IN THE COMBINED GROUP HAD BEEN
 DIVERTED BY TREATMENT INSTEAD OF COMMITTING THE OFFENSES FOUND IN THEIR RECORDS IN 2012
 U.S. DOLLARS

Offense	<i>n</i>	Estimated Diverted (52%)	Treatment Cost	Offense Cost	Savings (Loss)
Neglect	31	16	252,688	12,178	(106,552)
Dependency	3	2	31,588	12,178	(7,232)
Truancy	1	1	15,794	362	(5,432)
Disorderly conduct, solicitation, phone harassment, forgery, mob action	24	12	185,526	464	(179,948)
Violating court order	2	1	15,794	189	(15,605)
Drug possession and/or sales	11	6	94,763	3,390	(74,443)
Property damage	5	3	47,381	2,511	(39,848)
Auto theft	6	3	47,381	4,465	(33,986)
Theft	17	9	142,144	463	(137,977)
Burglary	7	4	63,176	1,758	(56,144)
Abuse (physical, sexual)	27	14	22,113	109,222	1,530,508
Robbery	9	5	78,969	10,043	50,215
Unlawful weapon possession (firearm)	12	6	94,763	2,512	15,072
Arson	7	4	63,176	47,078	188,312
Assault/battery	28	14	221,113	13,810	193,340
Molestation (aggravated criminal sexual assault to minor) Pedophilia	9	5	78,969	124,287	621,435
Rape (aggravated criminal sexual assault to adult)	4	2	31,588	124,287	248,564
Homicide (Suicide)	4 2	2	31,588	4,660,986	8,441,972
Total Nonviolent Offenses	107	57	896,235		(657,167)
Total Violent Offenses	100	52	622,279		10,667,139 (ROI = 17.14)
Total Offenses	207	109	1,518,514		9,999,992 (ROI = 6.64)

Note.—2012 U.S. dollar costs based on U.S. Department of Agriculture (1994), Lino (2007), Cohen (1995; 1998), Cohen and Miller (1994), Cohen, Miller, and Rossman (1994), Cohen and Piquero (2007), Miller (2012), Zagar, Zagar, Bartikowski, and Busch (2009), Consumer Price Index (2012), and U.S. Bureau of Labor Statistics (2012). Boldface represents the most important results.

TABLE 5
SIX POPULATIONS WITH ESTIMATED RISKS, COSTS, SAVINGS, AND RETURN ON INVESTMENT (ROI) USING INTERNET-BASED ACTUARIAL TESTING

Population	Risks	Cost	Actuarial Test Cost	Savings	ROI
Airlines	Among 6,025 Air Force pilots, 1 suicide attempt, 57 depressed, 40 substance abusers/dependent, 23 PTSD ¹	\$2,000 per paper-and-pencil administration × 615,000; Cost of screening = \$1.23 billion	\$300 per internet test × 615,000; Cost of screening \$184.5 million	\$1.045 billion million in screening costs improving the quality of pilots	9–58
Energy Industry employees	Among nuclear power workers fit for duty, 1% marijuana, cocaine or alcohol use ² and among nuclear power employees examined at baseline and 1-yr. later, 1% at risk for mental health issues ³	\$2,000 per paper-and-pencil test administration × 400,000; Cost of screening = \$800 million	\$300 per internet test × 400,000; Cost of screening = \$120 million	\$680 million in screening costs improving quality of workers	20–90
Military	Rejection of recruits (19.6%) for unidentified psychiatric issues ⁴ ; 30% positive drug tests in boot camp ⁵ ; 672 of enlisted men commit sexual assault with punitive damages ⁶ ; 365 suicides and 50 homicides ⁷	Cost to find recruit = \$11,000; boot camp = \$35,000; attrition = 19.6% of 200,000 recruits; 39,200 × \$46,000 = \$1.8 billion annual loss to attrition ¹²	\$300 per internet test × 200,000; Cost of screening to reduce attrition = \$60 million	\$1.74 billion to reduce attrition, improving quality of recruits	90–110

(continued on next page)

