Article

Not peer-reviewed version

# Evaluation of Smallpox Vaccination Coverage and Attitude towards Monkeypox Vaccination among Healthcare Workers in An Italian University Hospital

Sergio Scarinci , Martina Padovan , Bianca Cosci , Armando Petillo , Vittorio Gattini , Francesca Cosentino , Aldo Mignani , Rudy Foddis , Giovanni Guglielmi *

Posted Date: 5 September 2023

doi: 10.20944/preprints202309.0154.v1

Keywords: Vaccine coverage; monkeypox; Mpox; Smallpox; healthcare workers; occupational health; occupational exposure; vaccination attitude.

*Article*

# Evaluation of Smallpox Vaccination Coverage and Attitude towards Monkeypox Vaccination among Healthcare Workers in An Italian University Hospital

**Sergio Scarinci [1,2], Martina Padovan [1,2], Bianca Cosci [1,2], Armando Petillo [1,2], Vittorio Gattini [1], Francesca Cosentino [1], Aldo Mignani [1], Rudy Foddis [2] and Giovanni Guglielmi [1,*]**

[1] Occupational Preventive Medicine Department, Azienda Ospedaliero-Universitaria Pisana, 56124 Pisa, Italy; scasers@gmail.com (S.S.); padovan.martina@gmail.com (M.P.); coscibianca@gmail.com (B.C); armando.petillo@virgilio.it (A.P.); v.gattini@ao-pisa.toscana.it (V.G.); f.cosentino@ao-pisa.toscana.it (F.C.); a.mignani@ao-pisa.toscana.it (A.M.)

[2] Department of Translational Research and New Technologies in Medicine and Surgery, University of Pisa, Pisa, Italy; rudy.foddis@unipi.it

* Correspondence: g.guglielmi@ao-pisa.toscana.it; Tel.: +39-3483057554

**Abstract:** (1) Background: Mpox was declared an international public health emergency by WHO. Initially, Smallpox vaccine in Italy was offered only to laboratory personnel at direct risk of infection. Currently, Healthcare workers (HCWs) are all considered by European Centre for Disease Prevention and Control (ECDC) to be at low or moderate risk. (2) Methods: To assess smallpox vaccination coverage among HCWs in an Italian hospital with different levels of risk of exposure to Mpox infection and to assess their attitudes toward vaccination, a self-report was administered to HCWs stratified at high and low/moderate risk. (3) Results: Of the 338 HCWs evaluated, 60.36% provided the requested data; among them the percentage of previously vaccinated staff was 38.7%, which corresponds to 23.4% of the total HCWs in the departments considered. Considering those born before 1979 as vaccinated, vaccination coverage increases from 23.4% to 41.4%. The department with the highest percentage of vaccinated is infectious diseases (60.5%); The percentage of HCWs who adhered to vaccination is 23%; only 8.8% of laboratory staff want to vaccinate, compared with 100% of midwives. The department with the highest percentage of vaccination adherence is proctology (85.7%). (4) Conclusions: Given the vaccination adherence rate and the vaccination coverage of the departments analyzed, it would be useful to extend vaccination against Smallpox to frontline HCWs involved in patient care in Italy too.

**Keywords:** vaccine coverage; monkeypox; mpox; smallpox; healthcare workers; occupational health; occupational exposure; vaccination attitude

## 1. Introduction

### *1.1. Monkeypox*

Mpox (formerly named monkeypox) is a viral infection known as Human Monkeypox (HMPX) and is caused by the Monkeypox virus (MPV), a type of DNA virus member of the Orthopoxvirus, which is part of the Chordopoxvirinae subfamily and the Poxviridae family [1].

After the eradication of smallpox declared in 1980 and the discontinuation of universal smallpox vaccination, mpox has emerged as the predominant zoonotic disease caused by orthopoxvirus infection in humans [2].

On 23 July 2022, the World Health Organization (WHO) declared the global Mpox outbreak a public health emergency [3].

Since the start of the mpox outbreak, and as of 7 June 2023, a total of 25,910 cases of Mpox have been reported from European countries [4].

In Italy 957 cases have been confirmed up to 07 June 2023 (no other cases have been recorded since that date) [5].

 doi:10.20944/preprints202309.0154.v1



The clinical manifestations include fever, asthenia, intense headache, lymphadenopathy, back pain, and myalgia. The fever subsides, and distinctive skin eruptions characterised by maculopapular lesions usually begin within 1–3 days after fever onset [6,7].

Human-to-human transmission may occur through contact with skin lesions, bodily fluids, and respiratory droplets, whereas indirect transmission may occur through contact with infected materials, such as clothing, bedding, blankets, or other supplies (fomites) [8].

In this outbreak, most reported cases have been transmitted through sexual contact with multiple partners, but Mpox can also spread via close physical contact with skin rashes, crusts, bodily fluids, and respiratory secretions originating from patients infected (occupational infections) [9].

In the context of the Mpox multi-country outbreak, mass vaccination is not recommended but targeting primary (pre-exposure) preventive vaccination (PPV) to population groups at highest risk of exposure may help outbreak control. High risk groups are individuals who identify themselves as gay, bisexual, or other men, as well as transgender people who engage in sexual activity with men, and specific categories of workers, like healthcare workers (HCWs) [10].

The European Centre for Disease Prevention and Control (ECDC) evaluates the level of risk for healthcare professionals in different scenarios. When wearing suitable personal protective equipment (PPE) and applying the correct precautions, the risk is considered low. However, the risk increases to moderate in situations where they are exposed to a case without appropriate PPE for an extended period, perform procedures that generate aerosols without PPE, or experience occupational exposure in a laboratory lacking proper PPE or equipment. When HCWs use appropriate PPE and correct precautions, the likelihood of exposure is very low, resulting in an overall low risk from Mpox. For laboratory personnel, the risk assessment remains consistent with the initial evaluation and depends on their use of proper PPE and adherence to appropriate laboratory protocols. Furthermore, the risk may be heightened for HCWs and laboratory personnel who are older or have weakened immune systems, as they are more susceptible to experiencing significant effects from exposure [11].

ECDC then gives an indication to consider vaccination for occupational exposure of HCWs, especially those at repeated risk of exposure, laboratory personnel and outbreak response staff based on risk assessment [12].

