Objective: To examine the associations between displayed alcohol use and intoxication/problem drinking (I/PD) references on Facebook and self-reported problem drinking using a clinical scale.

Design: Content analysis and cross-sectional survey.

Setting: Facebook Web site (http://www.facebook.com/).

Participants: The study included undergraduate students (age range, 18-20 years) at 2 state universities with public Facebook profiles.

Main Exposures: The profiles were categorized into 1 of 3 distinct categories: Nondisplayers, Alcohol Displayers, and I/PD Displayers.

Outcome Measures: An online survey measured problem drinking using the Alcohol Use Disorders Identification Test (AUDIT) scale. Analyses examined associations between alcohol display category and (1) AUDIT problem drinking category using logistic regression, (2) AUDIT score using negative binomial regression, and (3) alcohol-related injury using the Fisher exact test.

Results: Among 307 profiles identified, 224 participants completed the survey (73% response rate). The average age was 18.8 years; 122 (54%) were female; 152 (68%) were white; and approximately 50% were from each university. Profile owners who displayed I/PD were more likely (odds ratio, 4.4; 95% CI, 2.0-9.4) to score in the problem drinking category of the AUDIT scale, had 64.0% (incidence rate ratio, 1.64; 95% CI, 1.27-2.11) higher AUDIT scores overall, and were more likely to report an alcohol-related injury in the past year (P = .002).

Conclusions: Displayed references to I/PD were positively associated with AUDIT scores suggesting problem drinking as well as alcohol-related injury. Results suggest that clinical criteria for problem drinking can be applied to Facebook alcohol references.


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These Web sites are popular among and consistently used by college students; current data suggest that between 94% and 98% of students maintain a SNS profile and most report daily use. The SNSs allow students to create a personal Web profile, to communicate with online friends, and to build an online social network. References to alcohol use are common on SNS; up to 83% of college students’ SNS profiles reference alcohol.

The association between SNS references to alcohol use and self-reported alcohol use remains unexplored. Facebook profiles may include disclosures of alcohol use, intoxication, or problem drinking. If references to these types of drinking behaviors are valid, these displayed references could potentially aid health care providers or college health systems in identifying students who may benefit from interventions to reduce problem drinking or alcohol-related injury. The objectives of this study were to examine the validity of references to alcohol use and intoxication/problem drinking (I/PD) on public US Facebook profiles applying clinical criteria and then to compare these displayed references with self-report using a validated problem drinking scale.

METHODS

This study was conducted between September 1, 2009, and September 15, 2010, and received institutional review board approval from both the University of Wisconsin–Madison and the University of Washington, Seattle.

SETTING AND PARTICIPANTS

This study was conducted using the SNS Facebook (http://www.facebook.com/). This site was selected because it is the most popular SNS among our target population of underaged college students. We investigated publicly available Facebook profiles of undergraduate students who were members of 2 large state US university Facebook networks. Profile owners were selected for the study if their reported age on the profile was between 18 and 20 years and if the profile showed evidence of activity in the last 30 days. We analyzed only profiles for which we could confirm the profile owner’s identity by calling a phone number listed on either the Facebook profile or the university directory.

PROFILE SELECTION

To reach a target sample size of 200 participants, 307 Facebook profiles owners were invited to participate in the study. Eligible profiles were identified by a random search of the freshmen, sophomore, and junior undergraduate classes at our 2 selected universities using the Facebook search engine. All profiles returned in the search results were assessed sequentially for eligibility until the target sample size was reached. Profiles were excluded if the students (1) did not meet search criteria and were thus incorrectly listed, including those who were not undergraduates (n=448), (2) did not meet the age criteria (n=313), or (3) did not display their age (n=49). They were also assessed for privacy settings, including those that had any of the following sections set to private: information section, wall, or photograph (n=1630); and they were excluded if a profile examination revealed that the student would not be reachable for recruitment because no contact information (phone number or e-mail) was listed on the profile or in the university directory (n=303).

