Title of Entry: Blending Innovative Technology in Routine Clinical Care: Improving Mutual Decision Making and Individualized Treatment in the Psychiatric Hospital Setting

Division: Medium Organizations

Award: Excellence in Care

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Executive Summary: Must include: a) title of entry; b) description of the problem/opportunity, including goal, and target audience(s); c) evidence; d) baseline data; e) intervention; and f) results.

a. Problem/opportunity: We recognize the need to foster “reliable, open, and real-time” dialogue between patients, families and professionals when describing, reporting and monitoring mood changes in patients. This is particularly challenging on the inpatient units because majority of inpatients present with mood instability (regardless of the admission diagnosis) and families/relatives are limited to few times a day hospital visits to see their loved ones.

b. Evidence: One may think that “mood monitoring” is analogous to blood sugar monitoring in patients with diabetes. However, there is very limited empirical knowledge about effective mood monitoring. Furthermore, late or wrong identification of the mood state may have a spiraling effect with worsening of symptoms with increased risk for aggression, suicide, and self-injurious behaviors. Thus, our program includes innovative approaches to use technology in an aim to connect youth, parents, and clinicians real-time to visualize the course of mood and energy that in turn can foster mutual decision on the relationship between mood changes and treatment.

c. Baseline data: Mood disorders are increasingly recognized as a significant public health problem and suicide is still one of the leading causes of death in youth. Studies suggest that many youth still receive wrong diagnosis including during the hospital admissions, which has significant implications for treatment of mood disorders in youth (e.g., antidepressants may induce mixed mania and suicide when prescribed for the depressed or anxious youth with undiagnosed mania). Several studies have shown that it takes on average 10 years to distinguish mood upswings from depression and begin correct treatment, indicating the need for timely detection and treatment of this serious illness. Early and correct diagnosis and treatment is critical to enable the youth to follow a normative psychosocial developmental.

d. Intervention: An innovative self-report mood rating (“Mood and Energy Thermometer:MET”) with subjective (mood) and objective (energy) anchors is developed by the treatment team in our hospital, and the paper-form of this scale has been shown to be an improved and practical way of monitoring complex mood cycles and daily schedule since 2010. This novel scale also takes into account time spent in depression and mania. Our inclusion of measuring energy levels is consistent with the new Diagnostical and Statistical Manual-DSM 5. We advanced our scale by including new “anger” and “anxiety” 1-10 ratings and then “in 2014 developed a web-based platform” to improve communication and partnership between youth, parents, and physicians. Youth now enter their ratings twice a day using an interactive projector on the inpatient unit while our trained clinicians coach them simultaneously about effective use of the MET scale, aiming for accurate and independent use. The web-based platform includes "alert my treatment team mode" for high score entries as well as "simplify me" options to engage diverse populations. The ratings are “pushed into parents’ and clinicians’ emails/telephones in real-time twice daily,” and are also available in a secure database for future online access. In addition, every youth on our inpatient unit are wearing a “durable wrist-worn actigraphy device (Philips ActiWatch 2)” since 2014 that enables the treatment team to monitor “minute-by-minute activity levels” of the youth. These activity measures are mapped on the electronic mood energy self-ratings to improve mood monitoring and diagnostic clarification. The objective sleep measures (e.g., time to go to sleep, number of awakenings, total sleep time) and change in the activity levels have become a part of our unit routine and are printed out daily from the actigraphy measures.

e. Results: These integrated innovative electronic real-time “mood and energy ratings” and “actigraphy” approaches have improved objective mood measures and enhanced mutual decision making about the correct diagnosis and the best intervention for the youth. About 98% of patients and parents are engaging in electronic mood and actigraphy monitoring proving that technology can be successfully blended/integrated in routine clinical care in the hospital setting. Youth reported that their overall outlook on life increased 332% after these approaches. As a result of integrated interventions, there were 97.3% of the youth showed overall “much and very much improvement (CGI ≤ 2)” after the inpatient treatment (out of 97.3%; many had improvement of both depression and mania, but in summary 94.6% regarding the clinical picture of depression and 65.8% regarding the clinical picture of mania). We identified a new primary mood disorder diagnosis who did not previously had on admission in majority of the patients (false negative rate 67%). Furthermore, we uncovered significant comorbid mental health conditions in all patients (100%) that were not identified before. Our program provided specific training to 60 inpatient staff and 20 child psychiatry residents and fellows, and 30 case managers of the local insurance company. There was overall 72% decrease in seclusion and restraint rates since we rolled out our program. Finally, readmission (30-day) rate for our program was 4% in the past year compared to 15% of the national average.
Mood disorders are the sixth leading cause of morbidity worldwide and increasingly recognized as a significant public health problem. Major depression, also known as persistent downswing of the mood, is the #1 leading cause of disability among adults (worldwide) while suicide is leading cause of death in US (#3 in youth and #9 in adults). Both depression and mania are often associated with impaired family and peer relationships, poor academic performance, high rates of comorbid psychiatric (e.g., ADHD, substance use) and medical problems (e.g. obesity, thyroid problems, diabetes), elevated rates of hospitalization and suicide.

