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Measuring perception of mental well-being in patients under short-term isolation precautions: a prospective comparative study

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Measuring perception of mental well-being in patients under short-term isolation precautions: a prospective comparative study

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Abstract

Objectives: Isolation precautions (IP) are applied to prevent transmission of pathogens in healthcare settings. Potential negative health outcomes experienced by patients have been described for long-term IP and mainly result from restricted interactions with healthcare workers and visitors. Little is known from patients in short-term isolation. We therefore aimed at evaluating the psychological impact of IP in adult patients in short-term isolation.

Study design: Prospective matched cohort study.

Setting: Tertiary care centre in Switzerland.

Participants: Hospitalized patients under IP and non-isolated patients were matched by ward, age, and illness severity.

Outcome measures: We measured surrogates of mental and social well-being by using the Pictorial Representation of Illness and Self Measure (PRISM) instrument once during hospitalization. PRISM is a visual psychometric instrument that has been validated as a quantitative measure of suffering. Smaller distance in self-to-illness separation (SIS) signifies higher importance for a patient.

Results: 156 patients agreed to participated of which 63 were under IP and 93 were matched controls. Median (interquartile range, IQR) duration of isolation was 5 days (2-10). The median SIS (IQR) for perceived inferior nurses’ care was 22.8 (18.5-24.3) and 23.8 (23.3-25.5) for isolated and non-isolated patients, respectively (p<0.001). Similarly, median SIS (IQR) was significantly smaller in isolated than non-isolated patients for avoidance by visitors with 17.5 (7.7-22.0) and 22.2 (21.8-22.6), for loneliness with 7.5 (3.6-16.0) and 18 (10.2-21.6), and for feeling impure with 19 (17.0-21.5) and 21.5 (18.9-22.1), respectively (all p-values < 0.05).

Conclusions: Short-term IP to prevent transmission of pathogens may negatively impact mental and social well-being. Measures to alleviate adverse effects of IP should be taken routinely.
Summary box

Strengths and limitations of this study

- This is the first study that applied a validated psychological assessment tool with a continuous measurement scale to evaluate adverse events related to a frequently applied infection control measure.
- The tool enables more accurate and precise answers that are not achievable with other instruments.
- The use of this tool allowed the evaluation of other aspects that are not considered in standardized depression questionnaires.
- There is no reference standard to assess the impact of isolation on psychological strains.
- Application of this tool did not allow to evaluate the precise factors that led to impaired mental well-being.
Introduction

The Centres for Disease Control & Prevention (CDC) recommends isolation precautions (IP) to prevent transmission of pathogens in healthcare settings, preferably by placing the patient in a single room. Multidrug-resistant organisms (MDRO) are the most common indication for IP in non-pandemic times. (1) According to the Healthcare Infection Control Practices Advisory Committee (HICPAC) and the European Society for Clinical Microbiology and Infectious Diseases (ESCMID) patients infected or colonized with transmissible pathogens should preferably be placed into a single room and medical staff is required to wear gloves, gowns and facial masks upon entry into the room for the duration of disease or the entire hospital stay, depending on the causative agent. (1, 2) In addition, visiting patients may be restricted, or hampered by the circumstance, that next kin also must wear personal protective equipment. Despite the fact that these measures can effectively limit the spread of MDRO (3) and even stop epidemics such as SARS-CoV-1 (potentially eliminated) and SARS-CoV-2 (strong impact on transmission by limiting the freedom of moving. (4) Such policies can potentially be harmful for the affected patients in terms and result in higher costs. (5) Results from mainly observational studies indicate that medical personnel is more reluctant to enter the room of patients in IP resulting in fewer monitoring of vital signs and omitted medical progress notes. (6) Others have measured higher mean scores for depression and anxiety and lower scores for self-esteem in isolated compared to non-isolated patients. (7, 8) Therefore, some institutions abandoned IP for specific MDRO given the risk of transmission is acceptable balancing risk for transmission and potential harm for the patient. (9, 10)

It has been criticized that many of the studies assessing adverse events from IP have not been adequately controlled for illness-severity. (11) Furthermore, most of the studies looked at the impact of long-term isolation, which nowadays is a rare situation in the acute care setting. Shorter
isolation tends to have less impact on various health outcomes including patient satisfaction, medical encounter and depression. (12-15) However, these data seem to be more conflicting and less generalizable. We therefore aimed to quantify the impact of short-term IP on perception of psychological strain in acute care patients colonized or infected with transmissible pathogens, especially MDROs, and various degrees of comorbidities using a standardized approach borrowed from psychology research. (16) These results may serve as basis for interventions to alleviate psychological side-effects for patients in IP.

Patients and Methods

The Basel University Hospital is an 800-bed tertiary care hospital in the North-western part of Switzerland, with approximately 38’000 admissions/year. For one year, we prospectively measured the effects on mental well-being in patients under IP and concurrently with patients not being placed under IP as part of a quality assurance program. All consecutive patients in IP in single rooms either in contact, droplet or aerosol isolation for a minimum of 24 hours, and with appropriate languages skills were invited to participate in the study. The infection control policy in our hospital follows the IP measures recommended by HICPAC and ESCMID. (1, 2) For every study participant in isolation we asked two non-isolated patients matched by ward, McCabe score (17) and age range (≤ 40 years, 41-50 years, 51-60 years, 61-70 years and > 70 years). Matching by ward ensured that the two cohorts were treated by the same medical staff.

The Pictorial Representation of Illness and Self Measure (PRISM) was applied to measure psychological and emotional impact of isolation. PRISM is a visual psychometric instrument that has been validated as a quantitative measure of suffering. (16) On a white magnetic board that representing the life of an individual, a yellow disk (7cm diameter) at the bottom right hand
corner reflects the patients’ personage or “self”. The patients are then prompted to put a second
disk (e.g. red, 5cm diameter) representing their illness or condition on the board with the
instruction that the placement should reflect the importance of this condition in their lives at this
moment. The quantitative outcome measure derived from PRISM is the Self-to-Illness Separation
(SIS) which represents a patient’s perception on how a condition is intruding in his or her life.
The distance between the centres of the “illness” and the “self” disks can range from zero to
27cm with higher distances reflecting less suffering. (16)
PRISM has been widely applied in patients suffering from various chronic conditions e.g. trauma
or cancer and it shows consistently significant negative correlation of the SIS with depression,
pain, and disease-specific or generic measures of health-related quality of life. (18) The
conditions of interest in our study included loneliness, worry to jeopardize somebody’s health,
feelings of severe illness or bacterial contamination, inferior care by medical staff and avoidance
by visitors. We further interrogated the patients on the importance of isolation measures. Except
for the last item that required adaptation, we addressed the same questions to the control patients.
Instead of inquiring about the importance of isolation measures, we asked non-isolated patients to
estimate the importance they attributed to overall hygiene measures. Differently coloured disks
represented one condition and the SIS was measured for every condition separately. Each patient
completed the PRISM-tool once. We obtained written informed consent from the study
participant or next kin. The local ethics committee approved the study.
We used descriptive statistics to express medians and proportions. We run McNemar’s test to
compare categorical and ordinal data and the Wilcoxon signed-rank test for continuous non-
normally distributed data, respectively. To check for normal distribution of the data we inspected
the normal Q-Q plots and applied the Shapiro-Wilk test. The independent variable was contact
isolation. We considered a two-sided p-value of < 0.05 statistically significant. All statistical analyses were performed using IBM SPSS for Windows version 23.0. (19)

Patient and Public Involvement

Neither patients nor the public were involved in the design and conduct of the study. However, the authors of the study carefully weighed the benefits for patients and the public against the possible disadvantages and concluded that the conduct of this study would also be of great interest from the perspective of patients and the public.

Results

Participants’ characteristics.

Between November 2011 and August 2012, we approached 90 patients in IP. Of these, 27 (30%) were excluded from the study due to language barriers, study denial, lack of cooperation or the presence of a severe psychiatric disorder unable to complete the PRISM test. Full data from 63 patients were available for analyses matched with 93 (98%) of 95 eligible non-isolated patients as controls. There were no statistically significant differences with regard to age, sex and McCabe score between isolated and non-isolated study participants (Table 1). There was, however, a significantly higher proportion with a mental disorder (depression or anxiety) in the non-isolated group compared to the patient cohort under IP (23% vs. 5%, p < 0.024). The participants stayed in IP for the following reasons: carriage of Extended-Spectrum-Beta-Lactamase producing (ESBL) E. coli (n=33), non-E. coli ESBL (K. pneumonia: n=11; E. cloacae: n=3), or Methicillin-resistant S. aureus (MRSA) (n= 6), respectively, or infection with hypervirulent types of Clostridioides difficile (n=4) (20) or multi-drug resistant gram-negative bacteria not otherwise specified (n=1), and for viral infections (n=1) respectively. The median duration of isolation was 5 days (IQR: 2 to 10 days).
Impact of isolation as evaluated by PRISM.

Compared to non-isolated patients, patients in IP reported a significantly higher degree of psychological strain and expressed a significantly stronger perception that nurses (but not doctors) did not care at a level they expected. The SIS (median, IQR) for “nurses’ care is inferior” was statistically significantly smaller in isolated (22.8, 18.5-24.3) than in non-isolated patients (23.8, 23.3-25.5, p <0.001), whereas the median SIS (IQR) for “doctors’ care is inferior” was 24.5 (23.0-25.3) and 25.3 (23.5-26.0) in isolated and non-isolated patients, respectively (p=0.525). Avoidance by visitors was significantly stronger perceived in isolated patients than in controls for a median SIS (IQR) of 17.5 (7.7-22.0) and 22.2 (21.75-22.6), respectively (p<0.001).