Note.—¹Otto & Webber (2013); ²U.S. Nuclear Regulatory Commission (2013); ³Bromet, Dew, Parkinson, and Schulberg (1988); ⁴AMISARA (2007); ⁵AMISARA (2008); ⁶U.S. Department Sexual Assault Prevention and Response (2007); ⁷AMISARA U.S. Department of Defense (2009a); ⁸Mokros, Osterheider and Neithle (2012); ⁹Virginia (1998); Knox, Virginia, and Lombardo (2002); ¹⁰Fyfe and Kane (2005); ¹¹Teplin (1994); ¹²U.S. Department of Defense (2009b); ¹³Wikipedia (2013); ¹⁴U.S. Bureau of Justice Statistics (2013).

TABLE 5 (CONT'D)
SIX POPULATIONS WITH ESTIMATED RISKS, COSTS, SAVINGS, AND RETURN ON INVESTMENT (ROI) USING INTERNET-BASED ACTUARIAL TESTING

Population	Risks	Cost	Actuarial Test Cost	Savings	ROI
Nonprofits, Religious, Clergy, Teachers	1% pedophilia* at risk for mental health issues, 4% for substance abuse ⁹	2007 pedophilia liability payout = \$615,164,689; 2006 pedophilia payout = \$436,143,197; cumulative pedophilia payouts \$5 billion; Gallagher pedophilia payouts \$1.5 billion; total \$6 billion ¹³	\$300 per internet test × 400,000; Cost of screening to reduce pedophilia, mental health, substance abuse = \$1.2 billion	Total pedophile payouts \$6.5 billion - \$1.2 billion to screen all religious, clergy, teachers, personnel with youth contact = \$4.3 billion in savings	250–323
Police, Fire Personnel	200 wrongful death or injury claims, 1% at risk for mental health issues, 1% for substance abuse ¹⁰	\$2,000 per paper-and-pencil test administration × 1,000,000 cost of screening = \$2 billion	\$300 per internet test × 1,000,000; Cost of internet screening = \$300 million	\$1.7 billion	20–100
Prisoners	Violent prisoners institutionalized ¹¹	Cost of keeping the nonviolent in jail total \$1.15 billion. ¹⁴	\$300 per internet testing × 500,000; Cost of screening = \$1.5 million	Savings in 50 states by moving of non-violent prisoners to electronic monitoring = \$17 billion annually	3–20

Note.—¹Otto & Webber (2013); ²U.S. Nuclear Regulatory Commission (2013); ³Bromet, Dew, Parkinson, and Schulberg (1988); ⁴AMISARA (2007); ⁵AMISARA (2008); ⁶U.S. Department Sexual Assault Prevention and Response (2007); ⁷AMISARA U.S. Department of Defense (2009a); ⁸Mokros, Osterheider and Neitche (2012); ⁹Virginia (1998); Knox, Virginia, and Lombardo (2002); ¹⁰Fyfe and Kane (2005); ¹¹Teplin (1994); ¹²U.S. Department of Defense (2009b); ¹³Wikipedia (2013); ¹⁴U.S. Bureau of Justice Statistics (2013).

billion, while using internet testing would cost approximately \$184.5 million (column 4). The savings for a safer air space is approximately \$1 billion (column 5) with ROIs ranging from 9 to 58 (column 6, Table 5).

Energy industry.—Nuclear power plants supply 20% of U.S. electricity, run by 4,000 controllers who are certified annually. The probability of some depressed or suicidal individuals among these controllers is ample reason to consider actuarial testing (Bostok & Daley, 2007). There are about 400,000 workers involved in the various sectors of energy production from oil well rigs, refineries, natural gas exploration, and transport, as well as coal power and electrical grid employees. There are mental health and substance abuse issues among these workers (Bromet, Dew, Parkinson, & Schulberg, 1988; U.S. Energy Information Administration, 2009; U.S. Nuclear Regulatory Commission, 2013). The cost estimate of fitness-for-duty screening for all energy workers using paper-and-pencil tests is \$800 million (column 3, Table 5), while internet testing would cost \$120 million (column 4), with savings of \$680 million and ROIs of 20 to 90 within the overall energy industry.

