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Policy of vaccination of “fragile children”: Results of a survey of 14 Italian children’s hospitals

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ABSTRACT

Children with chronic disease are at higher risk of invasive infectious disease, including several vaccine-preventable infections. The Italian Association of Pediatric Hospitals (AOPI) carried out a survey of immunization practices: 14/16 AOPI hospitals completed the survey; 50% of them include 100–199 beds, while 21% have <100 beds. In 12/14 hospitals (86%) all vaccinations included in the National Immunization Plan (plus influenza e COVID-19 vaccines) are available for inpatients, in selected wards ($n=4$), on single pediatrician initiative ($n=3$), by a centralized in-hospital immunization service ($n=2$), and the remaining 3 in a “protected vaccination area” or in a COVID-19 pathway. The wards in which vaccination is more frequently offered to in-patients are: General Pediatrics, Neonatology, Pediatric Hematology & Oncology, Pediatric Diabetology, Pediatric Cardiology, and Pediatric Infectious Diseases (range, 58% to 83%). In 58% of vaccinating hospitals, <500 vaccinations/year are reported, while in 17% this number is >2,000/year. A COVID-19 vaccination team is in place for any inpatient child older than 12 years in 42% of hospitals, in 42% only for “fragile” children. A centralized in-hospital immunization service is an emerging model that may contribute to increase compliance to vaccination of fragile patients and to fight against vaccination hesitancy.

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Introduction

In Italy, prevention of infectious diseases through vaccination of children since the first year of life is a public health priority. The immunization schedule, included in the National Vaccine Plan (PNPV) 2017–2019 and approved by the State-Regions Conference in the Agreement of January 19, 2017, was included in the fundamental levels of care (LEA). Since 2017, 10 vaccines are provided as mandatory by law for children under 16 years of age: diphtheria – tetanus–pertussis, DTP; hepatitis B HBV; Haemophilus influenzae B, HiB; inactivated Polio vaccine, IPV; Measles-Mumps-Rubella-Varicella, MMRV. Four additional vaccines (Pneumococcal Conjugate Vaccine, PCV; Rotavirus; B- and A-CYW meningococcal vaccines) are strongly recommended (Table 1) to be offered actively and free of charge.¹

Children with chronic disease (such as cardiovascular, respiratory, metabolic, congenital or acquired immune deficiency) are at higher risk of invasive infectious disease, including several vaccine-preventable infections.^{2,3} The individual risk of a fragile child is also increased by frequent access to outpatient or inpatient care.⁴ Thus, such individuals would benefit from targeted vaccination interventions and should therefore be the subject of specific programs (PNPV 2017–19).⁵ Their immunization strategy, coverage and timeliness of

immunization vaccines need to be monitored. Measurements of coverage and of timeliness, the types of vaccines administered, immunization schedules, and diagnostic criteria for at-risk populations generally differ depending on the study setting, methodology, and year of study. Thus, updated and affordable data are rarely available.^{6,7}


Nevertheless, it is a common experience that vaccination coverage among pediatric inpatients is lower than in the general population, and hospitalization has been shown to be a risk factor for delaying or missing immunization in children.^{8–14}

The lack of recent data and the need to remark the primary role of vaccination after the end of the COVID storm led the Italian Association of Pediatric Hospitals (AOPI), a no-profit organization committed to improve the quality of pediatric assistance, to carry out a scanning of immunization practices for preventable diseases among AOPI children’s hospitals.

Methods

Between March 1 and March 30, 2023, AOPI invited all the 16 member hospitals to participate in the survey, by filling an on-line questionnaire.

Following acceptance to join the study, the link to fill-in the on-line questionnaire was sent to the hospital C.E.O. or a designated member.

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Table 1. Vaccinations offered actively and free of charge by the Italian National Health Service (ref. 1).

