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1 **Research Paper**

2 ARE STUDENT NURSES READY FOR NEW TECHNOLOGIES IN MENTAL HEALTH?

3 MIXED-METHODS STUDY

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28

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30 The authors thank all the participating psychiatrists for their help.

31 **Conflicts of interest**

32 The authors have no conflict of interest.

33 **Ethical approval and patient consent**

34 This paper is not about a study that included patients.

35 The research was approved by the ethics committee that oversees nurse education in France.

36 **Author contribution statements**

37 AB and SM designed the study and performed the analytic calculations.

38 AB, SM and FF wrote the manuscript.

39 LO and CG performed the qualitative analysis. Both contributed to the theoretical sociological
40 background.

41 SM conceived the original idea and FF was in charge of overall direction and planning.

42 All authors discussed the results and contributed to the final manuscript.

43

44

1 **Research Paper**

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4

5 **ABSTRACT**

6 **Background:** Technical innovations such as ecological momentary assessment (EMA), machine
7 learning (ML), computerized adaptive testing (CAT), Digital Phenotyping, Clinical Decision
8 Support Systems (CDSS), Algorithms, and Biomarkers have caused a paradigm shift in
9 psychiatric care. The aim of the present study was to explore how student nurses view this
10 paradigm shift, by assessing the acceptability of smartphone-based EMA, CAT, and biosensor-
11 based Digital Phenotyping. We also investigated the factors affecting this acceptability.

12 **Method:** Student nurses recruited via nursing schools participated in a quantitative study
13 involving the *screenplay method*, in which they were exposed to two scenarios about depression
14 care, one featuring EMA and CAT, the other featuring a connected wristband (CW) for Digital
15 Phenotyping. Four acceptability domains (usefulness, usability, reliability, risk) were
16 investigated.

17 **Results:** We recorded 1216 observations for the first scenario and 1106 for the second. Regarding
18 overall acceptability, the CW was viewed less positively than CAT and EMA. Regarding
19 reliability, whereas respondents believed that the CW could correctly detect depressive relapse,
20 they did not think that EMA and CAT were sufficiently reliable for the accurate diagnosis of
21 depressive disorder. More than 70% of respondents stated that they would nevertheless be
22 interested in offering EMA, CAT or CW to their patients, but more than 60% feared that these
23 devices might hinder the therapeutic relationship.

24 **Conclusion:** This was the first study assessing student nurses' views of EMA, CAT and CW-
25 based digital phenotyping. Respondents were interested in these new technologies and keen to

26 offer them to their patients. However, our study highlighted several issues, as respondents
27 doubted the reliability of these devices and feared that they would hinder the therapeutic
28 relationship. Subgroup analysis revealed correspondences between acceptability profiles and
29 demographic profiles. It is therefore essential for nurses and student nurses to receive training
30 and become involved in the development of this new technologies.

31 **Keywords:** Ecological momentary assessment – Digital phenotyping – Computerized adaptive
32 testing - Professional culture – Acceptability

33

34

35 INTRODUCTION

36 New technologies have the potential to profoundly change the way we understand psychiatric
37 disorders and are now used in almost all areas of psychiatry, including mood disorders [1],
38 addictive disorders [2], posttraumatic stress disorder [3], and obsessive-compulsive disorder [4].
39 A large number of innovative tools are currently being developed for the computer-assisted
40 detection and course prediction of mood disorders, mainly using artificial intelligence and digital
41 phenotyping.

42 First introduced by Jain [5], and subsequently developed by Torous [6] in the field of psychiatry,
43 the concept of Digital Phenotyping refers to the *capture* by biosensor-based tools of specific
44 psychiatric symptoms that are *objectifiable* and *quantifiable*. For example, the graphorrhea
45 observed in manic episodes can be reflected in an increase in the number of text messages (SMS)
46 sent, while psychomotor retardation in depression can be assessed by an accelerometer. These
47 passive data are collected in background tasks for which no intervention is necessary. Collection
48 may involve either a smartphone and its onboard sensors (GPS, accelerometer, verbal flow
49 detector, etc.) or a connected wearable device (e.g. connected wristband CW), both of which
50 allow for realtime biometric monitoring. Several models based on this concept are beginning to
51 emerge in the areas of schizophrenia [7] and mood disorders [1]. Data can also be actively
52 collected. Smartphone-based ecological momentary assessment (EMA) consists of the evaluation
53 of symptoms from day to day (like a symptom diary), in the patient's habitual environment.
54 Participants self-assess *right then, not later; right there, not elsewhere*, so that there are fewer
55 recall biases [8, 9]. All these new technologies can be seen as either an aid or, on the contrary, a
56 constraint or even a hindrance to the therapeutic relationship. A recent study of psychiatrists'
57 attitudes toward these new technologies showed that overall acceptability was only moderate,
58 and all systems were described as carrying a potential risk (79.6%) [10].