Military.—In the military, better prescreening of recruits and enlisted is critical. In 2006, the joint forces had 205,000 recruits with an overall accession rate of only 46%. In 2008, the joint forces, Reserves, and National Guard had 196,000 trainees and 1,450,000 enlisted (Accession Medical Standards Analysis Research Activity (AMSARA), U.S. Department of Defense, 2009a, 2009b, 2009c). Actuarial tests would have a greater effect than drug testing (Non Instrumented Drug Test) introduced to the U.S. Navy, which reduced positive boot camp drug tests by 30%, saving \$3.3 million annually (Norbert, 2002), since an actuarial test can detect a far greater range of potential problems. In the United States Army in 2006, 1,472 of 43,574 recruits were rejected *after* training; 19.6% of recruits were discharged for unidentified psychiatric issues; 1.2% U.S. Marines were discharged because of substance abuse; 0.4 to 0.7% of enlisted recruits dropped out. It is projected that actuarial tests would reduce attrition rates as much as 26% due to better detection of conditions existing prior to service (AMSARA, U.S. Department of Defense, 2009a). Costly offenses are perpetrated by military personnel: in 2004, there were 1,798 sexual assault claims, of which 672 resulted in punitive damages (U.S. Department of Defense Sexual Assault Prevention and Response, 2006); 32% of enlisted women felt sexually harassed (Bostok & Daley, 2007). This could be explained by the fact that 13% of U.S. Navy enlisted men had committed sexual assault prior to service (Stander & Merrill, 2008). The dangerousness of these prior offenders could be assessed by an actuarial test. In Table 5, column 3, the cost of finding, recruiting and boot camp training is \$46,000, with an attrition rate of 19.6%, so that \$1.8 billion is lost yearly

by training persons with mental health or substance abuse problems, or sexually abusive behaviors. In Table 5, column 4, the cost of internet testing for 200,000 recruits is \$60 million, while the savings in reducing attrition is \$1.72 billion, with *ROIs* of 90 to 110 only considering recruits. This does not include possible reduction of sexually abusive behaviors among active personnel.

Nonprofits and clergy.—An obvious example for identification and prevention of abuse is the Roman Catholic Church, which has 40,000 active priests, 3,000 active seminarians, 16,000 active permanent deacons, and 65,000 nuns and monks. There are 7,000 Catholic schools with teachers and youth group volunteers. Worldwide, 0.5 to 1% of Catholic clergy, regardless of age, education, ethnicity, race, or SES, are accused of sexual offenses; roughly 80% of these are in the U.S. Although pedophilia is a problem in the E.U., the legal and the financial consequences are not as extreme. In 2007, the total pedophilia liability payout by the Roman Catholic Church was \$615 million, and in 2008 the U.S. cost was \$436 million. The cumulative 30-year total payout exceeds \$5 billion (Dillon & Wayne, 2002; Wikipedia, 2013). In Table 5, column 4, the cost of internet testing of all nonprofit religious personnel (clergy, teachers, youth workers) is \$1.2 billion, which would likely prevent any future pedophilia problems, saving \$4.3 billion (*ROIs* = 250–323).

Public safety personnel.—Annually, one in 154 police personnel have been accused of violence, including one in 1,549 charged with homicide. There are one million public safety officers and 200 wrongful injury or death claims yearly. Between January 2009 and November 2011, the City of Chicago paid \$45.5 million for damages in 441 lawsuits involving claims of police misconduct—a rate of \$5.54 annually per city resident. That is more than twice as much as in Los Angeles (\$2.66), and roughly half as much as in New York City (\$9.93) between 2009 and 2010 (Caputo, 2012). The most frequent primary charges against public safety personnel over time are: drugs, profit motivations, and on-duty abuse (Fyfe & Kane, 2005). In addition, every 17 hours, a public safety officer turns his own gun upon himself, depriving their families of their support, and the public of their experience and training. In Table 5, column 3, the cost of paper-and-pencil fitness for duty screening for all public safety officers in the U.S. is \$2 billion, while internet screening would cost approximately \$400 million (column 4) saving \$1.6 billion (column 5) with *ROIs* of 20 to 100.