Since July 22, the European Medicines Agency (EMA) has authorized the use of Imvanex/Jynneos, a third-generation non-replicating smallpox vaccine, for the protection against Mpox in adults [13].

Imvanex/Jynneos is administered as a subcutaneous injection (0.5 ml.) but In 19 August 2022 (EMA/689496/2022) EMA's Emergency Task Force advises on intradermal use of Imvanex/Jynneos against monkeypox) and so national authorities may decide as a temporary measure to use Imvanex/Jynneos as an intradermal injection at a lower dose to protect at-risk individuals while supply of the vaccine remains limited. The recommended vaccination regimen consists of two doses, with the second dose administered at least 28 days after the first dose. This two-dose regimen is intended as the primary vaccination for individuals who have not been previously vaccinated against smallpox, monkeypox, or vaccinia viruses. Individuals who have received prior vaccinations against smallpox, monkeypox, or vaccinia viruses may consider a single booster vaccination dose [14].

### *1.2. The Italian context*

In Italy vaccination strategy consists of Primary Preventive Vaccination (PPV). Considering the current epidemic scenario and the limited availability of vaccine doses, in August 2022, the Ministry of Health stipulated that vaccination in the healthcare sector will be offered initially to laboratory personnel with possible direct exposure to orthopoxvirus [15]. The vaccination regime followed in Italy is that recommended by the EMA.For anyone who has received at least one dose of smallpox vaccine or Imvanex/Jynneos (MVA-BN) in the past or who has completed the two-dose vaccination course of Imvanex/Jynneos more than two years ago, only one dose (booster vaccination) is scheduled. People vaccinated against smallpox in the past may have some protection against Mpox. But it is unlikely that people younger than 40-50 years of age have been vaccinated, since smallpox

 doi:10.20944/preprints202309.0154.v1



vaccination in Italy was suspended in 1979 and officially repealed in 1981 [16]. Evidence of previous smallpox vaccination can usually be found as a scar on the upper arm at the deltoid muscle.

Furthermore, the Italian ministry of health after initial guidance issued in August 2022 on categories at risk of contracting the infection such as laboratory personnel has not issued new guidance to extend vaccine offerings to HCWs engaged in frontline work and thus exposed to possible Mpox infection. Instead, the ECDC has given guidance to evaluate vaccination of HCWs based on risk assessment.

Italian law [17] establishes that HCWs involved in the activities for which the evaluation of the risks highlighted a health risk they are undergoing to health surveillance also including the provision of effective vaccines for those workers who are not already immune to the biological agent present during processing, to be administered by the doctor in charge of health surveillance.

On 11 May 2023, the WHO Director-General declared that Mpox is no longer a global health emergency, but the International Health Regulations (IHR) Emergency Committee also emphasised the necessity to continue to make vaccines available for primary preventive (pre-exposure) and post-exposure vaccination for persons and communities at high risk of Mpox [18].

However, ECDC has issued a cautionary notice regarding the potential rise in cases expected during the upcoming summer season (2023). This increase could be caused to various celebratory gatherings like Pride events and heightened travel activities. ECDC emphasizes the significance of implementing suitable vaccination strategies and promoting behavior change in response to heightened transmission, as vital components for successful control of of this outbreak [19].

Data on Smallpox vaccination coverage (VC) in the HCWs are limited in the international literature [20] and thus far, few research studies addressing this matter have been conducted in Italy [21].

Italian HCWs' knowledge about Mpox is often inadequate [22].

However, the positive attitude toward vaccination among healthcare professionals presents an opportunity for promoting VC and preventing the spread of Mpox [23].

### *1.3. Aim of the study*

The present study aims to investigate Smallpox VC among HCWs working in departments with a low, moderate, and high risk of acquiring Mpox infection in an Italian university hospital, as well as their attitudes towards smallpox vaccination. Understanding the VC rates and attitudes of HCWs is crucial, as they play a critical role in both the prevention and management of infectious diseases like Mpox.

## 2. Materials and Methods

### *2.1. Setting*

The Azienda Ospedaliero-Universitaria Pisana (AOUP) is the tertiary referral centre for the North-West area of Tuscany. The AOUP encompasses 10 divisions and 158 structures, employing more than 5000 individuals. This center has a medium-large volume of activity. In 2019, it had 94,436 emergency department admissions, 57,090 total hospitalizations, both acute and non-acute, and 296,532 outpatient specialist consultations.

Out of the 957 reported cases of Mpox in Italy as of 07/04/2023, 47 were observed in Tuscany, of which 12 were identified and reported in AOUP (all between 07/28/2022 and 08/26/2022). No cases have been registered in AOUP since then.

Between the end of September 2022 and the beginning of November 2022, in AOUP three HCWs of the Virology department have been vaccinated to orthopoxvirus with 2 doses (separated by 28 days) with Jynneos vaccine.

### *2.2. Data collection*

HCWs employed in AOUP departments considered both at high risk and at low/moderate risk for exposure to Mpox were taken into consideration.

 doi:10.20944/preprints202309.0154.v1



An initial survey through a questionnaire has been conducted in the Virology department.

After that, the survey has been conducted to three other departments (Infectious diseases, Emergency medicine and Proctological surgery), considered in having from low to moderate risk.

In these departments, a self-declaration form was distributed to HCWs through the heads of departments and nursing coordinators. The form was to be filled out by the HCWs certifying their previous VC for smallpox and reporting adherence to the vaccination with complete cycle or with booster dose in case of vaccination offer. Number of doses administered, and any vaccination certificate were also requested. The other data collected were sex, age, job category and the hospital department of affiliation.

Concerning the socio-demographic information of the personnel from the considered departments who did not respond to the survey, we derived this data by extrapolating from the management system utilized during health surveillance visits at the Occupational Medicine Department of AOUP.

The self-declaration, translated in English, is available in the Supplementary Materials (Figure S1).

### *2.3. Statistical Analysis*

The statistical analysis was performed using Prism v. 9. Categorical variables were expressed as frequencies whereas quantitative variables as means or medians as appropriate. The statistical differences between the groups were assessed using the Chi-Square test for categorical variables and the Mann-Whitney test or unpaired Student t-test for quantitative variables as appropriate. The statistical significance was accepted for $p < 0.05$.