59 Nurses play a central role in patient care, especially in psychiatry, where they have a well-defined
60 role combining a psychotherapeutic dimension with a clinical one. In addition, new treatments
61 for complex psychiatric disorders (e.g. organic psychiatric disorders) involve a higher level of
62 technical work [11]. It is therefore important to assess nurses' knowledge, representations,
63 opinions and attitudes toward these new technologies, which will inevitably modify the way they
64 care for their patients. Do they think that these devices will negatively impinge on the care they
65 provide? Or, on the contrary, do they think they will enrich the therapeutic relationship? Do they
66 think they are useful? Could these devices save them time? Do they result in a more technical
67 representation of psychiatry?

68 In France, nurse training is available for postgraduate students. It takes place over 3 years (i.e.
69 six semesters). In accordance with the European Credit Transfer System (ECTS), the nursing
70 diploma certifies a validated level by obtaining 180 ECTS (120 for teaching units and 60 for
71 clinical nursing practice). Among the different clinical training, a 10-week clinical practice in
72 psychiatry (internship) is compulsory during the course.

73 The main objective of the present study was to analyze how student nurses view these new
74 technologies, by assessing the acceptability of smartphone-based EMA, computerized adaptive
75 testing (CAT), and CW-based digital phenotyping. To this end, we applied the screenplay method
76 (vignette methodologies) [12, 13], a validated model specifically developed to assess
77 acceptability adopting a multidisciplinary approach (psychiatric and sociological). Our
78 secondary objective was to identify the factors affecting this acceptability.

79

80

MATERIAL AND METHOD

81 We conducted a quantitative study via a paper-and-pencil questionnaire, in collaboration with
82 the Sociology and Anthropology Laboratory (LaSA) of the University of Burgundy Franche-
83 Comté. The questionnaire was administered to a cohort of student nurses in their first, second or

84 third year of training, who took part on a voluntary basis. Data collection was machine based.
85 Survey documentation was erased after the data had been encoded. The research was approved
86 by the ethics committee that oversees nurse education in France.

87

88

89 Target population and sample composition

90 This study took place in July 2017, among a population of student nurses recruited through 10
91 nursing schools in the Paris region, France.

92 Questionnaire development

93 We administered an original form of assessment developed by LaSA [10]. This was based on the
94 screenplay method (vignettes methodologies), which exposes respondents to challenging and
95 problematic clinical cases involving systems or devices that are still essentially restricted to the
96 field of research. This is not a classic survey, as it captures aspects of reality that are not captured
97 by other types of evocation.

98 The screenplay method we used featured two clinical case presentations (scenarios) involving
99 new technologies linked to nursing practices (Table 1). The first scenario assessed the
100 acceptability of a diagnosis given by a machine. It also questioned the future of the profession,
101 including expanded skills in nursing and the lack of medical supervision in a growing number of
102 situations. The second scenario investigated how the students viewed the impact of a connected
103 object on their therapeutic relationship with their patients.

104

105

INSERT TABLE 1

106

107

108

109 All the questions were designed during three focus groups made up of nurses, psychiatrists and
110 sociologists, and were cross-validated with a sample of 20 nurses working at Saint-Antoine
111 Hospital in Paris. The first part of the questionnaire (4 questions) collected epidemiological data:
112 sex, age, training semester, and previous psychiatric training (internship). The second part
113 assessed the acceptability of the new technologies, with 9 questions for the first scenario and 11
114 for the second (20 questions in total).

115

116 Assessment of acceptability

117 Acceptability has several dimensions, and four of them were included in an acceptability model
118 specifically developed for studying new technologies (Fig. 1).

119

120 **INSERT FIGURE 1**

121

122 Inspired by research on human-machine interaction and management information systems, and
123 combining the ISO standard and the Nielsen and Shackel models [17, 18], our model assessed
124 four variables (usefulness, usability, reliability, and risk). For each item, participants could give
125 a positive, negative or neutral response (“Yes”, “No”, “Maybe”; “Are not reliable and will never
126 be”, “May be reliable one day”, “Are clearly reliable”, etc.). The questions are provided in Table
127 2.

128 **INSERT TABLE 2**

129

130 Data collection

131 The survey was implemented during the last session of courses in 10 nursing schools.
132 Respondents answered in a paper-and-pencil questionnaire. After a short introductory text, the
133 scenarios appeared one after the other, each followed by the corresponding questions. The survey

134 took about 10 minutes to complete. The analysis was performed with anonymous data
135 implemented in an Excel file.