Prisons, probationers, and parolees.—In the U.S., there are 1,000,000 prison inmates, 1,000,000 on parole, and 2,000,000 on probation, making up 4 million in the prison system, the highest rates in the world. The national yearly expense of adult prison averages \$30,000 while juvenile deten-

tion is \$80,000 to \$225,000 (U.S. Bureau of Justice Statistics, 2013; Zagar, Busch & Grove, 2013). Total annual U.S. prison system costs are \$37 million (Table 5, column 3). These make up nearly one-third of the costs of crime. Cost of internet screening of all prisoners would cost approximately \$1.5 billion (column 4). Releasing low-risk, nonviolent prisoners by screening with actuarial tests and placing them on electronic surveillance would reduce costs \$17 billion per year, as seen in column 5 (Zagar, Busch, & Grove, 2013). Estimated return on investment ranges from 3 to 20, depending upon which U.S. state is considered. For example in New York, the annual prison expense is \$3.26 billion; nonviolent prisoners make up \$2.71 billion of that cost, and in comparison, internet testing and electronic surveillance expenses would be approximately \$126 million, resulting in an annual savings of \$2.58 billion for Illinois alone.

Case Study: Moving Cook County Nonviolent Adult and Adolescents to Electronic Surveillance

Cook County, Illinois saved \$480 million in 18 months by placing nonviolent adult and juvenile prisoners on electronic surveillance.⁸ There were significant savings per adult prisoner: \$2,500 for electronic surveillance compared to the \$18,500 annual jail expense. Moser (2012) and Olson and Taheri (2012) reported a consistent drop in the Cook County Adult Jail total population from 75,496 in 2007 to 62,098 in 2011. Projecting those numbers into 2012 and 2013, one must also look at the percentages of inmate types, the average number of days in jail for those different inmate types, and the cost of prison.⁹ The Juvenile Detention Center population dropped from its maximum of 1,575 to 275 (Rogers, 2012). The total savings were \$292 million in the juvenile detention center's annual costs (Slife & Eldeib, 2011; Dardick, 2012; Byrne & Darkick, 2013). Combined, the savings from moving nonviolent adult or adolescent offenders to electronic surveillance were just over \$480 million. In addition to these monetary saving are the quality of life issues that may positively affect treatment

⁸In the fall of 2011, the senior author provided the Cook County (Chicago, Illinois) Board President with *Predicting and Preventing Homicide: a Cost Effective Empirical Approach from Infancy to Adulthood* (Psychological Reports, 104, 1-337) and the estimates on jail costs versus electronic surveillance expenses. This information was used to make the decisions to move nonviolent prisoners to electronic surveillance. Even more resources could be saved in Cook County and the state of Illinois by actuarial testing of incarcerated prisoners to identify those with lowest violence risk and release them to electronic surveillance.

⁹These include: (a) posted bond, $3774.5 \times 32.5\% \times 12.9 \text{ days} \times \$413/\text{day} = \$2,680,681.15$; (b) sentenced to prison, $3774.5 \times 18.8\% \times 153.3 \text{ days} \times \$413/\text{day} = \$15,555,911.80$; (c) sentenced to probation / supervision, $3774.5 \times 11.6\% \times 56.7 \text{ days} \times \$413/\text{day} = \$3,550,050.79$; (d) time served, $3774.5 \times 6.7\% \times 58.6 \text{ days} \times \$413/\text{day} = \$2,119,180$; (e) sentence expired, $3774.5 \times 8\% \times 32.7 \text{ days} \times \$413/\text{day} = \$1,411,995.10$; (f) charges dropped, $3774.5 \times 15\% \times 25.4 \text{ days} \times \$413/\text{day} = \$2,056,460.80$; and (g) not convicted, $3774.5 \times 0.5\% \times 285.4 \text{ days} \times \$413/\text{day} = \$770,228.24$. This totals $\$28,144,507.78 \times 1.5 \text{ years} = \$42,221,761.42$.

and diversion. Juveniles receive treatment akin to that in a psychiatric facility, given their special status within the prison system. With electronic surveillance for nonviolent adult or juvenile prisoners, quality of life and family relationships can be improved, since offenders are at home instead of living in jail.