## 3. Results

### *3.1. Risk Assessment*

Based on the corporate procedure "Management of suspect/confirmed cases of Mpox", the cases must be promptly isolated in a dedicated room. Patients presenting to the Emergency Department (ED) or in the case of Outpatient access must be immediately isolated in a dedicated examination cubicle (or, if not available, in a separate area, maintaining a distance of not < one meter from other patients). Again, according to the procedure, the path envisaged for these subjects with suspected/confirmed Mpox infection provides for access to the AOUP structures in 3 ways:

1. access through the ED (for adults and children).
2. access through dermatology, proctology, urology, andrology, pediatrics, otorhinolaryngology, dentistry clinics.
3. direct access to the infectious diseases' unit (sent by GPs and PPLS).

In all 3 cases, it will be the infectious disease specialist who will have to take care of the patient (for examination and possible hospitalization in Infectious Diseases.

Based on these considerations, we can identify the AOUP departments in which it is possible that patients with suspected/confirmed diagnosis of Mpox infection pass, stay, be hospitalized, and then evaluate the level of Mpox risk of the assistance personnel who work in the departments themselves (Table 1).

Regarding the Mpox Risk Assessment in AOUP, the departments involved are mainly Virology, low to high risk, Emergency Room (for adults and pediatrics) and Infectious Diseases, both low to moderate risk.

**Table 1.** Risk assessment (RA) for the different departments.

| Department | Type of exposure | Risk assessment |
|---|---|---|
| Virology | possible direct exposure to the virus | From low to high risk |
| Emergency room | assistance to infected cases (doctors and health assistants) | From low to moderate risk |
| Emergency medicine | assistance to infected cases (doctors and health assistants) | From low to moderate risk |
| Infectious diseases | assistance to infected cases (doctors and health assistants) | From low to moderate risk |

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 September 2023 doi:10.20944/preprints202309.0154.v1



| | | |
|---|---|---|
| proctological surgery | assistance to infected cases (doctors and health assistants) | From low to moderate |
| Dermatology | assistance to infected cases (doctors and health assistants) | From very low to low risk |
| Otolaryngology | assistance to infected cases (doctors and health assistants) | From very low to low risk |
| Urology | assistance to infected cases (doctors and health assistants) | From very low to low risk |
| Andrology | assistance to infected cases (doctors and health assistants) | From very low to low risk |
| Pediatric ED | assistance to infected cases (doctors and health assistants) | From low to moderate risk |
| Pediatrics | assistance to infected cases (doctors and health assistants) | From very low to low risk |
| Dentistry | assistance to infected cases (doctors and health assistants) | From very low to low risk |

*3.2. Results*

3.2.1. Answers to Sef-certification

Of the 338 HCWs working in the said departments, 204 (60.36%) provided the requested data by filling out the self-certification. They have a median age of 44 years (19); 71.6 percent (146) of them are female and 28.4 percent (58) are male.

Considering the division by department, 43 (56.3 percent) HCWs from the infectious diseases department, 116 (50 percent) from emergency medicine, 38 (88.4 percent) from virology and 7 (63.6 percent) from proctology completed the self-report.

Specifically, significant data emerged for virology, infectious diseases, and emergency medicine ($p<0.001$).

Stratifying the HCWs by job category, 3 (100%) of biologists, 98 (59.8%) nurses, 31 (46.3%) physicians, 35 (55.6%) social health operator, 3 (100%) of midwives, 34 (94.4%) laboratory technicians, and no physiotherapists filled out the self-declaration. Significant results were found for physicians ($p=0.007$), physiotherapists ($p=0.0008$) and laboratory technicians ($p<0.001$).

The results for self-report completion are shown in Table 2.

**Table 2.** Demographic and occupational data of HCWs who have answered to the self-declaration.

| | **Answered** | **Not answered** | **p** |
|---|---|---|---|
| **Department** | | | |
| Infectious diseases | 43 (56.3%) | 9 (43.7%) | |
| Emergency medicine | 116 (50%) | 116 (50%) | **<0.001** |
| Virology | 38 (88.4%) | 5 (11.6%) | |
| Proctological surgery | 7 (63.6%) | 4 (36.4%) | |
| Infectious diseases | 43 (82.7%) | 9 (17.3%) | <0.001 |
| Not Infectious diseases | 161 (56.3%) | 125 (43.7%) | |
| Emergency medicine | 116 (50%) | 116 (50%) | <0.001 |
| Not Emergency medicine | 88 (83%) | 18 (17%) | |
| Virology | 38 (88.4%) | 5 (11.6%) | <0.001 |
| Not Virology | 166 (56.3%) | 129 (43.7%) | |
| Proctological surgery | 7 (63.6%) | 4 (36.4%) | 0.84 |
| Not Proctological surgery | 197 (60.6%) | 128 (39.4%) | |
| **Job category** | | | |
| Biologist | 3 (100%) | 0 (0%) | |
| Nurse | 98 (59,8%%) | 66 (40.2%) | |
| Physician | 31 (46.3%) | 36 (53.7%) | **<0.001** |
| Social health operator | 35 (55.6%) | 28 (44.4%) | |
| Midwife | 3 (100%) | 0 (0%) | |
| Laboratory technician | 34 (94.4%) | 2 (5.6%) | |
| Physiotherapist | 0 (0%) | 2 (100%) | |
| Biologist | 3 (100%) | 0 (0%) | 0.162 |
| Not biologist | 201 (60%) | 134 (40%) | |

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 September 2023 doi:10.20944/preprints202309.0154.v1



| | | | |
|---|---|---|---|
| Nurse | 98 (59.8%) | 66 (40.2%) | 0.725 |
| Not Nurse | 106 (60.9%) | 68 (39.1%) | |
| Physician | 31 (46.3%) | 36 (53.7%) | 0.007 |
| Not Physician | 173 (63.8%) | 98 (36.2%) | |
| Social health operator | 35 (55.6%) | 28 (44.4%) | 0.388 |
| Not Social health operator | 169 (61.5%) | 106 (38.5%) | |
| Midwife | 3 (100%) | 0 (0%) | 0.162 |
| Not midwife | 201 (60%) | 134 (40%) | |
| Laboratory technician | 34 (94.4%) | 2 (5.6%) | <0.001 |
| Not Laboratory technician | 170 (56.3%) | 132 (43.7%) | |
| Physiotherapists | 0 (0%) | 2 (100%) | 0.008 |
| Not Physiotherapists | 204 (60.7%) | 132 (39.3%) | |

3.2.2. Vaccination coverage

The percentage of staff previously vaccinated for smallpox is 38.7% (79 employees), which corresponds to 23.4% of the total number of employees in the departments considered; the remaining 125 (61.3%) workers reported that they were not vaccinated for smallpox. The median age of those vaccinated was 54 (7), 59 (40.4%) were females, and 20 (34.5%) were males.