PROFILE EVALUATION

All profiles were evaluated by 1 of 3 trained coders using our research codebook. We have used this codebook in previous work evaluating displayed alcohol references on SNS profiles. The coders viewed publicly accessible elements of the Facebook profile, including the wall, tagged pictures, profile pictures, and bumper stickers, to determine whether alcohol references were present. One year of profile data were assessed, starting from the date of evaluation and going back to the same date 1 year earlier.

A 20% random subsample of profiles were evaluated by all 3 coders to test interrater reliability. The Cohen κ statistic was used to evaluate the extent to which there was overall agreement in the coding of the presence or absence of alcohol references on a profile, as well as overall agreement among coders for the categorization of the alcohol references. The Cohen κ value was 0.83 for the presence or absence of alcohol references on profiles and 0.82 for the agreement among coders for the categorization of alcohol references, indicating excellent agreement between coders.

RECRUITMENT

For profiles that met inclusion criteria, profile owners were called on the phone. After the profile owner’s identity was verified, the study was explained to the profile owner and permission was requested to send an e-mail that contained further information about the study. If the participant consented to receive the e-mail, an e-mail that provided detailed information about the study, as well as a link to the online survey, was sent to the profile owner’s university e-mail account. Profile coding was not discussed with participants. The survey was administered online via a Catalyst WebQ online survey.
engine. Survey respondents were provided a $15 iTunes gift card as compensation.

SURVEY

The online survey evaluated alcohol use and problem drinking behaviors using the AUDIT, which has been validated among college students. A previous study in college students found the AUDIT to have a sensitivity of 0.84 and specificity of 0.71 for identifying problem alcohol use. The AUDIT is a 10-question scale, with most answers on a 0 to 4 Likert scale assessing consumption, dependence, and harm or consequences of alcohol use. Questions include an assessment of the frequency of drinking alcohol (never, monthly or less, 2-4 times a month, 2-3 times a week, and 4 or more times a week) and the frequency of binge drinking (never, less than monthly, monthly, weekly, and daily) as well as the negative consequences associated with alcohol use. The AUDIT scores can theoretically range from 0 to 40; a score of 8 or higher indicates that the person is at risk for problem drinking.

ANALYSIS

All statistical analyses were conducted using STATA version 11.0 (StataCorp, College Station, Texas). Demographic characteristics and Facebook-displayed alcohol categories were summarized using descriptive statistics. Bivariate comparisons between demographic characteristics and Facebook-displayed alcohol categories were conducted using the Fisher exact test and \( \chi^2 \) tests when appropriate. Then, 2 methods were used to examine the relationship between AUDIT scores and displayed alcohol categories. First, participants who had a total AUDIT score of 8 or higher were categorized as being at risk for problem drinking, as described in previous literature. The odds of being in the AUDIT category of at risk for problem drinking and displayed alcohol categories were assessed using logistic regression, with adjustment for age and sex and using Nondisplayer as the referent. Second, the relationship between total AUDIT scores and Facebook-displayed alcohol categories was examined. Because AUDIT scores were ordinal and right-skewed with an overrepresentation of participants with 0 scores, zero-inflated negative binomial (ZINB) regression was used. Because ZINB is designed to apply to nonnegative ordinal or to count data with an overrepresentation of 0s, outcomes are represented as incidence rate ratios. Both forward and backward stepwise ZINB regression models were conducted, with age and sex as covariates to determine the best model fit. To explore sex differences, the ZINB model was run separately by sex as covariates to determine the best model fit. To explore sex differences, the ZINB model was run separately by sex as covariates to determine the best model fit. To explore sex differences, the ZINB model was run separately by sex as covariates to determine the best model fit. To explore sex differences, the ZINB model was run separately by sex as covariates to determine the best model fit.