Despite the sharp increase in the rates of pediatric depression and mania over the past decade, studies suggest that many youth still receive wrong diagnosis (false positive=overdiagnosis and false negative=underdiagnosis) during the hospital admissions, which has significant implications for treatment. For example, antidepressants may induce mixed mania and suicide when prescribed for the depressed or anxious youth with undiagnosed mania. On the other hand, if a youth is wrongly given a mania diagnosis, a mood stabilizer would not make his/her problems better and puts the child at risk for significant side effects. Furthermore, late or wrong identification of mood state may have a spiraling effect on mood cycles with increased risk for aggression, suicide, and self-injurious behaviors. Given the high rates of morbidity and mortality of depression and mania, “early and correct” diagnosis and treatment in youth with mood disorders is a key factor for not only mood stabilization but also enabling the child to follow a normative developmental path and prevent an unrecoverable loss in the child’s psychosocial development and education. However, many youth experience difficulty in identifying their mood state; for example a youth with significant depression may label their mood as manic when in fact she/he feels a little bit better due to a brief relief from depression. In addition, many parents experience great difficulty in correctly identifying and reporting mood state of their children, especially teenagers, that in turn complicate the correct diagnosis and treatment decisions.

This is particularly challenging on the inpatient unit because the majority of inpatients present with mood instability (regardless of the admission diagnosis) and parents are limited to few visits to see their children. Prolonged and significant change of the mood that is beyond the child’s cognitive/emotional development is necessary for a diagnosis of depression or mania. However, it is difficult to capture these changes as many inpatient youth experience multiple mood cycles during the day that includes both ups and downs. Furthermore, healthy adolescent development includes some mood fluctuations that make it more difficult to differentiate from psychopathology. In addition, available studies have consistently reported that parents and adolescents often disagree on the youth’s current mood state. This discordance between youth and parents in identifying the changes in mood confuse diagnosis and disrupt the therapeutic interventions. Furthermore, using the traditional/existing clinical practices, the inter-rater reliability between clinicians to make depression diagnoses (e.g., major depressive disorder and mixed anxiety-depressive disorders) had questionable (kappa=0.23) and unacceptable (kappa=0.05) scores. Thus, many patients get wrong diagnosis and harmful/contraindicated treatment interventions for about 10 years before their condition is correctly identified and appropriately treated.

One may think that “mood monitoring” is analogous to blood sugar monitoring in patients with diabetes or blood pressure monitoring for hyper/hypotension problems, but the normal/abnormal blood sugar levels are universally established for diabetes and hypertension/hypotension diagnoses, respectively. On the other hand, there is very limited empirical knowledge about effective and objective mood monitoring. Furthermore, late or wrong identification of the mood state may have a spiraling effect on mood cycles and costly higher level of services. The total economic burden of depression alone in 2000 was $83 billion in the US alone, and 26.1 billion dollars (31%) were direct medical costs, 5.4 billion dollars (7%) were suicide-related mortality costs, and 51.5 billion dollars (62%) were workplace costs mainly due to low productivity of workers.

Considering the limited empirical knowledge about mood monitoring in youth and lack of data in the hospital setting, a “reliable, open, and real-time” dialogue between patients, parents and professionals when describing, reporting, and monitoring mood cycles has great potential to aid early identification and treatment of pediatric mood disorders during inpatient stay. Thus, more investments are urgently needed in mood assessment & monitoring tools considering personal/family, community, and economic burden of late/incorrect identification of mood swings. Our program includes innovative approaches to use technology in an aim to connect youth, parents, and clinicians real-time to visualize the course of mood and energy, that in turn can foster mutual decision on the relationship between mood changes and treatment and improve correct diagnosis and individualization of treatment interventions.
Intervention: Identify the steps taken to initiate your effort(s) including strategies, implementation plan, and the interventions.