Of the 79 employees who reported having previously vaccinated, 32.7% (32) are nurses, 44.4% (12) are physicians, 62.9% (22) are Social Health operators, 33.3% (1) are midwives, 35.3% (12) are laboratory technicians.

60.5% (26) are HCWs of infectious diseases, 32.8% (38) are HCWs of emergency medicine, 31.6% (12) are HCWs of virology, 42.9% (3) are HCWs of proctology.

Notably, the age difference between vaccinated and unvaccinated was significant (p<0.001).

Assessing the VC stratified by task, significant data were recorded for social health operators (p=0.001); regarding the VC stratified by department, significant data were found for infectious diseases (p=0.001) and emergency medicine (p=0.045).

The results for VC are shown in Table 3

**Table 3.** Distribution of vaccine to unvaccinated subjects in AOUP departments, in number and percentage.

| | **Vaccinated** | **Not vaccinated** | **p** |
|---|---|---|---|
| Age | 54 (7) | 37 (19) | <0.001 |
| Male | 20 (34.5%) | 38 (65.5%) | 0.433 |
| Female | 59 (40.4%) | 87 (49.6%) | |
| **Department** | | | |
| Infectious diseases | 26 (60.5%) | 17 (39.5%) | **0.019** |
| Emergency medicine | 38 (32.8%) | 78 (67.2%) | |
| Virology | 12 (31.6%) | 26 (68.4%) | |
| Proctological surgery | 3 (42.9%) | 4 (57.1%) | |
| Infectious diseases | 26 (60.5%) | 17 (39.5%) | 0.001 |
| Not Infectious diseases | 53 (32.9%) | 108 (67.1%) | |
| Emergency medicine | 38 (32.8%) | 78 (67.2%) | 0.045 |
| Not Emergency medicine | 41 (46.6%) | 47 (53.4%) | |
| Virology | 12 (31.6%) | 26 (68.4%) | 0.316 |
| Not Virology | 67 (40.4%) | 99 (59.6%) | |
| Proctological surgery | 3 (42.9%) | 4 (57.1%) | 0.819 |
| Not Proctological surgery | 76 (38.6%) | 121 (61.4%) | |
| **Job category** | | | |
| Biologist | 0 (0%) | 3 (100%) | **0.032** |
| Nurse | 32 (32.7%) | 66 (67.3%) | |

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 September 2023 doi:10.20944/preprints202309.0154.v1



| | | | |
|---|---|---|---|
| Physician | 12 (44.4%) | 19 (70.4%) | |
| Social health operator | 22 (62.9%) | 13 (37.1%) | |
| Midwife | 1 (33.3%) | 2 (66.7%) | |
| Laboratory technician | 12 (35.3%) | 22 (64.7%) | |
| Physiotherapists | | | |
| Biologist | 0 (0%) | 3 (100%) | 0.165 |
| Not biologist | 79 (39.3%) | 122 (60.7%) | |
| Nurse | 32 (32.7%) | 66 (67.3%) | 0.087 |
| Not Nurse | 47 (44.3%) | 59 (55.7%) | |
| Physician | 12 (44.4%) | 19 (70.4%) | 0.998 |
| Not Physician | 67 (38.7%) | 106 (61.3%) | |
| Social health operator | 22 (62.9%) | 13 (37.1%) | 0.001 |
| Not Social health operator | 57 (33.7%) | 112 (66.3%) | |
| Midwife | 1 (33.3%) | 2 (66.7%) | 0.847 |
| Not midwife | 78 (38.9%) | 123 (61.2%) | |
| Laboratory technician | 12 (35.3%) | 22 (64.7%) | 0.653 |
| Not Laboratory technician | 67 (39.4%) | 103 (60.6%) | |

Analyzing the 134 HCWs who did not respond to the self-report, 61 HCWs were born before 1979 (the year when the vaccination requirement for smallpox was repealed in Italy): If we consider those born before 1979 as vaccinated, the VC increases from 23. 4% (79 HCWs) to 41.4% (140 HCWs), of which 33 (23.6%) belong to the infectious diseases department, 85 (60.7%) to the emergency medicine department, 17 (12.1%) to the virology department and 5 (3.6%) to the proctology department.

Data on VC by department considering also those who did not respond but were born before 1979 are shown in Table 4.

Data on the stratification by year of birth (born before 1979 vs. born since 1979) and department of employees who those who did not filled out the self-declaration are shown in **table S1** reported in Supplementary Materials.

**Table 4.** Vaccinated (self-certification plus the ones who have not responded, born before 1979).

| | **Vaccinated** | **Not vaccinated** | **p** |
|---|---|---|---|
| **Department** | | | |
| Infectious diseases | 33 (66%) | 17 (34%) | |
| Emergency medicine | 85 (52.1%) | 78 (47.9%) | **0.086** |
| Virology | 17 (39.5%) | 26 (60.5%) | |
| Proctological surgery | 5 (55.6%) | 4 (44.4%) | |

3.2.3. Willingness to vaccinate against Mpox

In terms of willingness to adhere to vaccination, the percentage of staff who declared willingness to vaccinate was 23% (47 employees).

Stratifying by department the 47 employees who declared willingness to adhere to vaccination (24.1% male and 22.6% female), 11 are HCWs from the infectious diseases department (23.4%), 25 from the emergency medicine department (53.2%), 5 from virology (10.6%), and 6 from proctology (12.8%).

In terms of adherence by job category, one biologist (2.1%), 21 (44.7%) nurses, 11 (23.4%) physicians, 8 (17%) HCWs, 3 midwives (6.4%), and 3 (6.4%) laboratory technicians adhered to the vaccination.

Of the 47 employees who adhered to vaccination, 10 (21%) required only one vaccination booster as they had already been vaccinated previously, while 37 (79%) needed full vaccination as they had never been vaccinated before.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 5 September 2023 doi:10.20944/preprints202309.0154.v1



Specifically, evaluating vaccination adherence by age, significant results were found for the infectious diseases department with a median age of 34 years (20) (p=0.002); evaluating vaccination adherence by job category, statistically significant results were recorded for midwives (p= 0.001) and laboratory technicians (p=0.031); evaluating vaccination adherence by department, significant values were found for the proctology department (p<0.001).