136 Data analysis

137 We performed an initial descriptive analysis of the population using multiple regression analysis.
138 Comparisons of proportions were carried out using a z test with Bonferroni correction. Pearson
139 correlation coefficients were used to analyze correlations between variables. The variables were
140 compared with nonparametric chi-square tests (or with Fisher's test when the conditions for chi-
141 square application were not met), using Microsoft Excel®, SPSS v24 and R-STAT software. The
142 significance level was set at 5%, such that differences with a p value < 0.05 were deemed to be
143 significant.

144

145 RESULTS

146 Survey implementation

147 A total of 1569 responses were received from 4121 students (38% return rate). We excluded 354
148 incomplete (at least 3 incomplete answers) surveys for the first scenario and 463 for the second,
149 such that 1215 observations were included in the analysis for the first scenario and 1106 for the
150 second.

151 Demographic characteristics

152 The study population was predominantly female (88.3%) and mainly aged below 25 years
153 (74.5%). More than half (55.1%) were in the first part of their curriculum, and 50.1% had already
154 completed their mandatory internship in psychiatry. The students' demographic characteristics
155 are summarized in Table 3.

156 **INSERT TABLE 3**

157

158

159 Primary outcome: overall acceptability

160 EMA and CAT

161 76% of the respondents highlighted the potential usefulness of these types of device, mainly for
162 tasks they did not "know how to do" (54.2%) or that "waste time" (29.9%). However, their
163 opinions of the reliability of these devices were mostly negative, with 62% of respondents
164 answering that these devices were not able to make correct depression diagnoses. Moreover, 75%
165 thought that they were not reliable at the present time, although they might become so one day.
166 Whereas 75.5% of students stated that they would be interested in offering these kinds of devices
167 to their patients, 14.8% said they would never do so. Regarding risk, 72.6% thought that there
168 was a potential risk, and 16.8% thought that this risk was serious, mainly insofar as the devices
169 might hinder the therapeutic relationship (62.1%). A total of 51.2% of respondents believed that
170 these types of device could increase patients' involvement in their care, and 25.1% responded
171 instead that they could decrease it. Finally, 65.4% thought that these devices were useful to
172 psychiatrists.

173 Connected wristband-based digital phenotyping

174 69.8% of respondents highlighted the usefulness of this type of device, mainly for tasks that could
175 be described as a "waste of time" (41.6%) or that they did not "know how to do" (36.9%) Their
176 verdict on the ability of this device to accurately detect a depressive relapse was generally
177 positive, with 66.8% of respondents answering that it could potentially do so correctly, and 70.8%
178 saying they would be interested in offering it to their patients. However, 70.5% thought that CWs
179 were not yet sufficiently reliable, although they might well become so one day. Regarding risk,
180 63.4% thought that there was a potential risk and 16.9% that there was a major risk. Nearly half
181 (49.8%) thought that this type of device might hinder the therapeutic relationship. Roughly a
182 third (32.4%) believed that it could increase patients' involvement in their care, but 34.3%
183 responded instead that it could decrease it, while 33.2% thought that it would change nothing.

184 Furthermore, 44.6% believed that it was a little intrusive, 30% that it was moderately intrusive,
185 and only 12% that it was not intrusive at all. More than half of respondents (53.2%) thought that
186 they would use these kinds of data (heart rate, motion, etc.) to monitor patients with depressive
187 disorders. Finally, 81.6% thought that CWs were useful to psychiatrists.

188

189 Secondary outcome: characterization of influencing factors

190 EMA and CAT

191 The main results are summarized in Table 4.

192 *Sex*

193 There was no statistically significant difference between men and women.

194 *Age*

195 Concerning usability (i.e. intention to use), the 26-30 age group was the most reluctant as 24.6%
196 stated they would “never use it” ($p = 0.032$). As for reliability, 25.4% of the 31-35 years group
197 believed that these devices were reliable ($p < 0.001$). Regarding the impact on the therapeutic
198 relationship, the 18-25 years group believed that these devices might hinder the relationship,
199 whereas the 31-35 years and over 40 years groups believed the opposite ($p = 0.007$).

200 *Psychiatric internship*

201 There was no statistically significant difference between those who had completed a psychiatric
202 internship and those who had not.

203 *Curriculum semester*

204 These devices were given their lowest usefulness judgments by students in S5 and S6 (i.e. final
205 year of study), and this result was statistically significant ($p = 0.033$). There was no statistically
206 significant difference for other criteria.

207

INSERT TABLE 4

208

209 Connected wristband-based digital phenotype

210 The main results are summarized in Table 5.

211 *Sex*

212 Regarding the impact on the therapeutic relationship, 51.9% of women versus 33.3% of men
213 believed that the device could be a hindrance, while 38.1% of men considered that it could be
214 beneficial ($p < 0.001$).

