

REVIEW



Vaccination in people with disability: a review

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ABSTRACT

People with disabilities are vulnerable to complications from vaccine-preventable diseases, and every effort should be made to ensure equitable access to immunization for this population. This paper aims to summarize the research on immunizations in people with disabilities, in order to ensure a comprehensive understanding of knowledge in this area and direct further research. The literature is weighted towards coverage data that is difficult to synthesize because of the different definitions of disability, and the variety of settings, vaccinations and age groups across the studies. In-depth qualitative data and data from a variety of health-care providers and people with disability is notably lacking. This is vital to redress in order to develop effective immunization interventions in this population.

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Immunization is arguably the most successful public health initiative of all time,¹ through prevention of death and reduction in disease severity, complications, and disability. Effective immunization programs also improve health equity for vulnerable groups in society who have a higher burden of vaccine-preventable diseases (VPDs).^{1,2} However, there appears to be a disconnect in identifying the need for the prevention of disability by immunization against VPDs and efforts to ensure optimal protection in those with existing disability. Underlying disability, particularly physical disability or disability related to prematurity, predisposes an individual to respiratory illness and more severe respiratory compromise from viral and bacterial infections.³ Disability is as a factor in a disproportionate number of hospitalizations and complications, including death, from varicella⁴ and influenza.^{5–10}

The Tailoring Immunization Program (TIP) framework, developed by the World Health Organization (WHO), identifies barriers to immunization in under-vaccinated populations.^{11,12} This approach has been used in migrant and transient populations, orthodox Jewish communities, and pregnant women, leading to targeted interventions to improve uptake for these groups. However, unlike other vulnerable and medically at-risk groups, strategies to improve vaccine uptake in people with physical and/or intellectual disabilities, who face considerable access and acceptance barriers, have not been explored. This literature review aims to summarize the state of knowledge about vaccination in people with disability, in order to establish this group as a population vulnerable to under-immunization and to identify areas for further research and intervention.

Definitions of disability

The International Classification of Functioning, Disability, and Health (ICF) is a broad measure of disability based on impairments of body function, activity limitations and participation restrictions.¹³ Data from WHO suggest that 15% of the world's population has some impairment in function, with 2–4% having significant difficulties with activities of daily living.¹⁴ This includes those with disability due to aging, mental illness, trauma, and chronic illness as well as those with physical and intellectual disabilities diagnosed early in life.

The ICF classification incorporates environmental factors that impact on an individual's ability to participate. This definition of disability, therefore, goes beyond the medical and biophysical aspects to allow for the recognition that disability is a social and cultural construct. This highlights that without special attention to ensure there are no social, logistical, communication or education barriers to the provision of good and equitable health care for people with disabilities, they are at risk of poor health outcomes.

UNICEF clearly articulates the intersect between disability rights, health, and immunization, and highlights the inequity in access to immunization for children, young people, and adults with disabilities and the subsequent impact on their health and well-being.¹⁵ Identifiable factors include inequitable access to health services, exclusion from health-care initiatives and a lack of understanding of the safety of immunization for those with underlying disability.¹⁵ UNICEF highlights the need to better understand the factors

that influence immunization practices for this population and to advocate for further research in this area.

Search strategy

The literature search aimed to identify any primary research on immunization in children, adolescents or adults with physical and/or intellectual disability with any underlying etiology present from early in life.

A list of search terms was compiled in discussion with a developmental pediatrician, accounting for the number of terms used to describe disability, and incorporating both broad descriptors and specific diagnoses, to ensure a comprehensive search of the disability literature (see Table 1). These terms were paired with immunization search terms in order to find relevant articles through five databases: PubMed, CINAHL, ERIC, Embase, and Scopus. Reference lists of identified articles were searched for other relevant studies. Excluded were studies focusing on disability occurring post immunization, and immunization in adults with disabilities primarily due to aging. In total 28 studies were found (see Table 2).

Results

The studies on immunization in people with a disability are characterized by the diverse settings, study design, disability type, and vaccinations included.