The results regarding willingness to adhere to vaccination are shown in Table 5.

**Table 5.** Descriptive analysis results of the subgroups that wants to get vaccinated and the subgroup that does not want to get vaccinated of the study population.

| | **Willigness to vaccination** | **Denies willingness** | **p** |
|---|---|---|---|
| Age | 38 (17.5) | 46 (18) | 0.01 |
| Male<br>Female | 14 (24.1%)<br>33 (22.6%) | 44 (75.9%)<br>113 (77.4%) | 0.814 |
| Age Infectious diseases | 34 (20) | 54.50 (12) | 0.002 |
| Age Emergency medicine | 38 (16.5) | 42 (17) | 0.1 |
| Age virology | 33 (12.5) | 42 (22.5) | 0.238 |
| **Department**<br>Infectious diseases<br>Emergency medicine<br>Virology<br>Proctological surgery | <br>11 (25.6%)<br>25 (21.6%)<br>5 (13.2%)<br>6 (85.7%) | <br>32 (74.4%)<br>91 (78.4%)<br>33 (86.8%)<br>1 (14.3%) | **<0.001** |
| Infectious diseases<br>Not Infectious diseases | 11 (25.6%)<br>36 (22.4%) | 32 (74.4%)<br>125 (77.6%) | 0.656 |
| Emergency medicine<br>Not Emergency medicine | 25 (21.6%)<br>22 (25%) | 91 (78.4%)<br>66 (75%) | 0.562 |
| Virology<br>Not Virology | 5 (13.2%)<br>42 (25.3%) | 33 (86.8%)<br>124 (74.7%) | 0.109 |
| Proctological surgery<br>Not Proctological surgery | 6 (85.7%)<br>41 (20.8%) | 1 (14.3%)<br>156 (79.2%) | <0.001 |
| **Job category**<br>Biologist<br>Nurse<br>Physician<br>Social health operator<br>Midwife<br>Laboratory technician<br>Physiotherapists | <br>1 (33.3%)<br>21 (21.4%)<br>11 (35.5%)<br>8 (22.9%)<br>3 (100%)<br>3 (8.8%) | <br>2 (66.7%)<br>77 (78.6%)<br>20 (64.5%)<br>27 (77.1%)<br>0 (0%)<br>31 (91.2%) | **0.005** |
| Biologist<br>Not biologist | 1 (33.3%)<br>46 (22.9%) | 2 (66.7%)<br>155 (77.1%) | 0.182 |
| Nurse<br>Not Nurse | 21 (21.4%)<br>26 (24.5%) | 77 (78.6%)<br>80 (75.5%) | 0.599 |
| Physician<br>Not Physician | 11 (35.5%)<br>36 (20.8%) | 20 (64.5%)<br>137 (67.2%) | 0.074 |
| Social health operator<br>Not Social health operator | 8 (3.9%)<br>39 (19.1%) | 27 (13.2%)<br>130 (79.2%) | 0.976 |
| Midwife<br>Not midwife | 3 (100%)<br>44 (21.9%) | 0 (0%)<br>157 (78.1%) | 0.001 |
| Laboratory technician<br>Not Laboratory technician | 3 (8.8%)<br>44 (25.9%) | 31 (91.2%)<br>126 (74.1%) | 0.031 |

 doi:10.20944/preprints202309.0154.v1



## 4. Discussion

AOUP is one of the largest hospitals in Italy, with high specialization in several clinical fields.

As of 04/07/2023, a total of 12 cases of Mpox were identified and notified in AOUP (all from 07/28/2022 to 08/26/2022); no cases have been recorded since then.

Considering the global epidemic scenario, in August 2022, following the EMA's Emergency task force advises, the Italian Ministry of Health stipulated that the vaccination in the healthcare sector would have been offered initially to laboratory personnel with possible direct exposure to orthopoxvirus.

Regarding the response to the self-certification, statistically significant differences have emerged among the departments; HCWs of Virology and infectious diseases departments have completed the self –declaration to a greater extent compared to the other departments: 88.4% (38 out of 43) of HCWs from Virology department completed the survey, as opposed to 56.3% (166 out of 295) of HCWs from other departments ($p<0.001$). Additionally, 82.7% (43 out of 52) HCWs from infectious diseases department completed the questionnaire, in contrast to 56.3% (161 out of 286) of HCWs from other departments ($p<0.001$).

On the contrary, the emergency medicine department had the lowest number of HCWs who completed the self-certification (50%, 116 out of 232 HCWs) compared to the other departments (83%, 88 out of 106, $p<0.001$). It is not uncommon for vaccination-related surveys to be completed by personnel who perceive themselves to be at a higher risk for a specific pathology compared to others [24,25].

When considering the response stratified by job category, significant differences emerged among physicians, physiotherapist, and laboratory technicians. Only 46.3% (31 out of 67) of physicians completed the questionnaire, whereas 63.8% (173 out of 271) of HCWs did so ($p=0.007$). In addition, no physiotherapist responded to the self-certification, compared to 39.3% of other HCWs (132 out of 336) ($p=0.008$) In contrast, laboratory technicians showed a higher rate of questionnaire completion (94.4%, 34 out of 36) compared to other HCWs (56.3%, 170 out of 302) ($p<0.001$). This differs from the findings of consolidated literature data, where nurses tend to be the most responsive to surveys [24,26].

Regarding the VC, the Infectious Diseases Department has the highest percentage of vaccinated individuals (60.5%, 26 out of 43 HCWs) compared to the total of other departments (32.9%, 53 out of 161 HCWs, $p<0.001$). Conversely, the Emergency Medicine Department statistically has a lower number of previously vaccinated employees (32.8%, 38 out of 116 HCWs) compared to the total of other departments (46.6%, 41 out of 88 HCWs, $p=0.045$). This data is explicable if we consider the median age of HCWs in their respective departments in correlation with the year when smallpox vaccination was suspended.