215 *Age*

216 For usability, the over 40 years age group was the most enthusiastic (18.5% “will use it”), and
217 this result was statistically significant ($p < 0.05$). A total of 30.9% of participants in the 31-35
218 years age group considered that the potential usefulness for psychiatrists was high ($p = 0.022$).

219 *Psychiatric internship*

220 Regarding reliability, 19.0% of students who had not completed a psychiatric internship believed
221 that this device was reliable ($p = 0.033$)—a significantly higher percentage than in the other group.

222 *Curriculum semester*

223 This device was given its lowest usefulness judgments by students in S6 ($p < 0.05$). A total of
224 13.4% of students in S2 believed that this device could accurately detect depressive relapse—a
225 higher percentage than for all the other semesters (6.6–9.6%, $p < 0.05$). Finally, for the use of
226 biometric data to monitor patients, the most positive responses came from students in S2 ($p <$
227 0.05).

228 ***INSERT TABLE 5***

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230

231

232

DISCUSSION

233 Main findings

234 We achieved our primary objective of determining the acceptability of new technologies to
235 student nurses. To our knowledge, ours study was the first to assess their views on CAT, EMA,
236 and CW-based digital phenotyping. We used clinical situations that frequently arise in both
237 ambulatory and inpatient care. The CW was considered less useful than CAT and EMA.
238 Regarding reliability, respondents believed that the CW could correctly detect depressive relapse,
239 whereas EMA and CAT were not considered reliable for the accurate diagnosis of depressive
240 disorder. More than 70% of respondents said they would nevertheless be interested in offering
241 EMA, CAT or CW-based digital phenotyping to their patients. More than 60% were afraid that
242 these devices would hinder the therapeutic relationship. EMA and CAT were considered more
243 risky than CWs (72.6% vs. 63.4%).

244 Considering overall acceptability, it is clear that respondents were interested in these new
245 technologies and were keen to be able to use them or offer them to their patients. However, our
246 study highlighted two main issues:

- 247 - These devices are not yet considered sufficiently reliable;
- 248 - They are seen to have a potentially negative impact on the therapeutic relationship.

249 The subgroup analysis showed that acceptability was possibly mediated by respondent's profile,
250 and more specifically by:

- 251 - Age group and curriculum semester for EMA and CAT;
- 252 - Sex and age group for CW.

253 For CW-based digital phenotyping, men regarded it as helpful, whereas women saw it as a
254 hindrance, and usability was most highly rated by the over 40 age group. For EMA and CAT, the
255 most negative judgments of usability and impact on the therapeutic relationship came from the
256 two youngest age groups (18-25 and 26-30 years), while two of the oldest groups (31-35 and >
257 40 years) provided the most positive judgments of reliability and impact on the therapeutic
258 relationship.

259 End-of-course students were less likely to use new technologies than younger students were (1st
260 and 2nd years). Perhaps new technologies can seem reassuring when knowledge is still limited.
261 Conversely, once knowledge and experience have been gained, self-confidence can encourage
262 individuals to do without these objects. In addition, practice allows students to discover the
263 importance of a caring relationship for quality of care. There is a legitimate apprehension of the
264 emergence of tools that may dehumanize this relationship.

265 The number of usable responses we collected (1215 for the first scenario and 1106 for the second)
266 allowed us to have a representative sample of a good size and it was representative (multicenter
267 study). The questions were developed in collaboration with sociologists, to ensure the relevance
268 of the data we collected and allow for the construction of a sociological hypothesis. Furthermore,
269 the questions were based on a model specifically adapted to medical technology acceptance and
270 inspired by several valid theoretical models.

271 From a sociological point of view, technological upheavals are calling the nurses' professional
272 culture into question. *Professional culture* is a sociological concept that assumes that professional
273 activity influences the individuals who exercise it, almost to the extent of modifying their identity
274 [19]. Individuals are defined by their membership of a profession that has its own culture,
275 ideology and beliefs, as well as its own specific way of expressing this belonging (symbols,
276 myths, rites of passage). Based on a professional community that strengthens the group's
277 cohesion, the culture of the profession is also cognitive, insofar as there is a shared way of
278 thinking, of thinking about one's profession, and of practicing it. The loss of certain qualities of
279 empathy, patience, and listening could precisely threaten nurses' professional culture, but our
280 study shows that student nurses are not challenged by the new technologies presented.

281

282

283

284 Assumptions and recommendations

285 Disparities between devices highlighted varying degrees of acceptability, according to the nature
286 of the technology and the underlying theoretical presupposition. Thus, CW use seemed to be
287 viewed more positively than EMA or CAT, contradicting a previous study of the acceptability of
288 these technologies. Indeed, a study [10] that used the same scenario-based methodology (passive
289 vs. active data collection) to explore the acceptability of these new technologies among 515
290 French psychiatrists revealed considerable disparities in acceptability, depending on the
291 psychiatrists' profiles. The preferred devices were EMA and CAT, and CWs were considered to
292 be the least useful, although psychiatrists with neurobiological training positively appraised all
293 three devices.