Children from zero to 6 years	
●	Anti-diphtheria: basic cycle of three doses in the first year of life and booster at 6 years of age (mandatory for those born in 2001 and later)
●	Anti-polio: basic cycle of 3 doses in the first year of life and booster at 6 years of age (mandatory for those born in 2001 and later)
●	Tetanus booster: basic cycle of 3 doses in the first year of life and booster at 6 years (mandatory for those born in 2001 and later)
●	Anti-viral hepatitis B: 3 doses in the first year of life (mandatory for those born in 2001 and later)
●	Anti-pertussis: basic cycle of 3 doses in the first year of life and booster at 6 years of age (mandatory for those born in 2001 and later)
●	Anti-Haemophilus influenzae type B: 3 doses in the first year of life (mandatory for those born in 2001)
●	Anti-meningococcal B: 3 or 4 doses in the first year of life, depending on the month of administration of the first dose (strongly recommended for those born in 2017 and later)
●	Anti-rotavirus: 2 or 3 doses in the first year of life, depending on the type of vaccine (strongly recommended for those born in 2017 and later)
●	Anti-pneumococcal: 3 doses in the first year of life (strongly recommended for those born as of 2012)
●	Anti-meningococcal C/ACYW: 1st dose in the second year of life (strongly recommended for those born from 2012 onwards)
●	Anti-varicella (Chicken Pox): 1st dose in the second year of life and 2nd dose at age 6 (mandatory for those born in 2017 and later)
●	Anti-measles: 1st dose in the second year of life and 2nd dose at 6 years of age (mandatory for those born in 2001 and later)
●	Anti-mumps: 1st dose in the second year of life and 2nd dose at 6 years of age (mandatory for those born in 2001 and later)
●	Anti-rubella: 1st dose in the second year of life and 2nd dose at 6 years of age (mandatory for those born in 2001 and later)
Adolescents	
●	Anti-diphtheria: booster shot (mandatory for those born in 2001 and later)
●	Anti-polio: booster shot (mandatory for those born in 2001 and later)
●	Anti-tetanus: booster shot (mandatory for those born in 2001)
●	Anti-pertussis: booster shot (mandatory for those born in 2001)
●	Anti-HPV for girls and boys (2 doses during the 12th year of life)
●	Anti-meningococcal tetravalent ACWY135 (1 dose)
●	Anti-meningococcal B (2 doses)
Adults (over 64 years)	
●	Anti-pneumococcal
●	Anti-zoster
●	Anti-flu

By 13, multiple-choice questions, information was collected on: hospital size, policy of data collection on previous vaccination, opportunity to receive immunization included in the current calendar during hospitalization and if so: how, when, for which vaccines, in which units, by which personnel immunization is performed; certification of immunization; handling of immunization cost; estimated number of immunizations performed/expected per year; if not: why this practice was not implemented.

A copy of the structured questionnaire is reported as Supplementary material.

Results

Fourteen of the 16 (response rate 87%) AOPI hospitals completed the survey. They are scattered all-over the country and are highly representative of the Italian setting of hospital assistance for children; 50% of them include 100 to 199 beds, while 21% have <100 beds (Table 2).

Evaluation of individual patient immunization history as part of a diagnostic pathway is reported to be a common practice in 79% of hospitals, while in the remaining 21% it is performed only in selected wards.

In 12/14 hospitals (86%) all vaccinations included in the National Immunization Plan (NIP) (plus influenza e COVID-19 vaccines) are available for all inpatients (vaccinating hospitals, VH). Of these 12 vaccinating hospitals, 4 perform vaccination only in selected wards, 3 on single pediatrician initiative, 2 by a centralized in-hospital immunization service, and the remaining 3 by either single pediatrician initiative, or in a “protected vaccination area” or in a COVID-19 pathway.

Vaccinations are offered to in-patients according to regional immunization calendars in 7 cases, while in two

Table 2. Children’s hospitals participating in the Italian Association of Pediatric Hospitals (AOPI).

●	A.O. Santi Antonio e Biagio e Cesare Arrigo, Alessandria
●	Ospedale Pediatrico G. Salesi, Ancona
●	Ospedale Pediatrico Giovanni XXIII; A.O.U.C. Policlinico, Bari
●	Dipartimento Pediatrico, A.O. Policlinico Sant’Orsola Malpighi, Bologna
●	Ospedale dei Bambini, A.S.S.T. Brescia
●	A.O.U. Meyer, Firenze
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●	Dipartimento Salute Donna Bambino, A.O. Padova
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●	I.R.C.C.S. Ospedale Pediatrico Bambino Gesù, Roma
●	Presidio Ospedale Infantile Regina Margherita, A.O.U. Città della Salute e della Scienza di Torino
●	I.R.C.C.S. Burlo Garofolo, Trieste
●	Ospedale Materno-Infantile “Filippo Del Ponte” ASST dei Sette Laghi, Varese

vaccinations were decided by a specialist consultant, or by the pediatric ward; no involvement of the public health specialist is reported.