RESULTS

PARTICIPANTS

A total of 307 profile owners were invited to participate, and 224 participants completed the survey (73% response rate) (Table 1). The participants had an average age of 18.8 years and were 54.5% female and 67.9% white. Approximately 50% of the participants were from each university.

Table 1. Participant Information

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y (^a)</td>
<td>224</td>
</tr>
<tr>
<td>18</td>
<td>77 (34.4)</td>
</tr>
<tr>
<td>19</td>
<td>118 (52.7)</td>
</tr>
<tr>
<td>20</td>
<td>29 (12.9)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>102 (45.5)</td>
</tr>
<tr>
<td>Female</td>
<td>122 (54.5)</td>
</tr>
<tr>
<td>State</td>
<td></td>
</tr>
<tr>
<td>Washington</td>
<td>101 (45.1)</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>123 (54.9)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>152 (67.9)</td>
</tr>
<tr>
<td>Asian</td>
<td>38 (17.0)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (3.6)</td>
</tr>
<tr>
<td>Multiracial</td>
<td>17 (7.6)</td>
</tr>
<tr>
<td>Missing</td>
<td>9 (4.0)</td>
</tr>
<tr>
<td>Alcohol display category</td>
<td></td>
</tr>
<tr>
<td>Nondisplayer</td>
<td>144 (64.3)</td>
</tr>
<tr>
<td>Alcohol Displayer</td>
<td>44 (19.6)</td>
</tr>
<tr>
<td>I/PD Displayer</td>
<td>36 (16.1)</td>
</tr>
<tr>
<td>AUDIT score (^b)</td>
<td>216</td>
</tr>
<tr>
<td>Not a problem drinker, &lt;8</td>
<td>145 (64.7)</td>
</tr>
<tr>
<td>Problem drinker, ≥8</td>
<td>71 (31.7)</td>
</tr>
<tr>
<td>Missing</td>
<td>8 (3.6)</td>
</tr>
</tbody>
</table>

Abbreviations: AUDIT, Alcohol Use Disorders Identification Test; I/PD, intoxication/problem drinking.

\(^a\)Mean (SD) age, 18.8 (0.7) years.

\(^b\)Mean (SD) AUDIT score, 5.8 (4.9).

DESCRIPTIVE AND BIVARIATE DATA

Facebook-Displayed Alcohol Categories

Of the Facebook profiles coded, 64.3% had no alcohol references displayed on the profile (Nondisplayers), 19.6% displayed references to alcohol use (Alcohol Displayers), and 16.1% displayed references to intoxication or problem drinking (I/PD Displayers). There were no differences in age or sex or between the 2 universities among Nondisplayers, Alcohol Displayers, or I/PD Displayers. The I/PD Displayers were more likely to be white (83.0%) compared with other races (P = .03). Table 2 illustrates these bivariate relationships between demographic information and Facebook-displayed alcohol categories.

AUDIT Score

A total of 216 participants completed all AUDIT questions and received a total AUDIT score. The total AUDIT scores ranged from 0 to 26, with a mean (SD) score of 5.8 (−4.9) and a median score of 5. Using the standard cutoff of at-risk for problem drinking as a score of 8 or higher, 35.4% of participants scored into the at-risk for problem drinking category.

AUDIT PROBLEM DRINKING CATEGORY AND FACEBOOK-DISPLAYED ALCOHOL CATEGORIES

Displayed alcohol references on Facebook were positively related to being categorized as at risk for problem drinking: 58.3% of I/PD Displayers met the criteria for
the at-risk problem drinking category compared with 37.8% of Alcohol Displayers and 22.6% of Nondisplayers ($P = .001$). In a logistic regression model, compared with Nondisplayers, I/PD Displayers were more likely (odds ratio [OR], 4.4; 95% CI, 2.0-9.4) to be at risk for problem drinking. Findings for Alcohol Displayers were not statistically significant (OR, 1.97; 95% CI, 0.95-4.0) (Figure 1).