In addition, the median SIS (IQR) for boredom and loneliness was significantly more common in isolated patients (7.5; 3.6-16.0) compared to matched controls (18; 10.2-21.6) (p<0.001). SIS medians (IQR) for “being a threat to others” were 19.8 (16.0-21.6) and 20.1 (18.2-21.6) for patients in isolation and their matched controls, respectively; this difference was not statistically significant (p=1.000). Similarly, the SIS medians (IQR) for perceived “illness severity” were not statistically significantly different with 17.0 (10.1-20.0) vs. 15.4 (9.75-18.95) in isolated vs. non-isolated patients, respectively (p=0.801). However, compared to non-isolated patients the feeling of impurity was more strongly perceived in isolated patients (median SIS 19, IQR 17.0-21.5) compared to controls (median SIS 21.5, IQR 18.9-22.1), a statistically significant difference (p=0.012). Both, patients under IP and their matched controls, attributed high importance to isolation and precaution measures and general infection control standards, respectively. The perception in non-isolated patients, however, was even significantly stronger than in isolated patients with a median SIS (IQR) of 3.6 (3.25-3.9) and 4.0 (3.5-9.0), respectively (p <0.001) (Fig. 1).
Discussion

It is part of the art of medicine to balance the risk of transmission to other patients versus the potential negative impact on the care of the implicated patients under IP. The current pandemic with SARS-CoV2 demonstrates on a larger scale the medical and ethical dilemma between individual needs and responsibilities at the population-level. (21) Physicians face similar challenges at the hospital level: Patients may suffer from isolation to the benefit of the patient population. In this study, hospitalized patients in short-term IP significantly experienced various psychological constraints compared to their matched controls. Our results with respect to perceived inferior care of patients in isolation are in accordance with a large qualitative study. (22) In addition, Gasink et al. evaluated patient satisfaction and noted a consistently less favourable response in isolated patients compared to non-isolated patients. (14) The differences, however, were not statistically significant, but sample size was low precluding firm conclusions. Another recent study suggested higher anxiety and depression scores in hospitalized MDRO patients under IP compared to non-MDRO patients but the groups were not well balanced with a significantly higher mortality rate and lengths of hospital stay in the MDRO-group suggesting more severe underlying illness which might have affected the results. (23) The findings of a Dutch research group at a large tertiary care hospital, however, are in contrast to our results (13): Apart from being a single centre study and using different outcome measurement tools, confounding variables may have contributed to the indifferent levels of depression and anxiety amongst short-term-isolated and non-isolated patients. The Dutch infection prevention and control strategies are well known to be very strict countrywide but are also associated with one of the lowest MDRO incidence rates. (24, 25) Therefore, we assume that the attitude of Dutch patients under IP is more appreciative. Compared to the study by Day et al., who attributed the higher levels of depression and anxiety to the presence of existing psychiatric disorders rather
than to short-term contact isolation, (15) the proportion of patients with a history of psychiatric disorders was significantly higher in our control group, suggesting that the negative effects on mental well-being in our study were probably underestimated in isolated patient cohort.

**Implications of our results for clinical practice.**

IP require financial and human resources in hospitals. (26, 27) Barker *et al.* showed that nurses but not doctors need significantly more time in rooms with patients in contact precautions. (28) At least from a nurse’s perspective, this additional workload leads to e.g. less frequent visits of the patient, which may result in a perceived inferior quality of care from a patient’s point of view. (6) From an ethical perspective, IP have been criticized for their unfair participant selection, e.g. patients under IP carry the risk of potential harm to the benefit of all other patients not identified as being infectious. (29) Furthermore, IP alone do not prevent *per se* infectious complications in the respective individual but aim at preventing transmission of a potential harmful pathogen to other susceptible patients despite their considerable lower infectious risk. (6)

Simply abandoning IP - suggested for endemic MRSA or VRE (30) - to relief an individual patient while putting other patients at risk for acquisition may also increase the risk for outbreaks of gram-positive (31) as well as of gram-negative MDRO (32) or emerging pathogens such as *Candida auris.* (33, 34) Several studies indicate that training of staff in infection prevention as part of a prevention bundle effectively reduces healthcare associated infections related to MDRO. (35-37) However, we are not aware that such educational programs routinely address how negative psychological impacts of IP could be mitigated. Although concepts for accommodating colonized or infected patients in a multi-bed room instead of a single room have been evaluated, they focused on prevention of transmission (38) or feasibility and acceptance by health care workers (39) but did not examine the psychological impact on patients. Besides, a considerable proportion of isolated patients are not well informed about their reasons for isolation and its value.
for the community (14): thus, better information may help to decrease the negative impact of IP. A novel approach would be a program that alleviates the negative side-effects of IP while preserving the positive effect on transmission.

**Strengths of this study.**

We applied a matched cohort design allowing us to control for the most important confounders. It is the first study using a validated psychological assessment tool with a continuous measurement scale for the topic of infection control. The tool allows the patient to provide more accurate and precise responses that was not yet feasible with other tools. Application of this tool also allowed to evaluate other aspects not considered in standardized depression questionnaires.

**Weaknesses in the study.**

Firstly, we did not systematically ask nurses about their workload nor did we observe them when caring for a patient in isolation compared to a non-isolated patient. However, we subsequently checked on-site the additional workload that was on average 55 minutes per patient for certified nurses. (26) Secondly, since there is no reference standard to assess the impact of isolation on psychological strains, the performance of this tool remains ill-defined for this topic and results may differ when the tool is applied in another setting. Thirdly, application of this instrument did not allow to evaluate the precise factors that led to impaired mental well-being. Finally, our sample was too small to make any subgroup analyses with respect to the different pathogens.

**Conclusions**

This study suggests that short-term IP negatively affects mental and social well-being of patients. IP to prevent transmission in hospitals may become more and more important, and therefore, programs to minimize side-effects of IP should be integrated to decrease negative psychological effects on the individual patient while preserving the protective effect for other patients.
List of abbreviations

ESBL: extended-spectrum beta-lactamase

ESCMID: European Society of Microbiology and Infectious Disease

HICPAC: Healthcare Infection Control Practices Advisory Committee

IQR: interquartile range

IP: isolation precautions

MDRO: multi-drug resistant organism

MRSA: methicillin-resistant *Staphylococcus aureus*

PRISM: pictorial representation of illness and self-measure

SIS: self-to-illness separation

Declarations

**Ethics approval and consent to participate:** The local ethics committee from the University Basel approved the study. We obtained written informed consent from the study participant or next kin.

**Availability of data and material:** The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Competing interests:** All authors declare to have no potential conflicts of interest. All authors have submitted the ICMJE form for Disclosure of Potential Conflicts of Interest.

**Funding:** not applicable

**Authors’ contributions:** AW and RN conceived the study. RF collected the data and wrote a preliminary draft. MD was responsible for data management. DV performed the statistical analyses, interpreted the data, put them into context with current literature and wrote the
manuscript. AW and RN critically revised the manuscript. AW is responsible for data accuracy.

All authors read and approved the final manuscript.

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Tables:

Table 1. Baseline characteristics of isolated and non-isolated (controls) patients.

|                                | Isolated patients (n=63) | Controls (n=93) | p-value* |
|--------------------------------|--------------------------|----------------|----------|
| Age, median (IQR), years       | 68 (57-76)               | 67 (60-75)     | 0.65a    |
| Female sex, number (%)         | 35 (55.6)                | 44 (47.1)      | 0.25b    |
| History of prior psychiatric disorder, number (%) | 3 (5)                  | 16 (23)        | 0.02     |
| McCabe score, median (IQR)     | 3 (2-3)                  | 3 (2-3)        | 0.11a    |
| No. patients with McCabe 1 (%) | 6 (9.5)                  | 4 (4.3)        |          |
| No. patients with McCabe 2 (%) | 21 (33.3)                | 31 (33.3)      | 0.29b    |
| No. patients with McCabe 3 (%) | 36 (57.1)                | 58 (62.4)      |          |
| Single bedroom, number (%)     | 59 (94)                  | 0 (0)          |          |
| Duration of isolation, median (IQR), days | 5 (2-10)              | n.a.           |          |
| No. patients in contact isolation (%) | 58 (92)                | n.a.           |          |
| No. patients in contact and/or droplet isolation (%) | 3 (5)                  | n.a.           |          |
| No. patients in aerosol isolation (%) | 2 (3)                  | n.a.           |          |

* We used the Wilcoxon ranked-sign test\textsuperscript{a} and McNemar’s\textsuperscript{b} test to compare nonparametric continuous and categorical data, respectively, in dependent samples.
**Figure legends:**

**Figure 1. Boxplot of the results of the Pictorial Representation of Illness and Self Measure (PRISM).** Measuring the importance of different surrogates of mental and social well-being in patients confined to isolation measures (index) compared to non-isolated (control) patients by means of PRISM with smaller self-to-illness separation (SIS) representing higher importance of this particular item.

* signifies a statistically significant difference (p < 0.05).