We aim to incorporate technology to transform how patients can better participate in their assessment and how patients, parents, and physicians can better connect and partner for diagnostic and treatment decisions.

- **Developing an innovative mood monitoring scale:** An innovative self-report mood rating scale (“Mood and Energy Thermometer: MET”) with subjective (mood) and objective (energy) anchors is developed by the treatment team in our hospital, and the paper-form of this scale has been shown to be an improved and practical way of monitoring complex mood cycles and daily schedule since 2010. Mood is subjective by definition, but—in contrast to the 1-10 pain scale—no universally accepted scale existed in the field for mood. Youth can identify and report the changes in their energy levels (an “objective/observable measure of mood state”) more accurately than labeling their mood (“a subjective report of mood state”); therefore, we incorporated energy levels in the mood rating. This novel MET scale also takes into account time spent in depression and mania. Our inclusion of measuring energy levels is consistent with the Diagnostical and Statistical Manual-DSM 5\(^{11}\) that is released in 2014, because energy level is now in DSM 5 as a main “objective mood symptom criterion.” Furthermore, in our scale, mania and increased energy are rated on a 1 to 10 scale and depression and tiredness are rated on -1 to -10 scale to form a common language between patients, parents, and clinicians.

- **Developing a unique web-based portal for real-time mood monitoring:** We advanced our scale two years ago by including new “anger” and “anxiety” 1-10 ratings and then with the support of “YYYYY’s Clinical Transformation Program” we “developed a web-based platform in 2014” to improve communication and partnership between youth, parents, and physicians (www.ZZZZZ.com). We have developed the web-based interactive platform, inpatient-safe interactive projector/computer, e-communication station for parents, and training activities. Youth now enter their ratings twice a day using an interactive projector (“touch-wall technology”) on the inpatient unit. Our trained clinicians coach them simultaneously about effective use of the scale, to enhance accuracy and independent use. We aim to engage diverse populations including those with cognitive and psychosocial challenges; thus, the web-based platform includes “simplify me” options (e.g., “mild/moderate/severe” rather than numbers). Our web portal has “alert my treatment team” mode for high score entries. These ratings are being pushed into parents’ and physicians’ emails or cell phones (with a secure web link) in real-time twice daily. They are also available in a secure database for parents’/physicians’ future access (with a secure ID/password) from any kind of smartphone or computer. We set up an e-communication station for parents in the waiting area in case some parents may not have access to internet outside the hospital.

- **Blending actigraphy measures into mood monitoring:** In an aim to measure change in activity levels for accurately and reliably, every youth on our inpatient unit are wearing a “durable wrist-worn actigraphy device (Philips ActiWatch 2)” since 2014 that enables the treatment team to monitor “minute-by-minute activity levels” of the youth. This approach mimics ongoing (heart rate) monitoring in cardiology inpatient units. There are available apps for mood tracking from free-of-charge to $4.99 as well as physical activity tracking apps, but none of them have a scientific way to integrate these measures. Even if they attempted, in addition to accelerometer related measurement differences, individual differences (e.g., job/school requirement, medical conditions, caffeine intake, and exercise habits) would make clinical interpretations of activity counts very difficult to interpret. In our novel program, these activity measures through actigraphy device are scientifically mapped on the electronic mood&energy self-ratings to improve mood monitoring and diagnostic clarification; thus, enables us individualization of these measures to generate clinically meaningful information.

- **Blending the tech-driven activities into routine clinical care:** The mood&energy ratings on our web-portal and the objective sleep measures (e.g., time to go to sleep, number of awakenings, total sleep time), change in the activity levels have become a part of our unit routine and are printed out daily from the actigraphy measures. Thus, our involving technology is not a burden to the unit’s schedule or staff’s treatment activities. In contrast, the treatment team, parents, and the youth “partner” in technology-driven real time objective information about mood, energy, activity, and sleep measures that enable them as a team to discuss critical information for correct diagnosis and individualized treatment interventions.
Results: Summarize the success of your initiative and provide evidence of sustained improvements.