AUDIT SCORE AND FACEBOOK-DISPLAYED ALCOHOL CATEGORIES

The AUDIT score for I/PD Displayers was 9.5 (−6.0); the AUDIT score for Alcohol Displayers was 6.7 (−4.3); and the AUDIT score for Nondisplayers was 4.7 (−4.0) ($P < .001$). Neither age nor sex was significant in forward and backward regression; therefore, the ZINB model included only AUDIT scores and Facebook-displayed alcohol categories. Compared with Nondisplayers, I/PD Displayers had 1.64 times higher AUDIT scores (95% CI, 1.27-1.10) ($P < .001$). Compared with Alcohol Displayers, I/PD Displayers had 1.48 times higher AUDIT scores (95% CI, 1.10-1.10). The difference in AUDIT scores between Alcohol Displayers and Nondisplayers did not reach statistical significance ($P = .20$).

SEX DIFFERENCES

When models were run separately by sex, the relationship between AUDIT scores and Facebook-displayed alcohol categories showed coefficient estimates for men that were nearly twice as large as for women. Men who were I/PD Displayers had an 89% higher AUDIT score than men who were Nondisplayers ($P = .001$). Women who were I/PD Displayers were not significantly more likely to have a higher AUDIT score (37% higher) ($P = .07$). However, when sex was included in the model, these differences did not reach statistical significance ($P = .15$).

FACEBOOK ALCOHOL DISPLAY CATEGORIES AND ALCOHOL-RELATED INJURY

Overall, 160 participants (88%) reported that they had never experienced an alcohol-related injury, 8 (4%) reported a history of alcohol-related injury but not in the last year, and 14 (5%) reported an alcohol-related injury in the past year. The I/PD Displayers were more than twice as likely as the Alcohol Displayers (19% vs 7%).

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**Table 2. Participant information by Alcohol Display Category**

<table>
<thead>
<tr>
<th></th>
<th>Nondisplayer</th>
<th>Alcohol Displayer</th>
<th>I/PD Displayer</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>53 (36.8)</td>
<td>16 (36.4)</td>
<td>9 (22.2)</td>
<td>.28</td>
</tr>
<tr>
<td>19</td>
<td>76 (52.8)</td>
<td>22 (50)</td>
<td>20 (55.6)</td>
<td>.32</td>
</tr>
<tr>
<td>20-21</td>
<td>15 (10.4)</td>
<td>6 (13.6)</td>
<td>8 (22.2)</td>
<td>.25</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>67 (45.9)</td>
<td>16 (35.6)</td>
<td>19 (52.8)</td>
<td>.03</td>
</tr>
<tr>
<td>Female</td>
<td>77 (52.7)</td>
<td>18 (62.2)</td>
<td>17 (47.2)</td>
<td></td>
</tr>
<tr>
<td><strong>State</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washington</td>
<td>68 (46.6)</td>
<td>15 (33.3)</td>
<td>18 (50.0)</td>
<td></td>
</tr>
<tr>
<td>Wisconsin</td>
<td>76 (52.1)</td>
<td>29 (64.4)</td>
<td>18 (50.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>89 (61.0)</td>
<td>33 (73.5)</td>
<td>30 (83.3)</td>
<td>.01</td>
</tr>
<tr>
<td>Asian</td>
<td>29 (19.9)</td>
<td>6 (13.3)</td>
<td>3 (8.3)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>3 (2.1)</td>
<td>4 (8.5)</td>
<td>3 (8.3)</td>
<td></td>
</tr>
<tr>
<td>Multiracial</td>
<td>15 (10.3)</td>
<td>2 (4.4)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>8 (5.5)</td>
<td>1 (2.2)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>AUDIT score</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Not a problem drinker, &lt;8</td>
<td>103 (70.5)</td>
<td>27 (60.0)</td>
<td>15 (41.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Problem drinker, ≥8</td>
<td>33 (22.6)</td>
<td>17 (37.8)</td>
<td>21 (58.3)</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>8 (5.5)</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: AUDIT, Alcohol Use Disorders Identification Test; I/PD, intoxication/problem drinking.