**Footnote:** The vertical line inside the box represents the median, the total length of the box spans the interquartile range, and the whiskers on both sides of the box extend to the highest and lowest observations.
STROBE Statement—checklist of items that should be included in reports of observational studies

| Item No | Recommendation | Page No |
|---------|----------------|---------|
| **Title and abstract** | 1 | (a) Indicate the study’s design with a commonly used term in the title or the abstract | 1 |
| | | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | 2 | Explain the scientific background and rationale for the investigation being reported | 4-5 |
| **Methods** | 3 | State specific objectives, including any prespecified hypotheses | 5 |
| Study design | 4 | Present key elements of study design early in the paper | 5 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 5-7 |
| Participants | 6 | (a) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up | 5 |
| | | *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls | |
| | | *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants | |
| | (b) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed | |
| | *Case-control study*—For matched studies, give matching criteria and the number of controls per case | 5 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 5 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement).Describe comparability of assessment methods if there is more than one group | 5 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 5 |
| Study size | 10 | Explain how the study size was arrived at | 5 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 6 |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding | 6 |
| | | (b) Describe any methods used to examine subgroups and interactions | |
| | | (c) Explain how missing data were addressed | |
| | | (d) *Cohort study*—If applicable, explain how loss to follow-up was addressed | 5-6 |
| | | *Case-control study*—If applicable, explain how matching of cases and controls was addressed | |
| | | *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy | |
| | | (e) Describe any sensitivity analyses | |

Continued on next page
### Results

| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed |
|--------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |     | (b) Give reasons for non-participation at each stage                                                                                                                                                        |
|              |     | (c) Consider use of a flow diagram                                                                                                                                                                          |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders  
|              |     | (b) Indicate number of participants with missing data for each variable of interest                                                                                                                                 |
|              |     | (c) *Cohort study*—Summarise follow-up time (eg, average and total amount)                                                                                                                                 |
| Outcome data | 15* | *Cohort study*—Report numbers of outcome events or summary measures over time  
|              |     | *Case-control study*—Report numbers in each exposure category, or summary measures of exposure                                                                                                                  |
|              |     | *Cross-sectional study*—Report numbers of outcome events or summary measures                                                                                                                                 |
| Main results | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included |
|              |     | (b) Report category boundaries when continuous variables were categorized                                                                                                                                 |
|              |     | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period                                                                                              |
| Other analyses | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses                                                                                                                   |

### Discussion

| Key results | 18  | Summarise key results with reference to study objectives                                                                                                                                                     |
|-------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Limitations | 19  | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results                                                                                                                                           |

### Other information

| Funding | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at [http://www.plosmedicine.org/](http://www.plosmedicine.org/), Annals of Internal Medicine at [http://www.annals.org/](http://www.annals.org/), and Epidemiology at [http://www.epidem.com/](http://www.epidem.com/)). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).
Measuring perception of mental well-being in patients under isolation precautions: a prospective comparative study

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Measuring perception of mental well-being in patients under isolation precautions: a prospective comparative study

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Abstract

Objectives: Isolation precautions (IP) are applied to prevent transmission of pathogens in healthcare settings. Potential negative health outcomes experienced by patients have been previously described but results remain conflicting. We aimed at evaluating the psychological impact of IP in adult patients in isolation using a novel psychological assessment tool.

Study design: Prospective matched cohort study.

Setting: Tertiary care center in Switzerland.

Participants: Hospitalized patients under IP and non-isolated patients were matched by ward, age, and illness severity.

Outcome measures: We measured surrogates of mental and social well-being by using the Pictorial Representation of Illness and Self Measure (PRISM) instrument once during hospitalization. PRISM is a visual psychometric instrument that has been validated as a quantitative measure of suffering. Smaller distance in self-to-illness separation (SIS) signifies higher importance for a patient.

Results: 156 patients agreed to participated of which 63 were under IP and 93 were matched controls. Median (interquartile range, IQR) duration of isolation was 5 days (2-10). The median SIS (IQR) for perceived inferior nurses’ care was 22.8 (18.5-24.3) and 23.8 (23.3-25.5) for isolated and non-isolated patients, respectively (p<0.001). Similarly, median SIS (IQR) was significantly smaller in isolated than non-isolated patients for avoidance by visitors with 17.5 (7.7-22.0) and 22.2 (21.8-22.6), for loneliness with 7.5 (3.6-16.0) and 18 (10.2-21.6), and for feeling impure with 19 (17.0-21.5) and 21.5 (18.9-22.1), respectively (all p-values < 0.05).

Conclusions: IP to prevent transmission of pathogens may negatively impact mental and social well-being. Measures to alleviate adverse effects of IP should be taken routinely.
Strengths and limitations of this study

- This is the first study that applied a validated psychological assessment tool with a continuous measurement scale to evaluate adverse events related to a frequently applied infection control measure.

- The tool enables more accurate and precise answers that are not achievable with other instruments.

- The analysis have been controlled for the most common confounders including illness severity.

- This is a single center study which precludes comparison with other hospitals

  The performance of this tool remains ill-defined for this topic and results may differ when applied in other settings
Introduction

The Centers for Disease Control & Prevention (CDC) recommends isolation precautions (IP) to prevent transmission of pathogens in healthcare settings, preferably by placing the patient in a single room. Multidrug-resistant organisms (MDRO) are the most common indication for IP in non-pandemic times.[1] According to the Healthcare Infection Control Practices Advisory Committee (HICPAC) and the European Society for Clinical Microbiology and Infectious Diseases (ESCMID) patients infected or colonized with transmissible pathogens should preferably be placed into a single room and medical staff is required to wear gloves, gowns and facial masks upon entry into the room for the duration of disease or the entire hospital stay, depending on the causative agent.[1, 2] In addition, visiting patients may be restricted, or hampered by the circumstance, that next kin also must wear personal protective equipment.

Despite the fact that these measures can effectively limit the spread of MDRO[3] and even stop epidemics such as SARS-CoV-1 (potentially eliminated) and SARS-CoV-2 (strong impact on transmission by limiting the freedom of moving).[4] Such policies can potentially be harmful for in terms of psychological constraints and result in higher costs.[5] Results from mainly observational studies indicate that medical personnel is reluctant to enter the room of patients in IP resulting in fewer monitoring of vital signs and omitted medical progress notes.[6] Others have measured higher mean scores for depression and anxiety and lower scores for self-esteem in isolated compared to non-isolated patients.[7, 8] Therefore, some institutions abandoned IP for specific MDRO balancing risk for transmission and potential harm for the patient.[9, 10]

It has been criticized that many of the studies assessing adverse events from IP have not been adequately controlled for illness-severity and were of small sample size.[11] Furthermore, most of the studies looked at the impact of long-term isolation, which nowadays is a rare situation in the acute care setting. Shorter isolation tends to have less impact on various health outcomes.
including patient satisfaction, medical encounter and depression.[12-15] However, these data seem to be more conflicting and less generalizable. We therefore aimed to quantify the impact of IP on perception of psychological strain in acute care patients colonized or infected with transmissible pathogens, especially MDROs, and various degrees of comorbidities using a standardized approach borrowed from psychology research.[16] These results may serve as basis for interventions to alleviate psychological side-effects for patients in IP.

Patients and Methods

The Basel University Hospital is an 800-bed tertiary care hospital in the North-western part of Switzerland, with approximately 38,000 admissions/year. For one year, we prospectively measured the effects on mental well-being in patients under IP and concurrently with patients not being placed under IP as part of a quality assurance program. All consecutive patients in IP in single rooms either in contact, droplet, or aerosol isolation for a minimum of 24 hours, and with appropriate languages skills were invited to participate in the study. The infection control policy in our hospital follows the IP measures recommended by HICPAC and ESCMID. [1, 2] We obtained written informed consent from the study participant or next kin.

The following parameters were obtained from the electronic medical record: Age, sex, McCabe score, and psychiatric disorder as indicated in the diagnosis list upon admission. For every study participant in isolation we asked two non-isolated patients matched by ward, McCabe score [17] and age range (≤ 40 years, 41-50 years, 51-60 years, 61-70 years and > 70 years). Matching by ward ensured that the two cohorts were treated by the same medical staff. Since we were unsure how severity of illness might affect our results, we wanted to control for it by matching patients by this factor using the McCabe score.
The Pictorial Representation of Illness and Self Measure (PRISM) was applied to measure psychological and emotional impact of isolation. PRISM is a visual psychometric instrument that has been validated as a quantitative measure of suffering.[16] On a white magnetic board that represents the life of an individual, a yellow disk (7cm diameter) at the bottom righthand corner reflects the patients’ personage or “self” (Fig. 1a). The patients are then prompted to put a second differently colored disk with a smaller diameter representing their illness or condition on the board with the instruction that the placement should reflect the importance of this condition in their lives at this moment. The quantitative outcome measure derived from PRISM is the Self-to-Illness Separation (SIS) which represents a patient’s perception on how a condition is intruding in his or her life. The distance between the centers of the “illness” and the “self” disks can range from zero to 27cm with higher distances reflecting less suffering (Fig. 1b).[16]

