Nurse Education Today 84 (2020) 104240

Contents lists available at ScienceDirect

Nurse Education Today

journal homepage: www.elsevier.com/locate/nedt

Are student nurses ready for new technologies in mental health? Mixed-methods study

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ARTICLE INFO

Keywords:
Ecological momentary assessment
Digital phenotyping
Computerized adaptive testing
Professional culture
Acceptability

ABSTRACT

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

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

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

Conclusion: This was the first study assessing student nurses' views of EMA, CAT and CW-based digital phenotyping. Respondents were interested in these new technologies and keen to offer them to their patients. However, our study highlighted several issues, as respondents doubted the reliability of these devices and feared that they would hinder the therapeutic relationship. Subgroup analysis revealed correspondences between acceptability profiles and demographic profiles. It is therefore essential for nurses and student nurses to receive training and become involved in the development of this new technologies.

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https://doi.org/10.1016/j.nedt.2019.104240
Received 31 March 2019; Received in revised form 26 July 2019; Accepted 8 October 2019

1. Introduction

New technologies have the potential to profoundly change the way we understand psychiatric disorders and are now used in almost all areas of psychiatry, including mood disorders (Bourla et al., 2017), addictive disorders (Ferreri et al., 2018), posttraumatic stress disorder (Bourla et al., 2018a), and obsessive-compulsive disorder (Ferreri et al., 2019a). A large number of innovative tools are currently being developed for the computer-assisted detection and course prediction of mood disorders, mainly using artificial intelligence and digital phenotyping.

First introduced by Jain (Jain et al., 2015), and subsequently developed by Torous (Torous and Gualtieri, 2016) in the field of psychiatry, the concept of Digital Phenotyping refers to the *capture* by biosensor-based tools of specific psychiatric symptoms that are *objectifiable* and *quantifiable*. For example, the graphorrhea observed in manic episodes can be reflected in an increase in the number of text messages (SMS) sent, while psychomotor retardation in depression can be assessed by an accelerometer. These passive data are collected in background tasks for which no intervention is necessary. Collection may involve either a smartphone and its onboard sensors (GPS, accelerometer, verbal flow detector, etc.) or a connected wearable device (e.g. connected wristband CW), both of which allow for realtime biometric monitoring. Several models based on this concept are beginning to emerge in the areas of schizophrenia (Torous et al., 2017) and mood disorders (Bourla et al., 2017). Data can also be actively collected. Smartphone-based ecological momentary assessment (EMA) consists of the evaluation of symptoms from day to day (like a symptom diary), in the patient's habitual environment. Participants self-assess *right then, not later; right there, not elsewhere*, so that there are fewer recall biases (Csikszentmihalyi and Larson, 1987; Firth et al., 2016). All these new technologies can be seen as either an aid or, on the contrary, a constraint or even a hindrance to the therapeutic relationship. A recent study of psychiatrists' attitudes toward these new technologies showed that overall acceptability was only moderate, and all systems were described as carrying a potential risk (79.6%) (Bourla et al., 2018b).

Nurses play a central role in patient care, especially in psychiatry, where they have a well-defined role combining a psychotherapeutic dimension with a clinical one. In addition, new treatments for complex psychiatric disorders (e.g. organic psychiatric disorders) involve a higher level of technical work (Ferreri et al., 2019b). It is therefore important to assess nurses' knowledge, representations, opinions and attitudes toward these new technologies, which will inevitably modify the way they care for their patients. Do they think that these devices will negatively impinge on the care they provide? Or, on the contrary, do they think they will enrich the therapeutic relationship? Do they think they are useful? Could these devices save them time? Do they result in a more technical representation of psychiatry?

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

The main objective of the present study was to analyze how student nurses view these new technologies, by assessing the acceptability of smartphone-based EMA, computerized adaptive testing (CAT), and CW-based digital phenotyping. To this end, we applied the screenplay method (vignette methodologies) (Evans et al., 2015; Hughes and Huby, 2002), a validated model specifically developed to assess acceptability adopting a multidisciplinary approach (psychiatric and sociological). Our secondary objective was to identify the factors affecting this acceptability.

2. Material and method

We conducted a quantitative study via a paper-and-pencil questionnaire, in collaboration with the Sociology and Anthropology Laboratory (LaSA) of the University of Burgundy Franche-Comté. The questionnaire was administered to a cohort of student nurses in their first, second or third year of training, who took part on a voluntary basis. Data collection was machine based. Survey documentation was erased after the data had been encoded. The research was approved by the ethics committee that oversees nurse education in France.

2.1. Target population and sample composition

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

Table 1
Screenplay method.

	Scenario	Device tested & objective
1	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.	Detection and diagnosis of a mood disorder using CAT (Gibbons et al., 2012) and smartphone-based EMA in a young patient suspected of having a depressive disorder (Torous et al., 2015). Evaluate the acceptability of a machine making a diagnosis instead of a doctor.
2	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 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), 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.	Early detection of depressive relapse, using a CW (biosensors) (Burton et al., 2013) to establish the digital phenotype 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.