These integrated innovative electronic real-time “mood and energy ratings” and “actigraphy” approaches have improved objective mood measures and enhanced mutual decision making about the correct diagnosis and the best intervention for the youth:

- Because communication between youth and their parents is often further disrupted during a psychiatric admission (e.g., avoiding communication or being angry about the behaviors that led to the hospitalization); our web-based platform foster uninterrupted exchange of information about the youth’s progress during the inpatient stay. Since 2014, about 98% of patients and parents (~300) are engaging in electronic mood and actigraphy monitoring proving that technology can be successfully blended/integrated in routine clinical care in the hospital setting.
- Youth reported that their overall outlook on life increased 332% after our integrated approaches using technology. Almost 100% of the inpatient youth enjoyed using technology in monitoring their mood state and reported interest in monitoring their mood changes even after hospital stay. Rather than seeing this as a boring inpatient routine like blood pressure/heart rate measures in the morning, majority of the inpatient youth were seen as taking the initiative on the inpatient use to use the hand-held scanners to start the web-portal’s mood&energy rating.
- As a result of our integrated interventions, there were 97.3% of the youth showed overall “much and very much improvement (CGI ≤ 2)” after the inpatient treatment (out of 97.3%; many had improvement of both depression and mania, but in summary 94.6% regarding the clinical picture of depression and 65.8% regarding the clinical picture of mania).
- Real-time information about the youth’s daily mood rating has improved parent’s understanding of complex mood cycles and minimizes discrepancy between youth- and parent-reports. This process helps improve informed decision on evidence-based treatment options.
- With the help of integrated approaches using technology (clinical assessment combined with mood&energy ratings on our web-portal, the objective sleep measures (e.g., time to go to sleep, number of awakenings, total sleep time), and change in the activity levels on actigraph), we identified a new primary mood disorder diagnosis that was not previously identified on admission in majority of the patients (false negative rate= 67%).
- Our integrated approach has helped us uncover significant comorbid mental health conditions in all patients (100%) that were not identified before.
- There was overall 72% decrease in seclusion and restraint rates since we rolled out our program.
- Additionally, securing the daily ratings on a secure database allows physicians, youth, and parents to visualize the longitudinal course of mood during the inpatient stay, and foster discussions for relapse prevention after discharge. Consequently, readmission (30-day) rate for our program was 4% in the past year compared to 15% of the national average for mental health admissions.
- Our program provided specific training to 60 inpatient staff and 20 child psychiatry residents and fellows, and 30 case managers of the local insurance company.
- We have received invitations to present our integrated approaches to the local, national, and international scientific communities.
Title: Blending innovative technology in routine clinical care: Improving mutual decision making and individualized treatment in the psychiatric hospital setting

Adaptability: Describe the potential ability to replicate your initiative in other organizations that provide the same service or serve the same type of population. Also, describe how to maintain the initiative and/or its results, any negative outcomes, areas of improvement or lessons learned.

- **Building up team:** Being proactive in updating the administration with each step is very important to keep multiple key people on the same page when developing an innovative program. Involving Information System Department (ISD) and employing electronic records is very important for screening purposes and incorporating technological advances. Providing repeated interactive training sessions is critical for not only building up clinicians’ assessment and intervention skills but also to share enthusiasm and strengthen the team spirit. Furthermore, our hospital has supported key staff’s attendance to national scientific meetings for learning from and networking with national experts. We implemented “family groups” and “community meetings” to proactively engage families and adolescents, successively, who are the most important members of the treatment team and we also learned that no program can succeed without their active participation.

- **Objective mood monitoring:** Given that differences in available 1-10 mood scales add more to the confusion (e.g., in contrast to the well-established pain scale where higher scores mean more pain, a 10 in commonly used mood scales could mean extreme or no depression), we considered to improve the language in communicating/monitoring mood cycles. Our novel MET scale will benefit all youth both to confirm and rule out mood disorders. Improving patients’ rating of their mood and energy levels every day with on-site guidance of our experienced clinician (and real-time communication between parents and physicians) has significant clinical value for not only correct diagnosis and treatment but also prevention of future episodes. We provide our novel MET scale free of charge (http://www.ZZZZZZ.zzz/content.asp?id=2333#3604)

- **Intervention:** Our promising results for early and correct identification of mood disorders using technology (clinical assessment combined with mood&energy rating scale on our web-portal, the objective sleep measures and change in the activity levels on actigraph) can be adapted by other providers. Investing in technological advances and using scientific methods to generate individual specific information that has significant clinical value can be convincing to other hospitals and insurance companies to adopt and support our integrated approaches for correct diagnosis and appropriate individualized treatment interventions.