Among the HCWs, it is noteworthy that statistically, the Social health operators are the most vaccinated group (62.9%, 22 out of 35) compared to other HCWs (33.7%, 57 out of 169, $p=0.001$), possibly due to their higher average age relative to other HCWs, in line with the latest report on the distribution of public employees by age published by the Italian Ministry of Economy and Finance in 2021. Assuming we extract data from the healthcare sector and include all individuals with a job title comparable to social health operators based on their contractual qualifications, we calculated the weighted average age. According to the report, the average age of social health operators is 51.4 years, while the entire healthcare personnel have an average age of 49.5 years [27]

The median age of those who reported being previously vaccinated is 54 years (7), while the median age of those who reported not being vaccinated is 37 years (19) ($p<0.001$).

There is no significant difference in gender between employees who have been vaccinated previously ($p=0.433$).

This lack of gender difference in vaccination status is presumably due to the universality of the Italian smallpox vaccination program, which was offered to all newborns within their first two years of age, with a booster shot around the age of eight, usually within the tenth year of age. This widespread and mandatory vaccination likely accounts for the lack of gender-based differences in vaccination rates.

 doi:10.20944/preprints202309.0154.v1



The mandatory vaccination requirement was first suspended in 1979 and it was later abolished in 1981 [16].

By estimating those who had not yet reached the age of two in 1981, we can consider individuals born before 1979 as vaccinated. If we include those born before 1979 as vaccinated, the statistical difference in VC between the departments disappears and the VC rate changes from 23.4% (79 HCWs) to 41.4% (140 HCWs).

Such higher VC related to age is consistent with a well-established and widespread trend among HCWs for influenza vaccinations [28] and for vaccinations in general as well [29]and it is also consistent with what has been previously found in the AOUP regarding VC in HCWs for flu and meningitis [30,31].

Regarding the willingness to adhere to vaccination, the Infectious Diseases Department has significantly younger personnel among those who expressed the intention to get vaccinated, with a median age of 34 years (20), compared to the personnel who do not want to get vaccinated, with a median age of 54.50 (12, p=0.002).

This is in line with the findings reported by Hong, Jing, et al., where the age group with the highest vaccine acceptance for Mpox among HCWs is the one between 31 and 40 years old [32].

Regarding adherence to Smallpox vaccination, there is no gender difference, and this finding contradicts the few studies that have assessed vaccine willingness in the literature. In "Harapan et al." men had lower odds of being willing to take the vaccine than women [33].

While in Riad, Abanoub, et al. Smallpox vaccine acceptance level to protect against Mpox in HCWs was higher among males than females [34] and in Ghazy, et al. males were more confident regarding Smallpox vaccination [35].

When stratifying by department, those who statistically showed the highest adherence to vaccination were the social health operator in the Proctology department (85.7%, 6 out of 7 HCWs in Proctology) compared to the other departments analyzed (20.8%, 41 out of 197 HCWs, p<0.001) probably because they assists physicians during the clinical examinations and are assigned to take care of the patients who may present a typical skin manifestation in the anal region.

Regarding the job category, on the other hand, 100% of the midwives (all belonging to the Proctology department) who responded to the self-certification expressed their willingness to get vaccinated (3 out of 3) compared to 21.9% (44 out of 201 HCWs) of other job category (p<0.001). In this context, midwives are probably particularly aware of the issue of potentially transmitting infectious diseases to a vulnerable population, like pregnant woman during pregnancy or childbirth.

Physicians are the second job category with a higher vaccination willingness among those who responded to the self-certification, with 35.5% (11 out of 31), consistent with a historically established trend in vaccinations for HCWs in Italy [36], even if, in this study, this difference is not statistically significant (p=0.074) [37].

On the other hand, only 8.8% of laboratory technicians, all belonging to the Virology department, have adhered to vaccination (3 out of 34), compared to 25.9% (44 out of 170) of other HCWs in different analyzed job category (p=0.031).

Therefore, in our study, it was particularly evident that workers with a minor attitude to be vaccinated vs. Smallpox to protect against Mpox were laboratory personnel despite being the only category of HCWs for whom Smallpox vaccination is currently indicated in Italy because they are at high risk of exposure. Likely, their attitude towards vaccination contradicts the Italian guidelines because they perceive the risk differently than what is outlined in the directives of the Italian Ministry of Health, where laboratory workers are considered to have a potential direct exposure to orthopoxviruses.

Our study has some limitations. The Smallpox VC and attitude to vaccinate against Mpox were evaluated only in some departments of the AOUP assessed with a low to moderate/high risk. Only 60,36 % of the HCWs involved completed the self-declaration.

Additionally, it was not possible to assess the perception of risk of Occupational Mpox infection transmission in HCWs and their reasons behind the refusal to undergo anti-Smallpox vaccination.

 doi:10.20944/preprints202309.0154.v1



Furthermore, we have not evaluated what is the level of epidemiological and clinical knowledge of HCWs toward the Mpox virus.

Finally, our study represents the experience of a single Italian hospital. Hence, it is important to conduct a multicenter study, encompassing a larger cohort of HCWs to validate our finding.

## 5. Conclusions

The incidence of Mpox cases in Italy appears to have shown a significant decline in 2023. Even though there has been a substantial reduction in Mpox cases, it is crucial to maintain a high level of attention, especially forHCWs involved in patient care.

From our study, a significant variability in vaccination adherence has emerged both among different job category and across the various departments analyzed.

Based on our experience and the assessment of Mpox infection risk in AOUP, it emerges that the risk of Mpox infection is not confined solely to the Virology department where laboratory personnel are identified as high-risk according to the Italian Ministry of Health guidelines. Additionally, our survey reveals that vaccination adherence is higher among HCWs from departments currently not granted free access to such vaccination. Considering the potential risk of Mpox transmission in healthcare settings and the importance of achieving a higher level of immunity among HCWs, it is essential to sensitizing Italian institutions to extend the availability of Smallpox vaccination beyond laboratory personnel. Following the guidelines set forth by the ECDC, we propose making the Smallpox vaccine accessible to all frontline HCWs involved in patient care.

By ensuring broad access to the vaccine for HCWs across various departments, we can work towards enhancing VC in Italian hospitals, ultimately contributing to a safer and more protected healthcare environment for both patients and HCWs alike.

Collaboration between occupational health physicians, hospital management, and infection control teams is vital for creating a comprehensive and sustainable vaccination program. By working together, they can identify and address barriers to vaccination, implement targeted interventions, and monitor the impact of vaccination efforts on overall healthcare worker immunization rates.