DISCUSSION

A sample of the general population was tested for risks using a battery of tests administered as paper-and-pencil or computer versions. For all tests, the scores obtained, either by paper-and-pencil scoring or by computer scoring, were equivalent. With medical, school, and court records as criteria, the paper-and-pencil or computerized decision making algorithms were also equal. The accuracy of these tests whether administered and scored by paper-and-pencil or computer is already well accepted within the research literature, as is the precision in the decision making algorithms. In this experiment, the sensitivity and specificity of the test battery were very high (97%), compared to the actual records of the individuals. Mean individual test time was 110 min. compared to the paper-and-pencil time of 200 to 250 min.

If the 207 nonviolent and violent offenders in the sample had been diverted with the empirical treatment of a job, mentor, and anger management training, 109 would have been given the intervention at a total cost of \$1.52 million; there would have been a savings of two lives and \$9.99 million in resources (cost of offenses prevented), for an *ROI* of 6.64. Just looking at the violent offenders and excluding the nonviolent, the *ROI* would be \$17.14 savings for every dollar spent. This makes a strong case for actuarial testing and targeting of empirical treatments that divert individuals from offending. Extending these estimates of savings from using actuarial tests, regressions, and targeted treatments, different key industries' highest risk applicants and employees could be identified, with projected returns on investment from \$9 to \$323 for every dollar spent. The possible savings of life, 2,600 of the 12,000 annual murders in a country of 300 million people, is also notable. The U.S. Department of Justice-sponsored "Culture of Calm" saved an estimated 104 youths' lives and \$492 million in resources (Zagar, Busch, & Hughes, 2009; Zagar, Busch, & Grove, 2013).¹⁰ It is clear that application of actuarial, statistical and empirical techniques is efficient, effective, and would reduce budget problems in cities, states, and at the federal level.

Risk Appraisal and Management

Describing appraisal and management of risk, Kaplan and Mikes (2012) listed several issues: (a) preventable internal issues arising within organizations; (b) managing or containing risks when they occur; and (c) exter-

¹⁰In 2013, 20,000 Chicago at-risk youth had jobs, lowering murders by 89, saving \$409 million.

nal risks beyond the organization's influence, including natural, political, and macro-economic shifts. Identification and mitigation, or prediction and prevention, are essential. Normally, human judgment is optimistic, anchoring estimates on readily available data, and tends to normalize the status quo, which may not be acceptable on many levels. Organizational teams must be comfortable thinking about what could go wrong with designs and how to intervene. Given that human resources make up the majority of organizations' resources, focusing on *what can go wrong with people* is critical to risk management and risk reduction. Planning for an unusual event, e.g., a fatal crime is important to strategically dealing with human risks. Preventable risks require mission statements, hiring and operational rules, and standard operating procedures that include the use of tools to identify individuals at risk, mitigate the risk by rejecting dangerous applicants, or application of employee assistance programs. Strategic risks involve maps of likely risks and impacts and resource allocation for management. This may include mental and physical health interventions during or after disasters, etc.

Constitutional and Ethical Issues

Because there are constitutional guarantees in the U.S., E.U., British Commonwealth, and under the United Nations Charter, judgments and decisions in each of these areas and for each of the individuals being actuarially tested must be handled carefully. Informed consent, notification, documentation and communication of findings, issues of multiple roles, confidentiality and privilege, third party presence during evaluations, release of reports and test data, reimbursement, the role of assessment in hiring, removal, employment decisions, reasonable accommodation, rules for records access, Equal Employment Opportunity, and addressing substandard practices by peers are all issues that need attention. Actuarial tests are increasingly popular and legislation and case law define the ground rules for use of tests, while professional associations and insurers add standards and guidelines. There are already specific legal guidelines, e.g., in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* (509 U.S. 579, 1993), the U.S. Supreme Court admitted technical evidence that is precisely factual to the trial issue. In *Frye v. U.S.* [293 F.1013 (D.C. Cir, 1923)], the U.S. Supreme Court held that scientific principles or discoveries must be generally accepted in a field. Both of these cases lend support to the broad use of proven actuarial tests. The most obvious difficulty in the use of actuarial tests is that they might be forced upon persons, so one must assess how tests help individuals and society and how these tests can and should be applied. Generally, in democratic societies, individuals are allowed to injure themselves and others, within limits; no agency or government may proactively force tests

or impose restraints on most behavior. However, at some point, professionals have the ethical and the legal responsibility to report such individuals, and at that time, action is taken to protect society first, and the individual second (Zagar, Zagar, Bartikowski, Busch, & Stark, 2009).