*a* Fisher exact test.

*b* Two-tailed test.

*c* Bivariate zero-inflated negative binomial regression.

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Figure 1. Association between displayed alcohol categories on Facebook and Alcohol Use Disorders Identification Test (AUDIT) problem drinking score. I/PD indicates intoxication/problem drinking.
and more than 6 times as likely as the Nondisplayers (19% vs 3%), to report an alcohol-related injury in the past year ($P = .002$) (Figure 2).

**COMMENT**

To the best of our knowledge, this is the first study to demonstrate an association between specific content of displayed alcohol references on Facebook using clinical screening criteria and self-reported problem drinking behaviors and consequences. Our data illustrate that participants who chose to display references to intoxication or problem drinking on publicly available Facebook profiles were more likely to meet problem drinking criteria using the AUDIT score than participants who displayed either no alcohol references or alcohol references on their Facebook profiles.

Our findings further illustrate that mean AUDIT scores increase as categories of displayed alcohol references on Facebook profile escalate. The lowest mean AUDIT scores were among the Nondisplayers; higher mean AUDIT scores were found among the Alcohol Displayers; and the highest mean AUDIT scores were among the I/PD Displayers. The group of I/PD Displayers was the only group with mean AUDIT scores in the problem drinking category. Also, I/PD Displayers were more likely to report experiencing an alcohol-related injury in the last year. Facebook displays of I/PD may be an indicator of overall problem drinking concerns as well as of short-term morbidity related to alcohol use in the college population. Therefore, it can be concluded that there is likely a difference in clinical relevance between displayed alcohol references and I/PD references as representations of college alcohol use.

Our findings related to sex suggest that the association between I/PD Displayers and AUDIT scores may be stronger for men than for women. Compared with female college students, male college students are more likely to drink alcohol as well as to engage in binge drinking. Furthermore, men are less likely to be seen in clinic; approximately 38% of men reported having a preventive health check in the past year compared with 69% of women. Therefore, if Facebook presents a valid complementary method of identifying men who are at high risk for problem drinking, then this method would likely capture a population with high rates of problem drinking and a low likelihood of seeking care in a clinic.

Our study findings are limited in that we only examined publicly available profiles on 1 SNS. Therefore, we cannot generalize our findings to profiles that have security set to private or to profiles on other SNSs. It is important to note that SNS profile privacy settings are not permanent; profile owners may change their privacy settings at any time or to reflect what security upgrades are offered by Facebook. It is unclear whether profile owners who maintained a private profile at the time of this study would be more likely, or less likely, to display alcohol references. For this study, the finding that our prevalence of problem drinking was consistent with other national estimates suggests that our sample was representative. Study findings are also limited in that our study sample included very few minority students and no African American participants, which is consistent with the demographic of our universities.

Despite these potential limitations, our findings have important implications. Although approximately half of the screened profiles were excluded because of privacy settings, at present only 12% of college students report undergoing alcohol screening using a standardized instrument. Facebook is used by up to 98% of the college population, and about half of college students’ profiles in our study were public; therefore, the use of Facebook as a complementary and innovative screening tool still represents a substantial improvement over the norm. Our goal in evaluating publicly available profiles was to assess information that could be viewed by any Facebook user’s peers, parents, professors, or other university affiliates. By assessing public profiles, our goal was to identify a subset of the Facebook population that may be accessible for future intervention efforts.