PRISM has been widely applied in patients suffering from various chronic conditions e.g. trauma or cancer and it shows consistently significant negative correlation of the SIS with depression, pain, and disease-specific or generic measures of health-related quality of life.[18] The conditions of interest in our study included loneliness, worry to jeopardize somebody’s health, feelings of severe illness or bacterial contamination, inferior care by medical staff and avoidance by visitors. We further interrogated the patients on the importance of isolation measures. We addressed the same questions to the control patients, except for the last item: Instead of inquiring about the importance of isolation measures, we asked non-isolated patients to estimate the importance they attributed to overall hygiene measures. The disk and corresponding question were randomly chosen by the patient. The patient was asked where he would put the perceived “illness” in his or her life at the moment and to place the disk accordingly. The SIS was measured for every condition separately. Each patient completed the PRISM-tool once during the hospital stay.
Statistical analyses

We used descriptive statistics to express medians and proportions. We ran McNemar’s test to compare categorical and ordinal data and the Wilcoxon signed-rank test for continuous non-normally distributed data, respectively. To check for normal distribution of the data we inspected the normal Q-Q plots and applied the Shapiro-Wilk test. We performed generalized linear models for each individual interrogated perception of mental well-being as dependent variable with contact isolation as independent binary predictor. To evaluate the model for potential confounders, we predefined to adjust it for the most important predictors that we considered to have a potential impact, regardless of whether the two groups differed significantly on these characteristics: Age, sex, McCabe score, ward, and psychiatric disorder. We considered a two-sided p-value of < 0.05 statistically significant. All statistical analyses were performed using IBM SPSS for Windows version 23.0.[19]

Patient and Public Involvement

Neither patients nor the public were involved in the design and conduct of the study. However, the authors of the study carefully weighed the benefits for patients and the public against the possible disadvantages and concluded that the conduct of this study would also be of great interest from the perspective of patients and the public.

Results

Participants’ characteristics.

Between November 2011 and August 2012, we approached 90 patients in IP. Of these, 27 (30%) were excluded from the study due to language barriers, study denial, lack of cooperation or the
presence of a severe psychiatric disorder unable to complete the PRISM test. Full data from 63 patients were available for analyses matched with 93 (98%) of 95 eligible non-isolated patients as controls. There were no statistically significant differences with regard to age, sex and McCabe score between isolated and non-isolated study participants (Table 1). There was, however, a significantly higher proportion with a psychiatric disorder (depression or anxiety) in the non-isolated group compared to the patient cohort under IP (24.7% vs. 4.8%, p < 0.001). The participants stayed in IP for the following reasons: carriage of Extended-Spectrum-Beta-Lactamase producing (ESBL) \textit{E. coli} (n=33), non-\textit{E. coli} ESBL \textit{(K. pneumonia): n=11; E. cloacae: n=3}, or Methicillin-resistant \textit{S. aureus} (MRSA) (n=6), respectively, or infection with hypervirulent types of \textit{Clostridioides difficile} (n=4) [20] or multi-drug resistant gram-negative bacteria not otherwise specified (n=1), and for viral infections (n=1) respectively. The median duration of isolation was 5 days (IQR: 2 to 10 days).

\textbf{Impact of isolation as evaluated by PRISM.}

Compared to non-isolated patients, patients in IP reported a significantly higher degree of psychological strain and expressed a significantly stronger perception that nurses (but not doctors) did not care at a level they expected. The SIS (median, IQR) for “nurses’ care is inferior” was statistically significantly smaller in isolated (22.8, 18.5-24.3) than in non-isolated patients (23.9, 23.3-25.5, p <0.001), whereas the median SIS (IQR) for “
doctors’ care is inferior” was 24.5 (23.0-25.3) and 25.3 (23.5-26.0) in isolated and non-isolated patients, respectively (p=0.525). Avoidance by visitors was significantly stronger perceived in isolated patients than in controls for a median SIS (IQR) of 17.5 (7.7-22.0) and 22.2 (21.8-22.6), respectively (p<0.001). In addition, the median SIS (IQR) for boredom and loneliness was significantly more common in isolated patients (7.5; 3.6-16.0) compared to matched controls (18.0; 10.2-21.6) (p<0.001). SIS medians (IQR) for “being a threat to others” were 19.8 (16.0-21.6) and 20.1 (18.2-21.6) for
patients in isolation and their matched controls, respectively; this difference was not statistically significant (p=1.000). Similarly, the SIS medians (IQR) for perceived “illness severity” were not statistically significantly different with 17.0 (10.1-20.0) vs. 15.4 (9.75-18.95) in isolated vs. non-isolated patients, respectively) (p=0.801). However, compared to non-isolated patients the feeling of impurity was more strongly perceived in isolated patients (median SIS 19, IQR 17.0-21.5) compared to controls (median SIS 21.5, IQR 18.9-22.1), a statistically significant difference (p=0.012). Both, patients under IP and their matched controls, attributed high importance to isolation and precaution measures and general infection control standards, respectively. The perception in non-isolated patients, however, was even significantly stronger than in isolated patients with a median SIS (IQR) of 3.6 (3.25-3.9) as compared to 4.0 (3.5-9.0), respectively (p <0.001) (Fig. 2a.-h.).

When applying the generalized linear models controlling for age, sex, McCabe score, ward and psychiatric disorders, the SIS significantly decreased for patients under isolation precautions for perceived inferior care by nurses (-2.7, 95% CI -4.1 to -1.2), avoidance by visitors (-6.7, 95% CI, -8.4 to -4.9), feeling bored and lonely (-6.3, 95% CI – 8.3 to -4.2) and feeling of impurity (-1.3, 95% CI -2.4 to -0.2), while the SIS significantly increased for importance of infection control standards (3.3, 95% 1.9 to 4.8) as compared to non-isolated patients. Care by doctors was also perceived as inferior in isolated patients, the difference, however, was not statistically significant (-1.3, 95% CI -2.7 to 0.0) (Table 2).

**Discussion**

It is part of the art of medicine to balance the risk of transmission to other patients versus the potential negative impact on the care of the affected patients under IP. The current pandemic with SARS-CoV2 demonstrates on a larger scale the medical and ethical dilemma between individual
needs and responsibilities at the population-level.[21] Physicians face similar challenges at the hospital level: Patients may suffer from isolation to the benefit of the patient population. In this study, hospitalized patients in short-term IP significantly experienced various psychological constraints compared to their matched controls. Our results with respect to perceived inferior care of patients in isolation are in accordance with a large qualitative study.[22] In addition, Gasink et al. evaluated patient satisfaction and noted a consistently less favorable response in isolated patients compared to non-isolated patients. [14] The differences, however, were not statistically significant, but sample size was low precluding firm conclusions. Another recent study suggested higher anxiety and depression scores in hospitalized MDRO patients under IP compared to non-MDRO patients but the groups were not well balanced with a significantly higher mortality rate and lengths of hospital stay in the MDRO-group suggesting more severe underlying illness which might have affected the results.[23] The findings of a Dutch research group at a large tertiary care hospital, however, are in contrast to our results.[13] Apart from being a single center study and using different outcome measurement tools, confounding variables may have contributed to the indifferent levels of depression and anxiety amongst short-term-isolated and non-isolated patients. The Dutch infection prevention and control strategies are well known to be very strict countrywide but are also associated with one of the lowest MDRO incidence rates.[24, 25] Therefore, we assume that the attitude of Dutch patients under IP is more appreciative. Compared to the study by Day et al., who attributed the higher levels of depression and anxiety to the presence of existing psychiatric disorders rather than to short-term contact isolation,[15] the proportion of patients with a history of psychiatric disorders was significantly higher in our control group, suggesting that the negative effects on mental well-being in our study were probably underestimated in the isolated patient cohort.

Implications of our results for clinical practice.
IP require financial and human resources in hospitals.[26, 27] Barker et al. showed that nurses but not doctors need significantly more time in rooms with patients in contact precautions.[28] At least from a nurse’s perspective, this additional workload leads to e.g. less frequent visits of the patient, which may result in a perceived inferior quality of care from a patient’s point of view.[6] From an ethical perspective, IP have been criticized for their unfair participant selection, e.g. patients under IP carry the risk of potential harm to the benefit of all other patients not identified as being infectious.[29] Furthermore, IP alone do not prevent per se infectious complications in the respective individual but aim at preventing transmission of a potential harmful pathogen to other susceptible patients despite their considerable lower infectious risk.[6]

Simply abandoning IP - suggested for endemic MRSA or VRE[30] - to relief an individual patient while putting other patients at risk for acquisition may also increase the risk for outbreaks of gram-positive[31] as well as of gram-negative MDRO[32] or emerging pathogens such as Candida auris.[33, 34] Several studies indicate that training of staff in infection prevention as part of a prevention bundle effectively reduces healthcare associated infections related to MDRO.[35-37] However, we are not aware that such educational programs routinely address how negative psychological impacts of IP could be mitigated. Although concepts for accommodating colonized or infected patients in a multi-bed room instead of a single room have been evaluated, they focused on prevention of transmission[38] or feasibility and acceptance by health care workers[39] but did not examine the psychological impact on patients. Besides, a considerable proportion of isolated patients are not well informed about their reasons for isolation and its value for the community [14]: thus, better information may help to decrease the negative impact of IP. A novel approach would be a program that alleviates the negative side-effects of IP while preserving the positive effect on transmission.

Strengths of this study.
We applied a matched cohort design and generalized linear models allowing us to control for the most important confounders. It is the first study that uses a validated psychological assessment tool with a continuous measurement scale for the topic of infection control. The tool allows the patient to provide more accurate and precise responses that was not yet feasible with other tools. Application of this tool also allowed to evaluate other aspects not considered in standardized depression questionnaires.