The wards in which vaccination is more frequently offered to in-patients are: General Pediatrics, Neonatology, Pediatric Hematology & Oncology, Pediatric Diabetology, Pediatric Cardiology, and Pediatric Infectious Diseases (range, 58% to 83%).

In 75% of hospitals, administered vaccination is specified in the discharge letter given to parents, while in the remaining ones only a generic statement (such as “administered missing vaccination foreseen by law”) is reported.

Seven vaccinating hospitals (58%) report that details of the administered vaccines (patient identifiers, vaccine batch code,

date of administration, etc.) were directly reported to the local public health office, with such communication being made “most of the times” in 2, “not always” in 2, and never in one hospital.

In most cases (10/12; 83%) vaccines were delivered within the hospital by the hospital pharmacy, while in one they were released by the LHU, and in another one vaccines were provided directly by the LHU only when they were intended for hospital health care personnel.

Vaccine costs were charged to the single ward in 42%, to the hospital budget in 16%, or to the public health unit in 42%.

In 58% of vaccinating hospitals, <500 vaccinations/year are reported, while in 17% this number is >2,000/year. A COVID-19 vaccination team is in place for any inpatient child older than 12 years in 42% of hospitals, in 42% only for “fragile” children, while it is not present in the remaining 16%.

In the two “non-vaccinating hospitals,” prescription on discharge of vaccination to administer outside the hospital is made according to the national guidelines or to ward protocol. Prescription is more often made for fragile children.

Discussion

In our survey, we explored the attitude of 16 Italian children’s hospitals, participating in the Italian association for children’s hospital (AOPI), to administer vaccination. To the best of our knowledge, this is the first such survey carried out in Italy and probably in Europe. Our survey shows that in 86% of pediatric hospitals all vaccinations included in the National Immunization Plan (plus influenza e COVID-19 vaccines) are available for all inpatients.

The major positive finding is that the vast majority, 12 of 14, of these children’s hospitals developed a specific organization for immunization of their inpatient or *in-charge* (i.e. those with chronic diseases who regularly attend the pertinent outpatient service) children.

In Italy, vaccination is almost completely in the hands of the public health service. Compliance with vaccination has been repeatedly challenged during the last decades.^{7,8} Thus, physicians – and in particular pediatricians – should feel the moral mandate to continuously support and develop the confidence of the parents and families toward active immunization. It is a common experience that vaccination coverage among pediatric inpatients is lower than in the general population, and hospitalization has been shown to be a risk factor for delaying or missing immunization in children. Otherwise, hospitalization could be regarded as an opportunity to reach more non-compliant children and adolescents, contributing to increase to efficacy of the vaccination programs.

One of the very few studies available in Italy on the topic reported that of 275 children, aged 6 months–18 months and affected by type 1 diabetes, HIV infection, Down syndrome, cystic fibrosis, or neurological diseases, coverage for DTP, polio (Pol), and HBV vaccines approximated 85% at 24 months, while measles – mumps–rubella (MMR) coverage was 62% and for seasonal influenza was 59%, with heterogeneity among children with different chronic diseases.¹⁰

A study published in 2014, and carried out in a large pediatric hospital in Italy, reported that among 1,102 preterm babies

active immunization coverage by 24 months of age was 95.9% for DTP-Pol-HBV-Hib; 84.0% for MMR; 49.7% for PCV; 38.5% for MenC; 4.1% for varicella.¹¹ Eighty-seven percent of participants received the first dose of DTP-Pol-HBV-Hib by 6 months of age – with a delay of three months – and 66.7% had their first MMR administered by 18 months, with a delay of 6 months. Hospitalization was associated with delay for all vaccines with the exception of MenC and Var.^{12,13}