There are several ways in which these findings could contribute to enhancing alcohol screening or intervention efforts among college students. Attention to both privacy concerns and ethics is paramount to the success of any future research or clinical efforts involving SNSs. A first option is to use displayed information on SNS profiles as a way to identify students at risk and to recommend that these students be seen in clinic for further screening or counseling. Findings in our study suggest that approximately half of the profiles were excluded because of privacy settings. Since the time of our data collection, Facebook profile security settings have again changed, and there are more options to set sections of the profile to private, while leaving the profile itself publicly available. It is possible that more profiles may now be publicly available. As Facebook security is always changing, it is likely that an ideal target to undertake initial screening is someone known to the college student who would have full access to profile content. This approach may also lead to better acceptance by the profile owner if he or she is approached with concerns and a request to undergo further clinical screening. It is possible that trusted peer leaders such as dormitory resi-
dent advisors could receive training in identification of at-risk students from Facebook I/PD references. These peer leaders could then provide resources to a student who displayed repeated concerning references on Facebook. Our findings suggest that training in CRAFFT criteria could allow such peer leaders to distinguish a student who displays references to problem drinking from students who may display references to alcohol on Facebook.

Another consideration is the role of the clinician in these screening efforts. It is unlikely that a clinician would have the time or the training to undertake evaluation of Facebook profiles in the college health setting. However, clinicians may be approached by parents, professors, or administrators regarding the content of a student’s Facebook profile. These study findings can be used for offering evidence-based guidance recommending that students who display references to I/PD on Facebook undergo clinical screening for problem alcohol use.

A final consideration is the use of targeted messaging based on the displayed content on a SNS profile. This approach could provide messages to Facebook profile owners regardless of privacy settings. Advertisements on Facebook are triggered by keywords displayed on the profile. For example, displayed text references to terms such as diet will trigger advertisements for weight loss services displayed next to the profile. It is possible that universities could choose to place messages or educational materials such as an online alcohol screening program targeted to keywords representing problem drinking behaviors. Our findings suggest that targeting key-words that relate to I/PD, rather than to general key-words regarding alcohol, may provide an innovative method to deliver a tailored message to a target population. Before such efforts can move forward, we need to have a better understanding of what type of messages would be acceptable to the college population as pop-up advertisements.

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Author Contributions: Dr Moreno had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Moreno, Christakis, and Brockman.

Analysis and interpretation of data: Moreno, Christakis, Egan, Brockman, and Becker.

Drafting of the manuscript: Moreno, Christakis, Egan, Brockman, and Becker.

Critical revision of the manuscript for important intellectual content: Christakis, Egan, Brockman, and Becker.

Statistical analysis: Christakis and Becker.

 Obtained funding: Moreno, Christakis, and Brockman.

 Administrative, technical, and material support: Christakis and Brockman.

Study supervision: Christakis and Brockman.

Financial Disclosure: None reported.

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Role of the Sponsor: These funding agencies had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript.

Additional Contributions: Hope Villiard, Megan Pumper, Lauren Kacvinsky, and Kaitlyn Bare contributed to the data collection for this project, and Marcia Scott, PhD, provided support and advice.

REFERENCES


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**Poetry in Pediatrics**

**Flags**

I am pointed
by the red flag
toward danger, perhaps . . .
an exanthem turned enanthem,
a marrow awakened at night,
a fever-stiffened neck,
an inappropriate touch.

Once inside,
the green flag
signals everyone.
I am symptomatically
engaged in battle,
an historic examiner,
searching for signs
of imminent death.

Do I need to raise
the blue flag?
A call for oxygen
to the gasps of the cyanotic
for fluids to the
cold and unperfused
vasodilated in vicious cycle
by a circulating enemy?

Or can I move with caution
the yellow flag
yielding more time,
for more information,
to gather blood or
peer through bone
and increase my certainty
of the origin of this war?

By the end of this day,
the white flag
is raised half-mast, perhaps . . .
to one lost in the fight,
wounded beyond victory
despite the protection
of a doctor fully surrendered.

*Aaron Michael McGuffin, MD*

Photograph taken by David Kendall, MA, graphic artist in the Office of Medical Education, Marshall University School of Medicine.