2.2. Questionnaire development

We administered an original form of assessment developed by LaSA (Bourla et al., 2018b). This was based on the screenplay method (vignettes methodologies), which exposes respondents to challenging and problematic clinical cases involving systems or devices that are still essentially restricted to the field of research. This is not a classic survey, as it captures aspects of reality that are not captured by other types of evocation.

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

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

2.3. Assessment of acceptability

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

Inspired by research on human-machine interaction and management information systems, and combining the ISO standard and the Nielsen and Shackel models (Shackel, 1991; Nielsen, 1993), our model assessed four variables (usefulness, usability, reliability, and risk). For each item, participants could give a positive, negative or neutral response (“Yes”, “No”, “Maybe”; “Are not reliable and will never be”, “May be reliable one day”, “Are clearly reliable”, etc.). The questions are provided in Table 2.

2.4. Data collection

The survey was implemented during the last session of courses in 10 nursing schools. Respondents answered in a paper-and-pencil questionnaire. After a short introductory text, the scenarios appeared one after the other, each followed by the corresponding questions. The survey took about 10 min to complete. The analysis was performed with anonymous data implemented in an Excel file.

2.5. Data analysis

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

3. Results

3.1. Survey implementation

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

3.2. Demographic characteristics

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

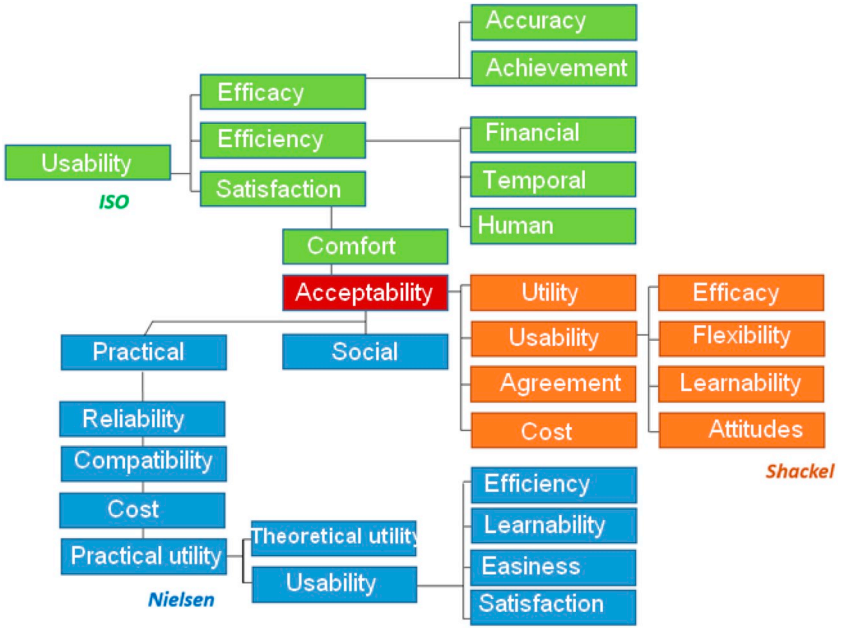

Fig. 1. Acceptability model (ISO, Nielsen, Shackel).

Table 2
Questions.

Scenario 1 (EMA and CAT)	Scenario 2 (CW for digital phenotyping)
1. Do you think that the devices mentioned in the scenario are useful?	*1. Do you think that devices like this CW are useful?*
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?	*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?*
3. Do you think that these algorithm-based devices can diagnose depression correctly?	*3. Do you think that devices based on biometric data can detect early depressive relapse?*
4. If the opportunity arose, would you suggest devices similar to those mentioned in the scenario to your patients?	*4. If the opportunity arose, would you encourage your patients to wear a CW like the one mentioned in the scenario?*
5. Do you think that these devices are reliable?	*5 Do you think that this kind of device is reliable?*
6. Do you think that the devices mentioned in the scenario present a risk?	*6. Do you think that CWs present a risk?*
7. Do you think that these devices change the relationship between patient and caregiver?	*7. Do you think that this kind of device changes the relationship between patient and caregiver?*
8. Do you think that these devices are transforming the role of patients by changing their involvement in their care?	*8. Do you think that this kind of device is transforming the role of patients by changing their involvement in their care?*
9. Do you think these devices can be useful to psychiatrists?	*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?*
	10. Do you think this kind of device is an intrusion in patients' lives?
	11. Do you think this kind of device can be useful to psychiatrists?

3.3. Primary outcome: overall acceptability

3.3.1. EMA and CAT

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

3.3.2. Connected wristband-based digital phenotyping

69.8% of respondents highlighted the usefulness of this type of device, mainly for tasks that could be described as a "waste of time" (41.6%) or that they did not "know how to do" (36.9%) Their verdict on the ability of this device to accurately detect a depressive relapse was generally positive, with 66.8% of respondents answering that it could potentially do so correctly, and 70.8% saying they would be interested in offering it to their patients. However, 70.5% thought that CWs were not yet sufficiently reliable, although they might well become so one day. Regarding risk, 63.4% thought that there was a potential risk and 16.9% that there was a major risk. Nearly half (49.8%) thought that this type of device might hinder the therapeutic relationship. Roughly a third (32.4%) believed that it could increase patients' involvement in their care, but 34.3% responded instead that it could decrease it, while 33.2% thought that it would change nothing. Furthermore, 44.6% believed that it was a little intrusive, 30% that it was moderately intrusive, and only 12% that it was not intrusive at all. More than half of respondents (53.2%) thought that they would use these kinds of data (heart rate, motion, etc.) to monitor patients with depressive disorders. Finally, 81.6% thought that CWs were useful to psychiatrists.