**Supplementary Materials:** The following supporting information can be downloaded at the website of this paper posted on Preprints.org. Figure S1: Self-certification translated in English. Table S1: Year of birth and department of HCWS who did not complete the self-declaration.

**Author Contributions:** Conceptualization, V.G., S.S, M.P. and G.G.; data curation, S.S., V.G. and M.P., formal analysis, B.C., S.S..; methodology, V.G., M.P., S.S.; supervision V.G. and G.G.; writing—original draft, M.P., S.S., B.C.; V.G., A.P. writing—review and editing, M.P., V.G., S.S., B.C., A.P.,F.C., A.M., G.G. ,R.F. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** The guidelines of the competent Ethics Committee for the University of Pisa define the studies for which the ethics committee review and approval is required. Our study did not anticipate the participation of patients, any form of medical interventions beyond standard practice, or the utilization of animals for experimental purposes. According to the competent Ethics Committee Ethical review and approval was not required for this study. The guidelines are publicly available here: https://alboufficiale.unipi.it/wp-content/uploads/2017/12/regolamento.pdf (accessed on 6 June 2023).

**Informed Consent Statement:** Written informed consent was obtained from all subjects involved in the study to publish this paper. We used aggregated data in order to conduct our analysis.

**Acknowledgments:** The authors extend their thanks to those who filled out the self-declaration.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References


1. Shchelkunov S.N., Marennikova S.S., Moyer R.W. *Orthopoxviruses Pathogenic for Humans*; 1st ed. Springer; New York, NY, USA: 2005. p. 425. doi: 10.1007/b107126
2. Simpson K, Heymann D, Brown CS, Edmunds WJ, Elsgaard J, Fine P, et al. Human monkeypox–After 40 years,an unintended consequence of smallpox eradication. *Vaccine.* **2020**,*38*(33):5077-81. doi: 10.1016/j.vaccine.2020.04.062.
3. Multi-country monkeypox outbreak: Situation update. Available online: https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON393 (accessed on 7 june 2023)
4. Joint ECDC-WHO Regional Office for Europe Mpox Surveillance Bulletin. Available online: https://monkeypoxreport.ecdc.europa.eu/ (accessed on 9 june 2023).
5. Communicable Disease Threats Report Week 23, 5–11 June 2023 ECDC. Available online: https://www.ecdc.europa.eu/en/publications-data/communicable-disease-threats-report-5-11-june-2023-week-23 (accessed on 10 june 2023).
6. Nyame J, Punniyakotti S, Khera K, Pal RS, Varadarajan N, Sharma P. Challenges in the treatment and prevention of Monkeypox infection; a comprehensive review. *Acta Trop.* **2023** 106960. doi: 10.1016/j.actatropica.2023.106960.
7. McCollum AM, Damon IK. Human monkeypox. *Clin Infect Dis.* **2014** ;*58*:260–7. https://doi.org/10.1093/cid/cit703
8. O'Neill M, LePage T, Bester V, Yoon H, Browne F, Nemec EC. Mpox (Formally Known as Monkeypox). *Physician Assist Clin.* **2023**,*8(3)*:483-494. doi:10.1016/j.cpha.2023.02.008
9. Salvato RS, Rodrigues Ikeda ML, Barcellos RB, Godinho FM, Sesterheim P, Bitencourt LCB, Gregianini TS, Gorini da Veiga AB, Spilki FR, Wallau GL. Possible Occupational Infection of Healthcare Workers with Monkeypox Virus, Brazil. *Emerg Infect Dis.* **2022** ,*28(12)*:2520-2523. doi:10.3201/eid2812.221343
10. Monkeypox multi-country outbreak - second update. Available online: https://www.ecdc.europa.eu/en/publications-data/monkeypox-multi-country-outbreak-second-update (accessed on 9 june 2023)
11. European Centre for Disease Prevention and Control (ECDC). Risk assessment: Monkeypox multi-country outbreak. Stockholm: ECDC; 2022. Available online: https://www.ecdc.europa.eu/en/publications-data/risk-assessment-monkeypox-multi-country-outbreak (accessed on 11 june 2023)
12. Public health considerations for mpox in EU/EEA countries. Avilable online. https://www.ecdc.europa.eu/en/publications-data/public-health-considerations-mpox-eueea-countries (accessed on 6 june 2023)
13. European Medicines Agency (EMA). EMA recommends approval of Imvanex for the prevention of monkeypox disease. Amsterdam: EMA; 2022. Available online: https://www.ema.europa.eu/en/news/ema-recommends-approval-imvanex-prevention-monkeypox-disease (accessed on 5 june 2023)
14. European Medicines Agency (EMA). Imvanex - EPAR - Product Information. Amsterdam: EMA; 2022. Available online: https://www.ema.europa.eu/en/medicines/human/EPAR/imvanex (accessed on 7 june 2023)
15. Circolare 5 agosto 2022 - Indicazioni ad interim sulla strategia vaccinale contro il vaiolo delle scimmie (MPX). Available online: https://www.epicentro.iss.it/mpox/documentazione-italia (accessed on 2 June 2023)
16. Decreto-legge 26 giugno 1981, n 334. Available online: https://www.normattiva.it/uri-res/N2Ls?urn:nir:::1981;334 (accessed on 12 june 2023)
17. Decreto legislativo 81/08, articolo n 39. Available online: https://www.ispettorato.gov.it/files/2023/03/TU-81-08-Ed-Gennaio-2023.pdf (accessed on 14 june 2023)
18. Monkeypox Strategic Preparedness, Readiness, and Response Plan (SPRP). Available online: https://www.who.int/publications/m/item/monkeypox-strategic-preparedness--readiness--and-response-plan-(sprp) (accessed on 14 june 2023)
19. ECDC highlights measures to mitigate possible increase in mpox cases during spring and summer. Available online: https://www.ecdc.europa.eu/en/news-events/ecdc-highlights-measures-mitigate-possible-increase-mpox-cases-during-spring-and-summer (accessed on 14 june 2023)
20. Yih WK, Lieu TA, Rêgo VH, O'Brien MA, Shay DK, Yokoe DS, Platt R. Attitudes of healthcare workers in U.S. hospitals regarding smallpox vaccination. *BMC Public Health.* **2003** ,*3:20*. doi:10.1186/1471-2458-3-20