294 This raises several questions: Are student nurses afraid of being isolated or being replaced?
295 Which technological aids are they willing to use and for which tasks? Can they stand comparison
296 with the machines? Can their role and relationships with doctors be better asserted through
297 machines? Nursing culture, particularly in its relationship dimension, could be challenged, by the
298 emergence of these technologies, which profoundly modify the collection and processing of
299 clinical psychiatric data. Our study shows that students have a globally positive view of these
300 new devices. In a way, these technologies can be compared to complementary tests or assessment
301 tools (e. heart rate monitor in cardiology (ref)) that support the way nurses monitor their patients.
302 It therefore seems logical that nurses are in first line for managing patients with stabilized
303 psychiatric conditions. This task delegate provides nurses with significant autonomy and an
304 important role in preventing relapse.

305 To fully benefit from these new tools, which can be considered as an aid to the medical history
306 or the diagnosis, additional training will be necessary. Advanced Practice Nurses (APN) could
307 certainly have a subspecialization in New Technologies (i.e. Psychiatric & Mental Health
308 Clinical Nurse Specialist or Psychiatric & Mental Health Nurse Practitioner, in the US). In

309 France, a teaching module on these techniques will be included in the training course of
310 Advanced Practice Nurses in psychiatry recently promoted by the Ministry of Health since they
311 perfectly fits the APN's objectives (comprehensive and sophisticated mental health assessment
312 of patients with complex multiple healthcare needs, multiple different assessments and
313 investigations interpretation).

314 To offset the fears raised by these new technologies, it is essential for nurses and student nurses
315 to be involved in the development and use of these devices. Developers have a vested interest in
316 communicating better about the design of these tools and the algorithms they want us to use in
317 the future. In order to complete our research, a comparative study using the same methodology
318 is being developed to better understand the acceptability of these technologies by patients and
319 general practitioners.

320 Limitations of the study

321 Our study took place in an educational setting, and it could be useful to repeat the measures after
322 nurses graduate and after they have started work, in order to see whether these opinions change.
323 In addition to questioning new technologies, our scenarios had a psychological or psychiatric
324 connotation. As these themes are not neutral, other medical situations need to be tested. Our
325 student population was homogeneous, but we did not ascertain their personal and family
326 psychiatric history. Our choice of clinical vignettes may have influenced our results.

327

328 CONCLUSION

329 Overall acceptability was high, but respondents expressed many reservations. Nurses and nurse
330 students need to adopt a clear stance with regard to these radical changes that are overturning
331 traditional practice, and they must be kept informed and allowed to contribute to the development
332 of these new technologies.

333

334 **Acknowledgements**

335 The authors thank all the participating psychiatrists for their help.

336 **Conflicts of interest**

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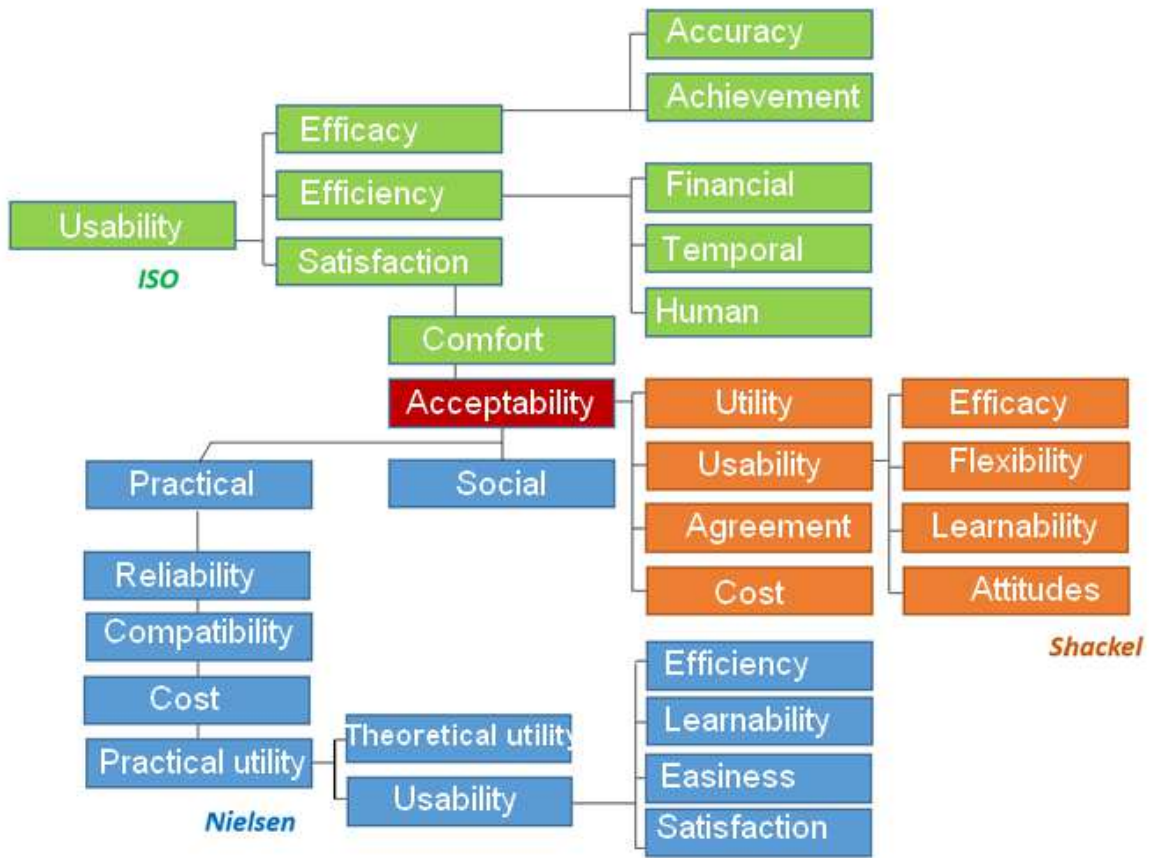
REFERENCES