**Weaknesses in the study.**

Firstly, we did not systematically ask nurses about their workload, nor did we observe them when caring for a patient in isolation compared to a non-isolated patient. However, we subsequently checked on-site the additional workload that was on average 55 minutes per patient for certified nurses.[26] Secondly, since there is no reference standard to assess the impact of isolation on psychological strains, the performance of this tool remains ill-defined for this topic and results may differ when the tool is applied in another setting. Thirdly, application of this instrument did not allow to evaluate the precise factors that led to impaired mental well-being. Finally, our sample was too small to perform a more in-depth analysis of the relation between the SIS and other host or ward factors. Similarly, the sample size did not allow us to conduct subgroup analyses related to the different pathogens.

**Conclusions**

This study suggests that IP negatively affects mental and social well-being of patients. IP to prevent transmission in hospitals may become more and more important, and therefore, programs to minimize side-effects of IP should be integrated to decrease negative psychological effects on the individual patient while preserving the protective effect for other patients. The fact that the isolated patients also acknowledged the need for the isolation measures may suggest that an
intervention with provision of easy-to-understand information could reinforce these positive aspects and reduce suffering.

**List of abbreviations**

ESBL: extended-spectrum beta-lactamase  
ESCMID: European Society of Microbiology and Infectious Disease  
HICPAC: Healthcare Infection Control Practices Advisory Committee  
IQR: interquartile range  
IP: isolation precautions  
MDRO: multi-drug resistant organism  
MRSA: methicillin-resistant *Staphylococcus aureus*  
PRISM: pictorial representation of illness and self-measure  
SIS: self-to-illness separation

**Ethics statement**

The study was approved in August 2011 by the Ethics Committee Basel, Switzerland as a masters thesis. The project is registered under the number 2011/25. However, at that time no official dispositions were issued. We obtained written informed consent from all the study participants or their next kin.
Availability of data and material:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests:

All authors declare to have no potential conflicts of interest. All authors have submitted the ICMJE form for Disclosure of Potential Conflicts of Interest.

Authors' contributions:

AW and RN conceived the study. RF collected the data and wrote a preliminary draft. MD was responsible for data management. DV performed the statistical analyses, interpreted the data, put them into context with current literature and wrote the manuscript. AW and RN critically revised the manuscript. AW is responsible for data accuracy. All authors read and approved the final manuscript.
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### Tables:

#### Table 1. Baseline characteristics of isolated and non-isolated (controls) patients.

|                                | Isolated patients (n=63) | Controls (n=93) | p-value* |
|--------------------------------|--------------------------|----------------|----------|
| Age, median (IQR), years       | 68 (57-76)               | 67 (60-75)     | 0.65a    |
| Female sex, number (%)         | 35 (55.6)                | 44 (47.1)      | 0.25b    |
| History of prior psychiatric disorder, number (%) | 3 (4.8) | 23 (24.7) | <0.001b |
| McCabe score, median (IQR)     | 3 (2-3)                  | 3 (2-3)        | 0.11a    |
| No. patients with McCabe 1 (%) | 6 (9.5)                  | 4 (4.3)        |          |
| No. patients with McCabe 2 (%) | 21 (33.3)                | 31 (33.3)      | 0.29b    |
| No. patients with McCabe 3 (%) | 36 (57.1)                | 58 (62.4)      |          |
| Medical ward, number (%)       | 39 (61.9)                | 50 (53.8)      | 0.313b   |
| Surgical ward, number (%)      | 24 (38.1)                | 43 (46.2)      |          |
| Single bedroom, number (%)     | 59 (94.0)                | 0 (0.0)        |          |
| Duration of isolation, median (IQR), days | 5 (2-10) | n.a.       |          |
| No. patients in contact isolation (%) | 58 (92) | n.a.       |          |
| No. patients in contact and/or droplet isolation (%) | 3 (5) | n.a.       |          |
| No. patients in aerosol isolation (%) | 2 (3) | n.a.       |          |

* We used the Wilcoxon ranked-sign test\(^a\) and McNemar’s test\(^b\) to compare nonparametric continuous and categorical data, respectively, in dependent samples.
### Table 2. Generalized linear model for the prediction of change (in cm) in the Self-to-Illness Separation (SIS) in patients being placed under isolation precautions.

|                                           | Univariate model | Multivariable model<sup>a</sup> |
|-------------------------------------------|------------------|----------------------------------|
|                                           | Coefficient      | SE | 95% confidence interval | Coefficient | SE | 95% confidence interval |
|                                           |                  |    | lower      | upper      |                  |    | lower      | upper      |
| Nurses' care is inferior                   | -2.7             | 0.7 | -4.1           | -1.2       | -2.9             | 0.7 | -4.4           | -1.5       |
| Doctors' care is inferior                  | -1.2             | 0.6 | -2.4           | 0.1        | -1.3             | 0.7 | -2.7           | 0.0        |
| Avoidance by visitors                     | -6.7             | 0.9 | -8.4           | -4.9       | -6.7             | 0.9 | -8.5           | -4.9       |
| Feeling bored and lonely                  | -6.3             | 1.0 | -8.3           | -4.2       | -6.5             | 1.1 | -8.6           | -4.4       |
| Being a threat to others                  | -1.2             | 0.7 | -2.6           | 0.1        | -1.1             | 0.7 | -2.5           | 0.4        |
| Perceived illness severity                | 1                | 1   | -0.8           | 2.8        | 1.3              | 0.9 | -0.5           | 3.2        |
| Importance of IPC measures                | 3.3              | 0.7 | 1.9            | 4.8        | 3.4              | 0.7 | 2.0            | 4.9        |
| Feeling of impurity                       | -1.3             | 0.6 | -2.4           | -0.2       | -1.3             | 0.6 | -2.4           | -0.1       |

<sup>a</sup> adjusted for age, sex, McCabe score, ward (surgical vs. medical), and psychiatric disorder

IPC= infection prevention and control
Figure legends:

Figure 1a.-b. Pictorial Representation of Illness and Self Measure (PRISM). a) A white A4-sized metal board with a yellow circle representing the patient's “self” is laid on a table. Colored disks reflecting “illness” are placed onto the board by the patient. b) For each condition they are asked “Where would you put the illness in your life at this moment?” The Self-to-Illness Separation (SIS) is the distance measured between the centers of the yellow circle and the colored disks.

Figure 2a.-h. Boxplots of the results of the Pictorial Representation of Illness and Self Measure (PRISM).

Measuring the importance of different surrogates of mental and social well-being (a.-h.) in patients confined to isolation measures compared to non-isolated patients by means of PRISM with smaller self-to-illness separation (SIS) representing higher importance of this particular item.
Figure 1a.-b. Pictorial Representation of Illness and Self Measure (PRISM). a) A white A4-sized metal board with a yellow circle representing the patient's "self" is laid on a table. Colored disks reflecting "illness" are placed onto the board by the patient. b) For each condition they are asked "Where would you put the illness in your life at this moment?" The Self-to-Illness Separation (SIS) is the distance measured between the centers of the yellow circle and the colored disks.
Figure 2a.-h. Boxplots of the results of the Pictorial Representation of Illness and Self Measure (PRISM). Measuring the importance of different surrogates of mental and social well-being (a.-h.) in patients confined to isolation measures compared to non-isolated patients by means of PRISM with smaller self-to-illness separation (SIS) representing higher importance of this particular item.

629x900mm (96 x 96 DPI)
STROBE Statement—checklist of items that should be included in reports of observational studies

| Item No | Recommendation | Page No |
|---------|----------------|---------|
| **Title and abstract** | | |
| 1 | (a) Indicate the study’s design with a commonly used term in the title or the abstract | 1 |
| | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 3 |
| **Introduction** | | 5-6 |
| 2 | Explain the scientific background and rationale for the investigation being reported | 5-6 |
| **Objectives** | | 6 |
| 3 | State specific objectives, including any prespecified hypotheses | 6 |
| **Methods** | | |
| 4 | Present key elements of study design early in the paper | 6-7 |
| 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 6-7 |
| 6 | (a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up. Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls. Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants | 6 |
| | (b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed. Case-control study—For matched studies, give matching criteria and the number of controls per case | 6 |
| 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 6 |
| 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 6 |
| 9 | Describe any efforts to address potential sources of bias | 6 |
| 10 | Explain how the study size was arrived at | 6 |
| 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 8 |
| 12 | (a) Describe all statistical methods, including those used to control for confounding | 8 |
| | (b) Describe any methods used to examine subgroups and interactions | 8 |
| | (c) Explain how missing data were addressed | 8 |
| | (d) Cohort study—If applicable, explain how loss to follow-up was addressed. Case-control study—If applicable, explain how matching of cases and controls was addressed. Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy | 8 |
| | (e) Describe any sensitivity analyses | 8 |

Continued on next page
### Results

| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed |
|--------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |     | (b) Give reasons for non-participation at each stage                                                                                                                                               |
|              |     | (c) Consider use of a flow diagram                                                                                                                                                                 |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders                                                                 |
|              |     | (b) Indicate number of participants with missing data for each variable of interest                                                                                                                                 |
|              |     | (c) Cohort study—Summarise follow-up time (eg, average and total amount)                                                                                                                           |
| Outcome data | 15* | Cohort study—Report numbers of outcome events or summary measures over time                                                                                                                                 |
|              |     | Case-control study—Report numbers in each exposure category, or summary measures of exposure                                                                                                           |
|              |     | Cross-sectional study—Report numbers of outcome events or summary measures                                                                                                                                 |
| Main results | 16  | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included |
|              |     | (b) Report category boundaries when continuous variables were categorized                                                                                                                         |
|              |     | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period                                                                                     |
| Other analyses | 17  | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses                                                                                                       |

### Discussion

| Key results | 18  | Summarise key results with reference to study objectives                                                                                                                                       |
|            |     |                                                                                                                                                                                              |
| Limitations | 19  | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias                                                  |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence                                |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results                                                                                                                          |

### Other information

| Funding | 22  | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at [http://www.plosmedicine.org/](http://www.plosmedicine.org/), Annals of Internal Medicine at [http://www.annals.org/](http://www.annals.org/), and Epidemiology at [http://www.epidem.com/](http://www.epidem.com/)). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).
# Measuring perception of mental well-being in patients under isolation precautions: a prospective comparative study

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Measuring perception of mental well-being in patients under isolation precautions: a prospective comparative study

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Abstract

Objectives: Isolation precautions (IP) are applied to prevent transmission of pathogens in healthcare settings. Potential negative health outcomes experienced by patients have been previously described but results remain conflicting. We aimed at evaluating the psychological impact of IP in adult patients in isolation using a novel psychological assessment tool.