- **New clinical knowledge:** Our program is the first mental health inpatient mental health services in the nation that integrates technology into the routine clinical practice and is a successful integrated model of an evidence-based care of inpatients with mood problems. With the help of the web-based platform supported by the YYYY’s Clinical Transformation Program, we are able to analyze daily mood cycles and their associations with youth’s psychiatric diagnosis, treatment, safety concerns (e.g., seclusion, restraints, self-injurious behaviors), and their satisfaction with the services/partnership. Thus, our project has the potential to contribute to the development of best practices that advance the quality of health care locally and nationally.

- **Disseminating the experience:** We have started to disseminate our results at regional/national meetings. We have provided training to 60 inpatient staff and 20 child psychiatry residents and fellows, and 30 case managers of the local insurance company. Three faculties from other university hospitals, 6 physicians from other countries rotated with us to learn about our innovative approaches. Our treatment team authored an article about assessment of BD (including the innovative methods about our decreasing false diagnostic rates) for a university publication that is distributed to nearly 25,000 psychiatric professionals nationwide. We generated a novel developmentally-appropriate “mood and energy thermometer (MET)” self-rating scale that was published in 2012 (updated in 2015) by a nationally known child and adolescent psychiatry association.

- **Building database:** By correctly identifying mood disorders in the hospital setting, we aim to collect data about the treatment interventions, outcomes, and patients’ and families’ perception of care for future revisions of assessment and interventions. Other hospitals can use similar approach and these data can be de-identified and shared by others for collaborations in quality improvement projects.
Title: Blending innovative technology in routine clinical care: Improving mutual decision making and individualized treatment in the psychiatric hospital setting

Appendix

References

[Removed for de-identification purposes]

Screenshot of our website (“ZZZZZ.com,” de-identified) for entries of daily mood & energy ratings:
Appendix B

- Screenshot of our main switchboard for the electronic mood and energy monitoring & actigraphy information:

- Mood and Energy Thermometer (MET):

How to read & rate on -10 to +10 mood & energy thermometer (+0 to +10 anger/anxiety):

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>EXTREME</td>
<td>Almost all day</td>
</tr>
<tr>
<td>9</td>
<td>ELEVATED&lt;br&gt;SEVERE</td>
<td>Almost all day</td>
</tr>
<tr>
<td>8</td>
<td>MODERATE&lt;br&gt;SLIGHT</td>
<td>Almost all day</td>
</tr>
<tr>
<td>7</td>
<td>SEVERE&lt;br&gt;SLIGHT</td>
<td>Almost all day</td>
</tr>
<tr>
<td>6</td>
<td>MODERATE&lt;br&gt;MILD</td>
<td>Almost all day</td>
</tr>
<tr>
<td>5</td>
<td>SEVERE&lt;br&gt;MILD</td>
<td>Almost all day</td>
</tr>
<tr>
<td>4</td>
<td>MILD</td>
<td>Almost all day</td>
</tr>
<tr>
<td>3</td>
<td>SLIGHT</td>
<td>Almost all day</td>
</tr>
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<td>2</td>
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<td>Almost all day</td>
</tr>
<tr>
<td>1</td>
<td>SLIGHT</td>
<td>Almost all day</td>
</tr>
<tr>
<td>0</td>
<td>(OKAY)</td>
<td>Almost all day</td>
</tr>
</tbody>
</table>
Appendix C

**Incorporating innovative technology into routine clinical practice:**

- **Electronic mood monitoring:** Our team integrates technology into mood monitoring: We advance our novel paper-based “mood & energy thermometer:MET” via developing a web-based platform to aid real-time communication and foster partnership between youth, parents, and physicians. In this project, youth enters their ratings twice a day using an interactive projector (“touch-wall technology”) on the inpatient unit while our trained clinicians coach them simultaneously about effective use of the scale, to enhance accuracy. The web-based platform pushes these ratings in real-time with parents’ and physicians’ emails or cell phones (with a secure web link). Our web-based platform serves as a model for other inpatient/outpatient programs.

- **Electronic sleep and activity monitoring:** Every youth at our unit (In-CABS) are wearing Philips ActiWatch 2 a durable wrist-worn actigraphy device that enables the treatment team monitor minute-by-minute activity levels of the adolescent. In addition, sleep measures including time to go to sleep, number of awakenings, total sleep time guide the treatment team to optimize sleep interventions for the youth. **Pictures do not include real patients.**