- 344 1. Bourla A, Ferreri F, Ogorzelec L, Guinchard C, Mouchabac S. [Assessment of mood disorders by passive
345 data gathering: The concept of digital phenotype versus psychiatrist's professional culture]. *Encephale*.
346 2017 Oct 30. pii: S0013-7006(17)30180-X. doi: 10.1016/j.encep.2017.07.007
- 347 2. Ferreri F, Bourla A, Mouchabac S, Karila L. e-Addictology: An Overview of New Technologies for
348 Assessing and Intervening in Addictive Behaviors. *Front Psychiatry*. 2018 Mar 1;9:51. doi:
349 10.3389/fpsyt.2018.00051.
- 350 3. Bourla A, Mouchabac S, El Hage W, Ferreri F. e-PTSD: an overview on how new technologies can improve
351 prediction and assessment of Posttraumatic Stress Disorder (PTSD). *Eur J Psychotraumatol*. 2018 Feb
352 6;9(sup1):1424448. doi: 10.1080/20008198.2018.1424448
- 353 4. Ferreri F, Bourla A, Perett CS, Jaafari N, Mouchabac S. e-OCD: A Review of How New Technologies Can
354 Improve Prediction, Assessment and Intervention in Obsessive Compulsive Disorder (OCD) *JMIR Mental*
355 *Health* (In press). 2019. 10.2196/preprints.11643.
- 356 5. Jain SH, Powers BW, Hawkins JB, Brownstein JS. The digital phenotype. *Nat Biotechnol*. 2015
357 May;33(5):462-3. doi: 10.1038/nbt.3223. PubMed PMID: 25965751
- 358 6. Torous J, Gualtieri L, Wearable devices for mental health: knowns and unknowns. *Psychiatr Times*.
359 2016;33(6):25-32

