Theoretical Formulas for Modeling Capability and Lethality in Normal and Abnormal Mental States

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Here are some formulas that may be useful in estimating human functionality and dangerousness.

They touch on the tradition of Structural Equation Modeling (SEM), but without the level of statistical and data-intensive work associated with SEM. Instead they more closely resemble heuristic formulas, such as Lewin’s equation. I chose the four variables -- self-worth, psychomotor activity, irrationality and futility -- not because they are the only factors of importance in determining healthy functioning and dangerousness, but because they represent basic elements that can be mathematically combined in ways that may have diagnostic and therapeutic significance. They can also be measured readily using existing psychometric instruments or as traditional components of the standard mental status exam.

The Formula for Modeling Capability (CPB) - the capacity for healthy functioning

\[
CPB = \left( \frac{e \times b}{f \times i^2} \right) \times k
\]

CPB is the product of motivation (m) and competence (c): \( CPB = m \times c \)

\( m \) is the ratio of self-worth (e as in “ego”) to hopelessness (f as in “futility”): \( m = e/f \).

\( c \) is the ratio of psychomotor activity (b as in “behavioral output”) to irrationality (i): \( c = b/i^2 \).

The four factors used in these formulas range in value from 1 (extremely low) to 5 (extremely high) with 3 representing normal in the case of the bivalent factors \( e \) and \( b \), and 1 being normal for the univalent factors \( f \) and \( i \). The squaring of \( i \) reflects its exponential decremental effect on competence. The value of \( ((e \times b)/(f \times i^2)) \) is multiplied by the constant \( k (k = 1.111) \) to adjust the scale so that the normal value of \( CPB \) is 10.

CPB measures mental health more than the usual notion of capability. For example, an individual with a severe antisocial personality disorder has a low \( CPB \), not because he cannot capably plan
and successfully carry out a lethal crime, but because he is incapable of healthy work and social relationships.

The Formula for Modeling Lethality (LTH) - suicide and/or homicide risk

\[ LTH = (e \times f^2 \times b \times i) \times k \]

$LTH$ is the product of volatility ($v$) and impulsivity ($I$): $LTH = v \times I$ where $v = e \times f^2$ and $I = b \times i$.

The squaring of $f$ reflects its exponential incremental effect on volatility. The product of $(e \times f^2 \times b \times i)$ is again multiplied by the constant $k$ ($k = 1.111$) to adjust the scale so that the normal value of $LTH$ is 10.

**EXAMPLES:**

<table>
<thead>
<tr>
<th>DIAGNOSIS</th>
<th>SELF-WORTH (e)</th>
<th>ACTIVITY (b)</th>
<th>FUTILITY (f)</th>
<th>IRRATIONALITY (i)</th>
<th>CAPABILITY (CPB)</th>
<th>LETHALITY (LTH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORMAL</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>SCHIZOPHRENIA</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>DEPRESSION</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>139</td>
</tr>
<tr>
<td>MANIA</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>139</td>
</tr>
<tr>
<td>ADDICTION</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>ANTISOCIAL</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1,111</td>
</tr>
</tbody>
</table>

The above values approximate epidemiological rankings.(1, 2) Although paranoid schizophrenia can increase dangerousness to others, the elevated $LTH$s associated with schizophrenia and mood disorders are primarily associated with increased suicide risk. The high $LTH$s seen in alcohol, drug and antisocial disorders, on the other hand, reflect higher homicide as well as suicide risk. Modeling equations are useful because the levels of independent variables like $e$, $b$, $f$ and $i$ are not identical within and between diagnostic groups. Differences in those levels caused by individual variation or perturbing influences can be applied in the formulas to observe resulting effects on dependent variables $CPB$ and $LTH$. For instance, higher levels of $f$ and $i$ (when not already maximized), which might result from the widespread economic hardship predicted to occur later in this century, would tend to lower $CPB$ and raise $LTH$ throughout the population.

Here is how these formulas can work in clinical practice. The depression example above represents severe major depression with psychosis. Values are based on very low self-worth ($e = 1$), extreme psychomotor retardation ($b = 1$), intense delusions of guilt ($i = 5$), and total hopelessness ($f = 5$). As shown in the table, $CPB = 0$ and $LTH = 139$. After 2 weeks of psychiatric inpatient treatment, the patient evidences some improvement in self-worth ($e = 2$),
remitted psychosis ($i = 1$) and increased energy ($b = 4$), but remains very hopeless about the future ($f = 5$); and yet he is now smiling more. Because of his seeming improvement, he is discharged on antidepressant and antipsychotic medications. Recalculating the two formulas it can be determined that his CPB has improved to 2, but LTH has worsened to 222. Careful assessment by the patient's outpatient psychiatrist reveals that this now more energetic and capable patient has actually decided to commit suicide using the medication received upon discharge. The increased LTH helps diagnose "smiling depression," the faux improvement seen when depressed patients recover enough energy to pursue a suicide plan. Coordinated suicide monitoring with the patient's family and appropriate therapeutic intervention enables the patient to survive the suicidal crisis. A month later, with his hopelessness significantly reduced ($f = 2$) and normal self-worth ($e = 3$) and activity ($b = 3$) restored, the patient's CPB improves to 5 and his LTH to 36. Remission is achieved and continues with ongoing psychotherapy and medication management by his treating psychiatrist.

The antisocial example with the LTH of 1,111 is modeled after an actual case assessed by police and mental health professionals as not dangerous just before he went on a killing spree resulting in six homicides and his own suicide. Were medical professionals and law enforcement personnel to measure CPB and LTH in their assessments, it is possible that they would be able to identify the dangerousness of cases like this more accurately. As instructive as formulas like these might be, however, they should only be utilized in the spirit of Pascal, who wisely noted 450 years ago that the truths of geometry are of limited value to human understanding. Characteristics that frequently elude accurate assessment are best addressed by combining the empirical objectivity of science with the deductive intuition of clinical experience.

References