Study design: Prospective matched cohort study.

Setting: Tertiary care center in Switzerland.

Participants: Hospitalized patients under IP and non-isolated patients were matched by ward, age, and illness severity.

Outcome measures: We measured surrogates of mental and social well-being by using the Pictorial Representation of Illness and Self Measure (PRISM) instrument once during hospitalization. PRISM is a visual psychometric instrument that has been validated as a quantitative measure of suffering. Smaller distance in self-to-illness separation (SIS) signifies higher importance for a patient.

Results: 156 patients agreed to participated of which 63 were under IP and 93 were matched controls. Median (interquartile range, IQR) duration of isolation was 5 days (2-10). The median SIS (IQR) for perceived inferior nurses’ care was 22.8 (18.5-24.3) and 23.8 (23.3-25.5) for isolated and non-isolated patients, respectively (p<0.001). Similarly, median SIS (IQR) was significantly smaller in isolated than non-isolated patients for avoidance by visitors with 17.5 (7.7-22.0) and 22.2 (21.8-22.6), for loneliness with 7.5 (3.6-16.0) and 18 (10.2-21.6), and for feeling impure with 19 (17.0-21.5) and 21.5 (18.9-22.1), respectively (all p-values < 0.05).

Conclusions: IP to prevent transmission of pathogens may negatively impact mental and social well-being. Measures to alleviate adverse effects of IP should be taken routinely.
Strengths and limitations of this study

- We applied a visual tool to evaluate the potential adverse effects of isolation precautions.
- The continuous measurement scale enabled more accurate and precise answers than with other psychological assessment tools.
- All analyses were adjusted for the commonest confounding factors including underlying mental illness.
- Compliance with infection control standards was not formally assessed.
- The generalizability of the results may be limited.
Introduction

The Centers for Disease Control & Prevention (CDC) recommends isolation precautions (IP) to prevent transmission of pathogens in healthcare settings, preferably by placing the patient in a single room. Multidrug-resistant organisms (MDRO) are the most common indication for IP in non-pandemic times.[1] According to the Healthcare Infection Control Practices Advisory Committee (HICPAC) and the European Society for Clinical Microbiology and Infectious Diseases (ESCMID) patients infected or colonized with transmissible pathogens should preferably be placed into a single room and medical staff is required to wear gloves, gowns and facial masks upon entry into the room for the duration of disease or the entire hospital stay, depending on the causative agent.[1, 2] In addition, visiting patients may be restricted, or hampered by the circumstance, that next kin also must wear personal protective equipment.

Despite the fact that these measures can effectively limit the spread of MDRO[3] and even stop epidemics such as SARS-CoV-1 (potentially eliminated) and SARS-CoV-2 (strong impact on transmission by limiting the freedom of moving).[4] Such policies can potentially be harmful for in terms of psychological constraints and result in higher costs.[5] Results from mainly observational studies indicate that medical personnel is reluctant to enter the room of patients in IP resulting in fewer monitoring of vital signs and omitted medical progress notes.[6] Others have measured higher mean scores for depression and anxiety and lower scores for self-esteem in isolated compared to non-isolated patients.[7, 8] Therefore, some institutions abandoned IP for specific MDRO balancing risk for transmission and potential harm for the patient.[9, 10]

It has been criticized that many of the studies assessing adverse events from IP have not been adequately controlled for illness-severity and were of small sample size.[11] Furthermore, most of the studies looked at the impact of long-term isolation, which nowadays is a rare situation in the acute care setting. Shorter isolation tends to have less impact on various health outcomes.
including patient satisfaction, medical encounter and depression.[12-15] However, these data seem to be more conflicting and less generalizable. We therefore aimed to quantify the impact of IP on perception of psychological strain in acute care patients colonized or infected with transmissible pathogens, especially MDROs, and various degrees of comorbidities using a standardized approach borrowed from psychology research.[16] These results may serve as basis for interventions to alleviate psychological side-effects for patients in IP.

**Patients and Methods**

The Basel University Hospital is an 800-bed tertiary care hospital in the North-western part of Switzerland, with approximately 38'000 admissions/year. For one year, we prospectively measured the effects on mental well-being in patients under IP and concurrently with patients not being placed under IP as part of a quality assurance program. All consecutive patients in IP in single rooms either in contact, droplet, or aerosol isolation for a minimum of 24 hours, and with appropriate languages skills were invited to participate in the study. The infection control policy in our hospital follows the IP measures recommended by HICPAC and ESCMID. [1, 2] We obtained written informed consent from the study participant or next kin.

The following parameters were obtained from the electronic medical record: Age, sex, McCabe score, and psychiatric disorder as indicated in the diagnosis list upon admission. For every study participant in isolation we asked two non-isolated patients matched by ward, McCabe score [17] and age range (≤ 40 years, 41-50 years, 51-60 years, 61-70 years and > 70 years). Matching by ward ensured that the two cohorts were treated by the same medical staff. Since we were unsure how severity of illness might affect our results, we wanted to control for it by matching patients by this factor using the McCabe score.
The Pictorial Representation of Illness and Self Measure (PRISM) was applied to measure psychological and emotional impact of isolation. PRISM is a visual psychometric instrument that has been validated as a quantitative measure of suffering.\[16\] On a white magnetic board that represents the life of an individual, a yellow disk (7cm diameter) at the bottom righthand corner reflects the patients’ personage or “self” (Fig. 1). The patients are then prompted to put a second differently colored disk with a smaller diameter representing their illness or condition on the board with the instruction that the placement should reflect the importance of this condition in their lives at this moment. The quantitative outcome measure derived from PRISM is the Self-to-Illness Separation (SIS) which represents a patient’s perception on how a condition is intruding in his or her life. The distance between the centers of the “illness” and the “self” disks can range from zero to 27cm with higher distances reflecting less suffering (Fig. 2).\[16\]

PRISM has been widely applied in patients suffering from various chronic conditions e.g. trauma or cancer and it shows consistently significant negative correlation of the SIS with depression, pain, and disease-specific or generic measures of health-related quality of life.\[18\] The conditions of interest in our study included loneliness, worry to jeopardize somebody’s health, feelings of severe illness or bacterial contamination, inferior care by medical staff and avoidance by visitors. We further interrogated the patients on the importance of isolation measures. We addressed the same questions to the control patients, except for the last item: Instead of inquiring about the importance of isolation measures, we asked non-isolated patients to estimate the importance they attributed to overall hygiene measures. The disk and corresponding question were randomly chosen by the patient. The patient was asked where he would put the perceived “illness” in his or her life at the moment and to place the disk accordingly. The SIS was measured for every condition separately. Each patient completed the PRISM-tool once during the hospital stay.
**Statistical analyses**

We used descriptive statistics to express medians and proportions. We ran McNemar’s test to compare categorical and ordinal data and the Wilcoxon signed-rank test for continuous non-normally distributed data, respectively. To check for normal distribution of the data we inspected the normal Q-Q plots and applied the Shapiro-Wilk test. We performed linear mixed models for each individual interrogated perception of mental well-being as dependent variable with contact isolation as independent binary predictor. We predefined to adjust all models for the most important predictors that we considered to have a potential impact, regardless of whether the two groups differed significantly on these characteristics. We treated age, sex, McCabe score, and psychiatric disorder as fixed effects and ward as a random effect. Because we examined multiple endpoints, we divided the alpha level of 0.05 by the number of tests performed and considered the Bonferroni-corrected alpha level of < 0.006 to be statistically significant. All statistical analyses were performed using IBM SPSS for Windows version 23.0.[19]

**Patient and Public Involvement**

Neither patients nor the public were involved in the design and conduct of the study. However, the authors of the study carefully weighed the benefits for patients and the public against the possible disadvantages and concluded that the conduct of this study would also be of great interest from the perspective of patients and the public.

**Results**

**Participants’ characteristics.**

Between November 2011 and August 2012, we approached 90 patients in IP. Of these, 27 (30%) were excluded from the study due to language barriers, study denial, lack of cooperation or the
presence of a severe psychiatric disorder unable to complete the PRISM test. Full data from 63 patients were available for analyses matched with 93 (98%) of 95 eligible non-isolated patients as controls. There were no statistically significant differences with regard to age, sex and McCabe score between isolated and non-isolated study participants (Table 1).