- 360 7. Torous J, Staples P, Sandoval L, Barnett I, Onnela JP, Keshavan M. Utilizing smartphones to collect
361 longitudinal digital phenotypes in patients with schizophrenia. *Biological Psychiatry*. 2017
362 May;81(10):S132-S133. doi: 10.1016/j.biopsych.2017.02.338
- 363 8. Csikszentmihalyi M, Larson R. Validity and reliability of the experience-sampling method. *Journal of*
364 *Nervous & Mental Disease*. 1987;175:526–537. PMID: 3655778
- 365 9. Firth J, Torous J, Yung AR. Ecological momentary assessment and beyond: the rising interest in e-mental
366 health research. *J Psychiatr Res*. 2016 Sep;80:3-4. doi: 10.1016/j.jpsychires.2016.05.002
- 367 10. Bourla A, Ferreri F, Ogorzelec L, Peretti CS, Guinchard C, Mouchabac S. Psychiatrists' Attitudes Toward
368 Disruptive New Technologies: Mixed-Methods Study. *JMIR Ment Health*. 2018 Dec 14;5(4):e10240. doi:
369 10.2196/10240. PubMed PMID: 30552086; PubMed Central PMCID: PMC6315247.
- 370 11. Ferreri F, Bourla A, Capron J, Quillerou B, Rossignol J, Borden A, Guechot J, Lamaziere A, Nuss P,
371 Mekinian A, Mouchabac S. Organic and psychiatric intricacy: the complex psychiatric disorder concept,
372 paraclinical investigations (part 1) *La Presse Médicale*. 2019 (In Press)
- 373 12. Evans SC, Roberts MC, Keeley JW, Blossom JB, Amaro CM, Garcia AM, Stough CO, Canter KS, Robles
374 R, Reed GM. Vignette methodologies for studying clinicians' decision-making: Validity, utility, and
375 application in ICD-11 field studies. *Int J Clin Health Psychol*. 2015 May-Aug;15(2):160-170. doi:
376 10.1016/j.ijchp.2014.12.001.
- 377 13. Hughes R, Huby M. The application of vignettes in social and nursing research. *J Adv Nurs*. 2002
378 Feb;37(4):382-6. Review. PubMed PMID: 11872108
- 379 14. Gibbons RD, Weiss DJ, Pilkonis PA, Frank E, Moore T, Kim JB, Kupfer DJ. Development of a
380 computerized adaptive test for depression. *Arch Gen Psychiatry*. 2012 Nov;69(11):1104-12. doi:
381 10.1001/archgenpsychiatry.2012.14
- 382 15. Torous J, Staples P, Shanahan M, Lin C, Peck P, Keshavan M, Onnela JP. Utilizing a personal smartphone
383 custom app to assess the Patient Health Questionnaire-9 (PHQ-9) depressive symptoms in patients with
384 major depressive disorder. *JMIR Ment Health*. 2015 Mar 24;2(1):e8. doi: 10.2196/mental.3889. eCollection
- 385 16. Burton C, McKinstry B, Szentagotai Tătar A, Serrano-Blanco A, Pagliari C, Wolters M. Activity
386 monitoring in patients with depression: a systematic review. *J Affect Disord*. 2013 Feb 15;145(1):21 doi:
387 10.1016/j.jad.2012.07.001

- 388 17. Shackel, B. Usability – context, framework, definition, design and evaluation. In: Shackel, B., Richardson,
389 B. (Eds), Human Factors for Informatics Usability. Cambridge University Press, Cambridge, pp. 21-38,
390 1991.
- 391 18. Nielsen, J. Usability Engineering. Academic Press, Boston, MA, 1993.
- 392 19. Rassin M. Nurses' professional and personal values. Nurs Ethics. 2008 Sep;15(5):614-30. doi:
393 10.1177/0969733008092870. PubMed PMID: 18687816.
- 394

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Figure 1. Acceptability model (ISO, Nielsen, Shackel).

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Table 1. Screenplay method

	Scenario	Device tested & Objective
1	<p>You are working with Dr D. (GP) in a clinic. Today, you see Mr P, who is 25 years old. For several weeks, he has felt "very sad". At the end of the clinical examination, Dr D. suspects clinical depression. To make a more accurate assessment, he asks you to help Mr P. respond to the CAT-DI questionnaire on a computer located in a side room off the waiting room. The CAT-DI is intelligent software that can evaluate depressive symptomatology as accurately as the validated scales, simply by asking a few questions and adapting them to the patient's answers. After analyzing the results of the CAT-DI, you conclude that Mr P. does indeed have depressive symptomatology. Dr D. suggests that the patient download the PsyEVAL application on his smartphone and use it for one week before coming back to see you. This app allows you to repeatedly evaluate the patient's mood using questions that are displayed several times a day on the phone. After 7 days, Mr P. comes back, and analysis suggests that Mr P.'s depressive symptomatology is severe, thus enabling Dr D. to tailor his care accordingly.</p>	<p>Detection and diagnosis of a mood disorder using CAT [14] and smartphone-based EMA in a young patient suspected of having a depressive disorder [15].</p> <p>Evaluate the acceptability of a machine making a diagnosis instead of a doctor.</p>
2	<p>Mrs V is 47 years old and has a recurrent depressive disorder that has been in remission for several months. She comes to see Dr D. about once a month to renew her treatment. Overburdened by new</p>	<p>Early detection of depressive relapse, using a CW (biosensors) [16] to establish the digital phenotype</p>

requests for care, he can no longer keep up these monthly appointments, and therefore proposes seeing Mrs V. again in 3 months' time. Anxious not to miss a depressive relapse, he suggests that she wear a CW to record biometric data and analyze their variations (e.g. modifications in motor activity, heart activity, skin conductance, temperature, etc.), allowing depression to be detected remotely and in real time. If warning signs are detected, the CW sends a signal and the patient is quickly offered an appointment to check her state. Dr D. asks you to take the CW to Mrs V's house, explain how it works, and then analyze the data.

of a patient with a recurrent depressive disorder in remission.

Investigate how the nurses view the impact of a connected object on their therapeutic relationship with their patients.

Investigate how the nurses view the digital phenotype concept.