Limitations

Many investigators question the sensitivity and specificity of statistical (actuarial) decision-making tests for risks such as abuse, mental health issues, substance abuse, and violence. False negatives can result in loss of life, while false positives may violate civil rights. Both have their associated costs (Zagar, Busch, Grove, & Hughes, 2009c). Due to the stakes of over- and under-identification, sensitivity and specificity of tests are crucial to any discussion of risk appraisal and management. Given the improved sensitivity and excellent specificity using the battery of tests in this study, such concerns are considerably lowered. The validity of this battery of tests for identification of unique risk factors among adults and adolescents gives administrators more options to save lives and lower costs proactively, because the prediction of violence, especially homicide and pedophilia, is practical, reliable, and valid. Analyses comparing this sample with the demographics of the E.U. and U.S. populations suggest that the cross-validated and replicated risks for violence, homicide, and pedophilia are generalizable to those broad areas (Zagar, Busch, Grove, & Hughes, 2009a).

There were of course limitations and threats to validity. There may be issues with the size of the sample of only 236 adults and adolescents in that there was not true random sampling. In any such study, there are validity threats due to history, selection, and expectancy bias. Official records may not accurately represent the amount of abuse, delinquency, crime, or other risks, the criteria upon which the accuracy of results are judged. There may be some bias in the referral for examination. Perhaps other risks may be observed in larger samples and at different rates. There was heterogeneity of variance on some measures or risks, although for most risks, the assumptions of normality and homogeneity of variance were met. With over 60 years of successful empirical treatments, some with 27% to 35% diversion rates, perhaps the diversion rate of 52% found in Zagar, Busch, and Grove (2013) in the "Culture of Calm" might be high, but violence rates were greatly decreased and associated costs were saved; it is hard to argue with those facts.

Abuse, mental health, problem solving, receptive vocabulary, substance abuse, and violence are trait qualities, not states, and can be reliably and validly measured with support from considerable research literature (e.g., Ammons & Ammons, 1962; Mednick, 1969; Advokat, Eustis, & Pickering, 2005; Beck, 1978, 1991; Milner, 1980, 1986, 1990; Couron, 1982; Haddock & Mc-

Queen, 1983; Milner & Robertson, 1985; Muller & Bruon, 1986; Eyde, Kowal, & Fishburne, 1991; Shores & Carstairs, 1998; Butcher & Pancheri, 1976; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989; Butcher, Williams, Graham, Archer, Tellegen, Youssef, & Kaemmer, 1992; Butcher, 1996; Pope, Butcher, & Seelen, 2004; Raven, 1965, 1990; Flynn, 1984, 1987; Shultz, Kay, & Hoyers, 1990; Dillon, Pohlman, & Lohmen, 1981; Pietariu, 1981; Zagar & Grove, 2010; Miller, 1985, 1988, 1990, 1997; Miller & Lazowski, 1999; Miller, Roberts, Brooks, & Lazowski, 2003). One may argue whether it is reasonable to identify homicide or pedophilia-prone behavior proactively and intervene in a manner that limits individuals' constitutional freedoms, but one can predict and prevent violence by applying empirical treatments and offering interventions to youths and adults through the schools or through employee assistance and other health interventions. Confidence in the legality and practical utility of this approach should be high now that actuarial identification combined with empirical treatments has been applied with federal funding in a large urban center (Saulny, 2009; Shelton & Banchemo, 2009). Providing decision makers with actuarial data about individuals at entry to high school, university, or workplace and offering age-appropriate empirical treatments can not only divert individuals from a career of delinquency and crime, but also lower violence.

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