Table 1. Baseline characteristics of isolated and non-isolated (controls) patients.

|                                | Isolated patients (n=63) | Controls (n=93) | p-value* |
|--------------------------------|--------------------------|-----------------|----------|
| Age, median (IQR), years       | 68 (57-76)               | 67 (60-75)      | 0.65a    |
| Female sex, number (%)         | 35 (55.6)                | 44 (47.1)       | 0.25b    |
| History of prior psychiatric disorder, number (%) | 3 (4.8) | 23 (24.7) | <0.001b |
| McCabe score, median (IQR)     | 3 (2-3)                  | 3 (2-3)         | 0.11a    |
| No. patients with McCabe 1 (%) | 6 (9.5)                  | 4 (4.3)         |          |
| No. patients with McCabe 2 (%) | 21 (33.3)                | 31 (33.3)       | 0.29b    |
| No. patients with McCabe 3 (%) | 36 (57.1)                | 58 (62.4)       |          |
| Medical ward, number (%)       | 39 (61.9)                | 50 (53.8)       | 0.313b   |
| Surgical ward, number (%)      | 24 (38.1)                | 43 (46.2)       |          |
| Single bedroom, number (%)     | 59 (94.0)                | 0 (0.0)         |          |
| Duration of isolation, median (IQR), days | 5 (2-10) | n.a. |          |
| No. patients in contact isolation (%) | 58 (92) | n.a. |          |
| No. patients in contact and/or droplet isolation (%) | 3 (5) | n.a. |          |
| No. patients in aerosol isolation (%) | 2 (3) | n.a. |          |

* We used the Wilcoxon ranked-sign test\(a\) and McNemar’s test\(b\) to compare nonparametric continuous and categorical data, respectively, in dependent samples.
There was, however, a significantly higher proportion with a psychiatric disorder (depression or anxiety) in the non-isolated group compared to the patient cohort under IP (24.7% vs. 4.8%, \( p < 0.001 \)). The participants stayed in IP for the following reasons: carriage of Extended-Spectrum-Beta-Lactamase producing (ESBL) \textit{E. coli} \((n=33)\), non-\textit{E. coli} ESBL (\textit{K. pneumonia}: \(n=11\); \textit{E. cloacae}: \(n=3\)), or Methicillin-resistant \textit{S. aureus} (MRSA) \((n=6)\), respectively, or infection with hypervirulent types of \textit{Clostridioides difficile} \((n=4)\) [20] or multi-drug resistant gram-negative bacteria not otherwise specified \((n=1)\), and for viral infections \((n=1)\) respectively. The median duration of isolation was 5 days (IQR: 2 to 10 days).

**Impact of isolation as evaluated by PRISM.**

Compared to non-isolated patients, patients in IP reported a significantly higher degree of psychological strain and expressed a significantly stronger perception that nurses (but not doctors) did not care at a level they expected. The SIS (median, IQR) for “nurses’ care is inferior” was statistically significantly smaller in isolated \((22.8, 18.5-24.3)\) than in non-isolated patients \((23.9, 23.3-25.5, p <0.001\)), whereas the median SIS (IQR) for “doctors’ care is inferior” was \(24.5 (23.0-25.3)\) and \(25.3 (23.5-26.0)\) in isolated and non-isolated patients, respectively \((p=0.525)\). Avoidance by visitors was significantly stronger perceived in isolated patients than in controls for a median SIS (IQR) of \(17.5 (7.7-22.0)\) and \(22.2 (21.8-22.6)\), respectively \((p<0.001)\).

In addition, the median SIS (IQR) for boredom and loneliness was significantly more common in isolated patients \((7.5; 3.6-16.0)\) compared to matched controls \((18.0; 10.2-21.6)\) \((p<0.001)\). SIS medians (IQR) for “being a threat to others” were \(19.8 (16.0-21.6)\) and \(20.1 (18.2-21.6)\) for patients in isolation and their matched controls, respectively; this difference was not statistically significant \((p=1.000)\). Similarly, the SIS medians (IQR) for perceived “illness severity” were not statistically significantly different with \(17.0 (10.1-20.0)\) vs. \(15.4 (9.75-18.95)\) in isolated vs. non-isolated patients, respectively \((p=0.801)\). However, compared to non-isolated patients the feeling
of impurity was more strongly perceived in isolated patients (median SIS 19, IQR 17.0-21.5) compared to controls (median SIS 21.5, IQR 18.9-22.1; p=0.012). Both, patients under IP and their matched controls, attributed high importance to isolation and precaution measures and general infection control standards, respectively. The perception in non-isolated patients, however, was even significantly stronger than in isolated patients with a median SIS (IQR) of 3.6 (3.25-3.9) as compared to 4.0 (3.5-9.0), respectively (p <0.001) (Fig. 3a.-h.).

When applying the linear mixed models controlling for age, sex, McCabe score, psychiatric disorders, and ward the SIS significantly decreased for patients under isolation precautions for perceived inferior care by nurses (-3.0, 95% CI -4.4 to -1.6), avoidance by visitors (-6.8, 95% CI, -8.3 to -5.2), and for feeling bored and lonely (-6.7, 95% CI – 8.8 to -4.5), while the SIS significantly increased for importance of infection control standards (3.4, 95% 2.2 to 4.7) as compared to non-isolated patients. Care by doctors and feeling of impurity were also perceived as inferior in isolated patients, the difference, however, was not statistically significant (Table 2).

Table 2. Linear mixed models for the prediction of change (in cm) in the Self-to-Illness Separation (SIS) in patients being placed under isolation precautions.

|                                      | Univariate model |                                  | Multivariable model* | p-value |
|--------------------------------------|------------------|----------------------------------|----------------------|---------|
|                                      | Coefficient | SE    | 95% confidence interval | Coefficient | SE    | 95% confidence interval |           |         |
|                                      |             |       | lower | upper |             |       | lower | upper |         |         |
| Nurses' care is inferior             | -2.7       | 0.7   | -4.1  | -1.2  | -3.0       | 0.7   | -4.4  | -1.6  | <0.001  |         |
| Doctors' care is inferior            | -1.2       | 0.6   | -2.4  | 0.1   | -1.3       | 0.7   | -2.6  | 0.0   | 0.045   |         |
| Avoidance by visitors               | -6.7       | 0.9   | -8.4  | -4.9  | -6.8       | 0.9   | -8.3  | -5.2  | < 0.001 |         |
| Feeling bored and lonely            | -6.3       | 1.0   | -8.3  | -4.2  | -6.7       | 1.1   | -8.8  | -4.5  | < 0.001 |         |
| Being a threat to others            | -1.2       | 0.7   | -2.6  | 0.1   | -1.1       | 0.7   | -2.4  | 0.4   | 0.079   |         |
| Perceived illness severity          | 1          | 1     | -0.8  | 2.8   | 1.2        | 0.9   | -0.7  | 3.2   | 0.218   |         |
Importance of IPC measures

| Importance of IPC measures | 3.3 | 0.7 | 1.9 | 4.8 | 3.4 | 0.7 | 2.2 | 4.7 | < 0.001 |
|---------------------------|-----|-----|-----|-----|-----|-----|-----|-----|---------|
| Feeling of impurity       | -1.3| 0.6 | -2.4| -0.2| -1.3| 0.6 | -2.5| -0.1| 0.029   |

a adjusted for age, sex, McCabe score, and psychiatric disorder as fixed effects, and ward (surgical vs. medical) as random effect.
IPC= infection prevention and control

Discussion

It is part of the art of medicine to balance the risk of transmission to other patients versus the potential negative impact on the care of the affected patients under IP. The current pandemic with SARS-CoV2 demonstrates on a larger scale the medical and ethical dilemma between individual needs and responsibilities at the population-level.[21] Physicians face similar challenges at the hospital level: Patients may suffer from isolation to the benefit of the patient population. In this study, hospitalized patients in short-term IP significantly experienced various psychological constraints compared to their matched controls. Our results with respect to perceived inferior care of patients in isolation are in accordance with a large qualitative study.[22] In addition, Gasink et al. evaluated patient satisfaction and noted a consistently less favorable response in isolated patients compared to non-isolated patients. [14] The differences, however, were not statistically significant, but sample size was low precluding firm conclusions. Another recent study suggested higher anxiety and depression scores in hospitalized MDRO patients under IP compared to non-MDRO patients but the groups were not well balanced with a significantly higher mortality rate and lengths of hospital stay in the MDRO-group suggesting more severe underlying illness which might have affected the results.[23] The findings of a Dutch research group at a large tertiary care hospital, however, are in contrast to our results:[13] Apart from being a single center study and using different outcome measurement tools, confounding variables may have contributed to the indifferent levels of depression and anxiety amongst short-term-isolated and non-isolated
patients. The Dutch infection prevention and control strategies are well known to be very strict
countrywide but are also associated with one of the lowest MDRO incidence rates.[24, 25]
Therefore, we assume that the attitude of Dutch patients under IP is more appreciative. Compared
to the study by Day et al., who attributed the higher levels of depression and anxiety to the
presence of existing psychiatric disorders rather than to short-term contact isolation,[15] the
proportion of patients with a history of psychiatric disorders was significantly higher in our
control group, suggesting that the negative effects on mental well-being in our study were
probably underestimated in the isolated patient cohort.