In a previous study, published in 2012, the Italian Cohort Naïve Antiretrovirals (ICONA) study group, documented a national mean coverage of >95% for Haemophilus influenza type b, 55% for Pneumococcus and 37% for Meningococcus C. Meningococcus C vaccination national coverage among adolescents was 16%.¹⁴

In their literature review of 30 articles published between January 1990 and January 2019 in which pediatric vaccination in the hospital setting was discussed, Mihalek et al. reported that 27% to 84% of pediatric inpatients were due or overdue for vaccines nationally according to official records. Interestingly, when offered inpatient vaccination, a majority of parents accepted immunizations for their children, thus suggesting that hospitalization may provide an opportunity to augment vaccine uptake.⁶ The American Academy of Pediatrics recommends using every healthcare visit as an opportunity to review and update vaccination status.¹⁵ In their guidelines, the Advisory Committee on Immunization Practices specifically includes a recommendation to vaccinate patients who are hospitalized.¹⁶

In Italy, practical indications have been issued on how to carry out vaccinations in a “protected environment” for situations linked to particular risks arising from the act of vaccination, but no recommendations are available on vaccination in hospital. In the new National Immunization Plan, an in-hospital vaccination is recommended: specialist network designed to follow up at-risk individuals should actively promote vaccination at both the hospital and territorial level. The COVID-19 pandemic has suddenly modified the concept that vaccination belongs to the territorial health care service. Indeed, the high reputation of the specialists based in top research hospital, including children’s hospital, played a significant role, not only by playing their moral suasion, but also in developing the vaccination teams for fragile children. Parents and caregivers of fragile children are definitely more confident on the advice given by their trustful and sometimes long-lasting referral specialist, rather than media driven messages.

Thus, children’s hospital teams should be warmly encouraged to promote or even provide vaccination of inpatients as well as in-charge outpatients with chronic disease. As nicely demonstrated by previous pilot experiences,^{17,18} and even more clearly by the COVID-campaign, this approach may turn out to be not only time sparing but also cost-effective and able to increase the compliance to vaccination of subjects at risk for lower compliance if not specifically targeted. Vaccination programs embedded in a children’s hospital also result in awareness raising, training and involvement of clinical specialists, which would further enhance their fundamental

role in specific counseling in complex diagnostic-therapeutic conditions (as experienced in adult patients).¹⁷

A survey was recently carried out in Italy among pediatricians and parents to investigate attitude, knowledge, and practices toward additional vaccinations for children affected by chronic conditions.⁴ This research highlighted important existing challenges hampering optimal vaccination coverage among pediatric chronic patients, including knowledge gaps on tailored vaccination schedules among pediatricians and organizational issues. Educational programs on the value of vaccination in hospital would increase the health care personnel scientific knowledge on vaccination and would contribute to harmonize hospital immunization pathways.

The results of our survey confirm that most of AOPI children's hospitals have adopted this strategy, having set and developed specific vaccination programs. Yet, there is room for improvement. Only in two of these hospitals, a centralized in-hospital immunization service is in place, while in the others the vaccination is voluntary sustained by individual physicians or teams. Hospital with lower percentage of coverage and activities should be encouraged to further push-on their effort along this line. Direct connection between children's hospital and local authorities for public health should be encouraged in order to make full information on vaccination timely and reliably available to all the national health system participants who co-operate all around our children, either healthy or closely monitored and cared.

In turn, formal adoption of this strategy would easily justify allocation of specific resources for this activity, which could be used by children's hospitals to improve documentation of vaccination provided, for both the patient and the family, but also for the public health information network.

Our survey has limitations. While focusing on major children's hospitals in our country, it does not fully reflect the picture of the many pediatric wards embedded in local general hospitals, which also might contribute to make the national picture even more detailed and informative. Also, to keep the survey structure simple, thus favoring spontaneous participation, some potentially interesting topics such as vaccine vigilance or specific immunization protocols were not included in the questionnaire, and might thus be part of further investigation in our country. Measuring the real impact of hospital vaccination on the total coverage and on reduction of immunization delay may be target for next studies.

Finally, according to our results, a centralized in-hospital immunization service is an emerging model that may contribute to increase compliance to vaccination of fragile patients and to fight against vaccination hesitancy.

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