3.4. Secondary outcome: characterization of influencing factors

3.4.1. EMA and CAT

The main results are summarized in Table 4.

3.4.1.1. Sex. There was no statistically significant difference between men and women.

Table 3
Demographic characteristics.

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

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

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

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

3.4.2. Connected wristband-based digital phenotype

The main results are summarized in Table 5.

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

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

Psychiatric internship.

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

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

4. Discussion

4.1. Main findings

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

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

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

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

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

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

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

The number of usable responses we collected (1215 for the first scenario and 1106 for the second) allowed us to have a representative sample of a good size and it was representative (multicenter study). The questions were developed in collaboration with sociologists, to ensure the relevance of the data we collected and allow for the construction of a sociological hypothesis. Furthermore, the questions were based on a

Table 4
Statistically significant influencing factors.

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

Note. Ns = non-significant.

Table 5
Statistically significant influencing factors.

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

Note. ns = non-significant.

model specifically adapted to medical technology acceptance and inspired by several valid theoretical models.

From a sociological point of view, technological upheavals are calling the nurses' professional culture into question. *Professional culture* is a sociological concept that assumes that professional activity influences the individuals who exercise it, almost to the extent of modifying their identity (Rassin, 2008). Individuals are defined by their membership of a profession that has its own culture, ideology and beliefs, as well as its own specific way of expressing this belonging (symbols, myths, rites of passage). Based on a professional community that strengthens the group's cohesion, the culture of the profession is also cognitive, insofar as there is a shared way of thinking, of thinking about one's profession, and of practicing it. The loss of certain qualities of empathy, patience, and listening could precisely threaten nurses' professional culture, but our study shows that student nurses are not challenged by the new technologies presented.

4.2. Assumptions and recommendations

Disparities between devices highlighted varying degrees of acceptability, according to the nature of the technology and the underlying theoretical presupposition. Thus, CW use seemed to be viewed more positively than EMA or CAT, contradicting a previous study of the acceptability of these technologies. Indeed, a study (Bourla et al., 2018b) that used the same scenario-based methodology (passive vs. active data collection) to explore the acceptability of these new technologies among 515 French psychiatrists revealed considerable disparities in acceptability, depending on the psychiatrists' profiles. The preferred devices were EMA and CAT, and CWs were considered to be the least useful, although psychiatrists with neurobiological training positively appraised all three devices.

This raises several questions: Are student nurses afraid of being isolated or being replaced? Which technological aids are they willing to use and for which tasks? Can they stand comparison with the machines? Can their role and relationships with doctors be better asserted through machines? Nursing culture, particularly in its relationship dimension, could be challenged, by the emergence of these technologies, which profoundly modify the collection and processing of clinical psychiatric data. Our study shows that students have a globally positive view of these new devices. In a way, these technologies can be compared to

complementary tests or assessment tools (e. heart rate monitor in cardiology (ref)) that support the way nurses monitor their patients. It therefore seems logical that nurses are in first line for managing patients with stabilized psychiatric conditions. This task delegate provides nurses with significant autonomy and an important role in preventing relapse.

To fully benefit from these new tools, which can be considered as an aid to the medical history or the diagnosis, additional training will be necessary. Advanced Practice Nurses (APN) could certainly have a subspecialization in New Technologies (i.e. Psychiatric & Mental Health Clinical Nurse Specialist or Psychiatric & Mental Health Nurse Practitioner, in the US). In France, a teaching module on these techniques will be included in the training course of Advanced Practice Nurses in psychiatry recently promoted by the Ministry of Health since they perfectly fits the APN's objectives (comprehensive and sophisticated mental health assessment of patients with complex multiple healthcare needs, multiple different assessments and investigations interpretation).

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

4.3. Limitations of the study

Our study took place in an educational setting, and it could be useful to repeat the measures after nurses graduate and after they have started work, in order to see whether these opinions change.

In addition to questioning new technologies, our scenarios had a psychological or psychiatric connotation. As these themes are not neutral, other medical situations need to be tested. Our student population was homogeneous, but we did not ascertain their personal and family psychiatric history. Our choice of clinical vignettes may have influenced our results.

5. Conclusion

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

Author contribution statements

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

AB, SM and FF wrote the manuscript.

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

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

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

Acknowledgments

The authors thank all the participating psychiatrists for their help.

Ethical approval and patient consent

This paper is not about a study that included patients.

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

Declaration of competing interest

The authors have no conflict of interest.

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