Implications of our results for clinical practice.

IP require financial and human resources in hospitals.[26, 27] Barker et al. showed that nurses
but not doctors need significantly more time in rooms with patients in contact precautions.[28] At
least from a nurse’s perspective, this additional workload leads to e.g. less frequent visits of the
patient, which may result in a perceived inferior quality of care from a patient’s point of view.[6]
From an ethical perspective, IP have been criticized for their unfair participant selection, e.g.
patients under IP carry the risk of potential harm to the benefit of all other patients not identified
as being infectious.[29] Furthermore, IP alone do not prevent per se infectious complications in
the respective individual but aim at preventing transmission of a potential harmful pathogen to
other susceptible patients despite their considerable lower infectious risk.[6]
Simply abandoning IP - suggested for endemic MRSA or VRE [30] - to relief an individual
patient while putting other patients at risk for acquisition may also increase the risk for outbreaks
of gram-positive [31] as well as of gram-negative MDRO [32] or emerging pathogens such as
*Candida auris.*[33, 34] Several studies indicate that training of staff in infection prevention as
part of a prevention bundle effectively reduces healthcare associated infections related to
MDRO.[35-37] However, we are not aware that such educational programs routinely address
how negative psychological impacts of IP could be mitigated. Although concepts for accommodating colonized or infected patients in a multi-bed room instead of a single room have been evaluated, they focused on prevention of transmission [38] or feasibility and acceptance by health care workers [39] but did not examine the psychological impact on patients. Besides, a considerable proportion of isolated patients are not well informed about their reasons for isolation and its value for the community:[14] thus, better information may help to decrease the negative impact of IP. A novel approach would be a program that alleviates the negative side-effects of IP while preserving the positive effect on transmission.

**Strengths of this study.**

We applied a matched cohort design and linear mixed models allowing us to control for the most important confounders. It is the first study that uses a validated psychological assessment tool with a continuous measurement scale for the topic of infection control. The tool allows the patient to provide more accurate and precise responses that was not yet feasible with other tools. Application of this tool also allowed to evaluate other aspects not considered in standardized depression questionnaires.

**Weaknesses in the study.**

Firstly, we did not systematically ask nurses about their workload, nor was there a formal auditing of adherence with infection control standards. Whether this had an impact on the result and the direction of the impact is difficult to conclude. However, we subsequently checked on-site the additional workload for certified nurses that was on average 55 minutes higher per patient in isolation.[26] Secondly, since there is no reference standard to assess the impact of isolation on psychological strains, the performance of this tool remains ill-defined for this topic and results may differ when the tool is applied in another setting. Thirdly, application of this instrument did not allow to evaluate the precise factors that led to impaired mental well-being. Finally, our
sample was too small to perform a more in-depth analysis of the relation between the SIS and other host or ward factors. Similarly, the sample size did not allow us to conduct subgroup analyses related to the different pathogens.

Conclusions

This study suggests that IP negatively affects mental and social well-being of patients. IP to prevent transmission in hospitals may become more and more important, and therefore, programs to minimize side-effects of IP should be integrated to decrease negative psychological effects on the individual patient while preserving the protective effect for other patients. The fact that the isolated patients also acknowledged the need for the isolation measures may suggest that an intervention with provision of easy-to-understand information could reinforce these positive aspects and reduce suffering.

List of abbreviations

ESBL: extended-spectrum beta-lactamase
ESCMID: European Society of Microbiology and Infectious Disease
HICPAC: Healthcare Infection Control Practices Advisory Committee
IQR: interquartile range
IP: isolation precautions
MDRO: multi-drug resistant organism
MRSA: methicillin-resistant Staphylococcus aureus
PRISM: pictorial representation of illness and self-measure
SIS: self-to-illness separation
Ethics statement

The study was approved in August 2011 by the Ethics Committee Basel, Switzerland as a masters thesis. The project is registered under the number 2011/25. However, at that time no official dispositions were issued. We obtained written informed consent from all the study participants or their next kin.

Availability of data and material:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Competing interests:

All authors declare to have no potential conflicts of interest. All authors have submitted the ICMJE form for Disclosure of Potential Conflicts of Interest.

Authors' contributions:

AW and RN conceived the study. RF collected the data and wrote a preliminary draft. MD was responsible for data management. DV performed the statistical analyses, interpreted the data, put
them into context with current literature and wrote the manuscript. AW and RN critically revised
the manuscript. AW is responsible for data accuracy. All authors read and approved the final
manuscript.
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Figure legends:

Figure 1. Pictorial Representation of Illness and Self Measure (PRISM). A white A4-sized metal board with a yellow circle representing the patient's “self” is laid on a table. Colored disks reflecting “illness” are placed onto the board by the patient. Image provided by Prismium GmbH, Zurich, Switzerland (Prismium.ch).

Figure 2. Self-to-Illness Separation, a quantitative outcome measure derived from PRISM. For each condition patients are asked “Where would you put the illness in your life at this moment?” The Self-to-Illness Separation (SIS) is the distance measured between the centers of the yellow circle and the colored disks.

Figure 3a.-h. Boxplots of the results of the Pictorial Representation of Illness and Self Measure (PRISM). Measuring the importance of different surrogates of mental and social well-being (a.-h.) in patients confined to isolation measures compared to non-isolated patients by means of PRISM with smaller Self-to-Illness Separation (SIS) representing higher importance of this particular item.
Figure 1. Pictorial Representation of Illness and Self Measure (PRISM). A white A4-sized metal board with a yellow circle representing the patient’s “self” is laid on a table. Colored disks reflecting “illness” are placed onto the board by the patient. Image provided by Prismium GmbH, Zurich, Switzerland (Prismium.ch).

82x39mm (600 x 600 DPI)
Figure 2. Self-to-Illness Separation, a quantitative outcome measure derived from PRISM. For each condition patients are asked "Where would you put the illness in your life at this moment?" The Self-to-Illness Separation (SIS) is the distance measured between the centers of the yellow circle and the colored disks.

208x116mm (300 x 300 DPI)
Figure 3a.-h. Boxplots of the results of the Pictorial Representation of Illness and Self Measure (PRISM). Measuring the importance of different surrogates of mental and social well-being (a.-h.) in patients confined to isolation measures compared to non-isolated patients by means of PRISM with smaller self-to-illness separation (SIS) representing higher importance of this particular item.

482x592mm (300 x 300 DPI)
STROBE Statement—checklist of items that should be included in reports of observational studies

| Item No | Recommendation | Page No |
|---------|----------------|---------|
| **Title and abstract** | | |
| 1 | (a) Indicate the study’s design with a commonly used term in the title or the abstract | 1 |
| | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 3 |
| **Introduction** | | |
| 2 | Explain the scientific background and rationale for the investigation being reported | 5-6 |
| **Methods** | | |
| 4 | Present key elements of study design early in the paper | 6-7 |
| 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 6-7 |
| **Participants** | | |
| 6 | (a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up | 6 |
| | Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls | |
| | Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants | |
| | (b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed | 6 |
| | Case-control study—For matched studies, give matching criteria and the number of controls per case | |
| **Variables** | | |
| 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 6 |
| **Data sources/measurement** | | |
| 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 6 |
| **Bias** | | |
| 9 | Describe any efforts to address potential sources of bias | 6 |
| **Study size** | | |
| 10 | Explain how the study size was arrived at | 6 |
| **Quantitative variables** | | |
| 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 8 |
| **Statistical methods** | | |
| 12 | (a) Describe all statistical methods, including those used to control for confounding | 8 |
| | (b) Describe any methods used to examine subgroups and interactions | |
| | (c) Explain how missing data were addressed | |
| | (d) Cohort study—If applicable, explain how loss to follow-up was addressed | |
| | Case-control study—If applicable, explain how matching of cases and controls was addressed | |
| | Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy | |
| | (e) Describe any sensitivity analyses | |

Continued on next page
### Results

| Section                  | Notes                                                                 | Page(s) |
|--------------------------|----------------------------------------------------------------------|---------|
| Participants             | 13* (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram | 8-9     |
| Descriptive data         | 14* (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Cohort study—Summarise follow-up time (eg, average and total amount) | 9       |
| Outcome data             | 15* (a) Cohort study—Report numbers of outcome events or summary measures over time Case-control study—Report numbers in each exposure category, or summary measures of exposure Cross-sectional study—Report numbers of outcome events or summary measures | 9-10    |
| Main results             | 16 (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | 9-10    |
| Other analyses           | 17 Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses |         |

### Discussion

| Section                  | Notes                                                                 | Page(s) |
|--------------------------|----------------------------------------------------------------------|---------|
| Key results              | 18 Summarise key results with reference to study objectives          | 10-11   |
| Limitations              | 19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 13      |
| Interpretation           | 20 Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 11-13   |
| Generalisability         | 21 Discuss the generalisability (external validity) of the study results | 12-13   |

### Other information

| Section                  | Notes                                                                 | Page(s) |
|--------------------------|----------------------------------------------------------------------|---------|
| Funding                  | 22 Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 15      |

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at [http://www.plosmedicine.org/](http://www.plosmedicine.org/), Annals of Internal Medicine at [http://www.annals.org/](http://www.annals.org/), and Epidemiology at [http://www.epidem.com/](http://www.epidem.com/)). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).