Table 2. Questions

Scenario 1 (EMA and CAT)	Scenario 2 (CW for digital phenotyping)
<p>1. Do you think that the devices mentioned in the scenario are useful?</p> <p>2. Do you think that these algorithm-based devices can support tasks that you dislike? That you don't know how to do? That waste your time?</p> <p>3. Do you think that these algorithm-based devices can diagnose depression correctly?</p> <p>4. If the opportunity arose, would you suggest devices similar to those mentioned in the scenario to your patients?</p> <p>5. Do you think that these devices are reliable?</p> <p>6. Do you think that the devices mentioned in the scenario present a risk?</p> <p>7. Do you think that these devices change the relationship between patient and caregiver?</p> <p>8. Do you think that these devices are transforming the role of patients by changing their involvement in their care?</p> <p>9. Do you think these devices can be useful to psychiatrists?</p>	<p>1. Do you think that devices like this CW are useful?</p> <p>2. Do you think that devices based on biometric data can support tasks that you dislike? That you don't know how to do? That waste your time?</p> <p>3. Do you think that devices based on biometric data can detect early depressive relapse?</p> <p>4. If the opportunity arose, would you encourage your patients to wear a CW like the one mentioned in the scenario?</p> <p>5. Do you think that this kind of device is reliable?</p> <p>6. Do you think that CWs present a risk?</p> <p>7. Do you think that this kind of device changes the relationship between patient and caregiver?</p> <p>8. Do you think that this kind of device is transforming the role of patients by changing their involvement in their care?</p> <p>9. In your future practice, will you take this type of data (i.e. heart rate, movements) into account when monitoring patients with depressive disorder?</p> <p>10. Do you think this kind of device is an intrusion in patients' lives?</p>

*11. Do you think this kind of device can be useful
to psychiatrists?*

Table 3. Demographic characteristics

	<i>n</i>	<i>%</i>
<i>Age range</i>		
- 18-25	904	74.5
- 26-30	114	9.4
- 31-35	73	6.0
- 36-40	49	4.0
- > 40	74	6.1
<i>Sex</i>		
- Men	135	11.2
- Women	1073	88.8
<i>Psychiatric internship</i>		
- Yes	609	50.4
- No	599	49.6
<i>Semester</i>		
- S1	306	25.2
- S2	210	17.3
- S3	154	12.7
- S4	194	16.0
- S5	233	19.2
- S6	118	9.7

Table 4. Statistically significant influencing factors

	<i>Usefulness</i>	<i>Usability</i>	<i>Reliability</i>	<i>Risk</i>	<i>Relationship</i>
<i>Age range</i>					
- 18-25	<i>ns</i>	*	*	<i>ns</i>	Hindrance
- 26-30	<i>ns</i>	Lowest	*	<i>ns</i>	*
- 31-35	<i>ns</i>	*	Strongest	<i>ns</i>	Support
- 36-40	<i>ns</i>	*	*	<i>ns</i>	*
- > 40	<i>ns</i>	*	*	<i>ns</i>	Support
<i>Semester</i>					
- S1	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>
- S2	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>
- S3	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>
- S4	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>
- S5	Lowest	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>
- S6	Lowest	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>

Note. *Ns* = non-significant.

	<i>Usefulness</i>	<i>Usability</i>	<i>Reliability</i>	<i>Relationship</i>	<i>Biometric</i>	<i>Psychiatrist</i>
<i>Age range</i>						
- 18-25	<i>ns</i>	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	*
- 26-30	<i>ns</i>	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	*
- 31-35	<i>ns</i>	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	Strongest
- 36-40	<i>ns</i>	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	*
- > 40	<i>ns</i>	Strongest	<i>ns</i>	<i>ns</i>	<i>ns</i>	*
<i>Sex</i>						
- Men	<i>ns</i>	<i>ns</i>	<i>ns</i>	Support	<i>ns</i>	<i>ns</i>
- Women	<i>ns</i>	<i>ns</i>	<i>ns</i>	Hindrance	<i>ns</i>	<i>ns</i>
<i>Internship</i>						
- Yes	<i>ns</i>	<i>ns</i>	*	<i>ns</i>	<i>ns</i>	<i>ns</i>
- No	<i>ns</i>	<i>ns</i>	Strongest	<i>ns</i>	<i>ns</i>	<i>ns</i>
<i>Semester</i>						
- S1	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	*	<i>ns</i>
- S2	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	Strongest	<i>ns</i>
- S3	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	*	<i>ns</i>
- S4	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	*	<i>ns</i>
- S5	*	<i>ns</i>	<i>ns</i>	<i>ns</i>	*	<i>ns</i>
- S6	Lowest	<i>ns</i>	<i>ns</i>	<i>ns</i>	*	<i>ns</i>

Note. *ns* = non-significant.