21. Riccò, M.; Ferraro, P.; Camisa, V.; Satta, E.; Zaniboni, A.; Ranzieri, S.; Baldassarre, A.; Zaffina, S.; Marchesi, F. When a Neglected Tropical Disease Goes Global: Knowledge, Attitudes and Practices of Italian Physicians towards Monkeypox, Preliminary Results. *Trop. Med. Infect. Dis.* **2022**, *7*, *135*. doi:10.3390/tropicalmed7070135
22. Miraglia Del Giudice G, Della Polla G, Folcarelli L, Napoli A, Angelillo IF; Collaborative Working Group. Knowledge and attitudes of health care workers about monkeypox virus infection in Southern Italy. *Front Public Health***. 2023**, *11*:1091267. doi:10.3389/fpubh.2023.1091267
23. Lulli LG, Baldassarre A, Mucci N, Arcangeli G. Prevention, Risk Exposure, and Knowledge of Monkeypox in Occupational Settings: A Scoping Review. *Trop Med Infect Dis*. **2022**, *7(10)*:276. doi:10.3390/tropicalmed7100276
24. Little KE, Goodridge S, Lewis H, Lingard SW, Din S, Tidley M, Roberts RJ, Williams NS, Hayes S. Occupational vaccination of health care workers: uptake, attitudes and potential solutions. *Public Health*. **2015** Jun;*129(6)*:755-62. doi: 10.1016/j.puhe.2015.02.031. Epub 2015 Mar 31. doi:10.1016/j.puhe.2015.02.031
25. Vaux S., Fonteneau L., Péfau M., Venier A.G., Gautier A., Soing Altrach S., Parneix P., Levy-Bruhl D. Vaccination against influenza, measles, pertussis and varicella in workers in healthcare facilities in France: a national cross-sectional study in 2019. *Vaccine* **2023**, *41.3* 812-820. doi:10.1016/j.vaccine.2022.12.023
26. Boey L, Bral C, Roelants M, De Schryver A, Godderis L, Hoppenbrouwers K, Vandermeulen C. Attitudes, believes, determinants and organisational barriers behind the low seasonal influenza vaccination uptake in healthcare workers - A cross-sectional survey. *Vaccine*. **2018,** *36(23)*:3351-3358 doi:10.1016/j.vaccine.2018.04.044
27. Mef, Ministero dell'Economia e delle Finanze - Distribuzione dei dipendenti per età. Available online: https://contoannuale.rgs.mef.gov.it/web/sicosito/struttura-personale/eta-acc (accessed on 20 july 2023)
28. Riphagen-Dalhuisen J, Gefenaite G, Hak E. Predictors of seasonal influenza vaccination among healthcare workers in hospitals: a descriptive meta-analysis. *Occup Environ Med*. **2012,** *69(4)* doi:10.1136/oemed-2011-100134
29. Haviari S, Bénet T, Saadatian-Elahi M, André P, Loulergue P, Vanhems P. Vaccination of healthcare workers: A review. *Hum Vaccin Immunother*. **2015 ,***11(11)*:2522-37. doi:10.1080/21645515.2015.1082014
30. Scardina G, Ceccarelli L, Casigliani V, Mazzilli S, Napoletano M, Padovan M, Petillo A, Sironi D, Brilli C, Gattini V, Tavoschi L, Foddis R, Guglielmi G, Privitera GP, Baggiani A. Evaluation of Flu Vaccination Coverage among Healthcare Workers during a 3 Years' Study Period and Attitude towards Influenza and Potential COVID-19 Vaccination in the Context of the Pandemic. *Vaccines (Basel).* **2021,** *9(7)*:769. doi:10.3390/vaccines9070769
31. Gattini V, Napoletano M, Bonotti A, Mignani A, Cosentino F, Guglielmi G, Fallahi P, Cristaudo A, Foddis R. Antimeningococcal Vaccination Coverage Among Healthcare Workers in an Italian University Hospital. *Front Public Health*. **2021** Apr 26; *9*:651100. doi:10.3389/fpubh.2021.651100
32. Hong J, Pan B, Jiang HJ, Zhang QM, Xu XW, Jiang H, Ye JE, Cui Y, Yan XJ, Zhai XF, Yu Q. The willingness of Chinese healthcare workers to receive monkeypox vaccine and its independent predictors: A cross-sectional survey. *J Med Virol*. **2023,** *95(1)* doi:10.1002/jmv.28294
33. Harapan H, Setiawan AM, Yufika A, Anwar S, Wahyuni S, Asrizal FW, Sufri MR, Putra RP, Wijayanti NP, Salwiyadi S, Maulana R, Khusna A, Nusrina I, Shidiq M, Fitriani D, Muharrir M, Husna CA, Yusri F, Maulana R, Itoh N, Andalas M, Wagner AL, Mudatsir M. Physicians' willingness to be vaccinated with a smallpox vaccine to prevent monkeypox viral infection: A cross-sectional study in Indonesia. *Clin Epidemiol Glob Health***. 2020**, *8(4)*:1259-1263. doi: 10.1016/j.cegh.2020.04.024.
34. Riad A, Drobov A, Rozmarinová J, et al. Monkeypox Knowledge and Vaccine Hesitancy of Czech Healthcare Workers: A Health Belief Model (HBM)-Based Study. *Vaccines (Basel)*. **2022,***10(12)*:2022. doi:10.3390/vaccines10122022
35. Ghazy RM, Okeh DU, Sallam M, et al. Psychological Antecedents of Healthcare Workers towards Monkeypox Vaccination in Nigeria. *Vaccines (Basel)*. **2022,***10(12)*:2151. doi:10.3390/vaccines10122151

36. Brusaferro S, Chittaro M, De Carli G, Raffaele B, Puro V. Italian hospitals policies for the prevention of influenza in health care workers. J. *Prev. Med. Hyg*. **2004**,*45*, 9–1
37. Leone Roberti Maggiore, U., Scala, C., Toletone, A., Debarbieri, N., Perria, M., D'Amico, B., Montecucco, A., Martini, M., Dini, G., & Durando, P. Susceptibility to vaccine-preventable diseases and vaccination adherence among healthcare workers in Italy: A cross-sectional survey at a regional acute-care university hospital and a systematic review. *Hum Vaccin Immunother*. **2017**,*13(2)*:470-476 doi: 10.1080/21645515.2017.1264746.