Disability type

Information was difficult to synthesize largely due to the variety of disability types. Some studies used specific diagnostic groups such as: those with inborn errors of metabolism,¹⁶ ASD,¹⁷ intellectual disability,^{18–20} cerebral palsy,³ and spina bifida.²¹ Other studies used broad definitions of disability such as: children with special health-care needs (CSHCN),^{22–24} women with physical disabilities,²⁵ youth attending specialist schools,^{26,27} children with neurological diseases, neurodevelopmental disorders, chronic neurological deficits or developmental disabilities,^{28–32} and females with mental and physical limitations.³³

The issue with broad definitions is illustrated by two American studies which found no difference between immunization uptake for people with disabilities as compared to their typically developing peers. The first study measured uptake in a cohort of children with special health-care needs³⁴ and the second explored whether a medical model of care for children with special health care needs improved immunization rates.²⁴ The definition of “children with special health-care needs” is commonly used in USA, and includes children who require health or medical input above what would be typical, or any child on prescription medication or with emotional or behavioral disorders or chronic illness, as well including those with a disability.³⁵ Therefore “children with special health care needs” is too broad a definition to measure the difference in immunization uptake in the subpopulation of those with disability. Other studies from America have not replicated this finding with more specific populations for children with spina bifida,²¹ autism,³⁶ and neurodevelopmental disorders.³²

Table 1. Search terms.

intellectual disability OR developmental delay OR mental retardation OR learning disability OR neuro disability OR physical disability OR epileptic encephalopathy OR hydranencephaly OR microcephaly OR schizencephaly OR lissencephaly OR polymicrogyria OR cortical migration disorders OR metabolic syndromes OR Cerebral palsy OR Autism Spectrum Disorders OR Prader-Willi OR Spina Bifida OR Epilepsy OR Cognitive impairment OR Dravet's syndrome OR Angelman syndrome OR Fragile X OR Ohtara OR West syndrome OR Infantile spasms OR neurodegenerative disorders OR neuroprogressive disorders OR Aicardi-Goutières syndrome OR Infantile neuroaxonal dystrophy OR Pantothenate kinase 2 deficiency OR Tuberos Sclerosis OR Leukoencephalopathies OR Rett Syndrome OR Trisomy 21 OR Trisomy 13 OR Trisomy 18 OR Cru-Du-Chat OR Cornelia de Lange OR Spinal muscular atrophy OR Duchenne's muscular dystrophy OR Batten's disease OR Mitochondrial diseases OR Neurofibromatosis OR Turner's syndrome OR Noonan's syndrome OR PKU OR Tay-Sachs disease OR Beckwith-Wiedemann OR 22q microdeletion OR storage disorders OR Fredrich's ataxia OR Leukodystrophy OR Niemann-Pick OR dystonia OR choreoathetosis OR spasticity OR quadriplegia OR tetraplegia OR diplegia OR Fetal Alcohol Syndrome OR Acquired brain injury OR agenesis of the corpus collosum OR Wilson's disease OR Familial Spastic Paraplegia OR Charcot Marie Tooth disease OR Cockayne syndrome OR Alexander disease OR Menkes kinky hair syndrome	AND	vaccination OR immunisation OR immunization OR vaccine hesitancy OR vaccine schedule OR vaccine acceptance OR vaccine complacency OR vaccine refusal OR vaccine decision-making OR vaccine concerns OR vaccine delay OR vaccine communication OR vaccine strategy OR vaccine recommendation
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Immunization coverage

The majority of the studies measured immunization uptake, with 18/28 (64%) calculating the uptake of one or more vaccinations in a population of people with disability.^{3,16,18–23,26–34,37} The recognition of inequities in immunization services for vulnerable populations relies on the existence of disaggregate data.³⁸ Aggregate

Table 2. Summary of articles.

Study and Year	Country	Study design/Data collection method	Research aim	Participants and disability type	Relevant results
Bazzano et al. (2012)	USA	Cross sectional telephone survey	To determine if parents change or discontinue their child's vaccination schedule after ASD diagnosis	197 parents of children under 18 years with ASD	50% changed or discontinued vaccination schedule after diagnosis
Cerutti et al. (2015)	France	Retrospective audit – Immunization record of children Questionnaire for parents	To evaluate vaccination rates of children with inborn errors of metabolism (IEM) and attitudes of their parents.	128 children with inborn errors of metabolism and 128 age and gender matched controls	Lower rates in children with IEM overall, with lowest in those with highest risk of decompensating and for live vaccines Most common reason for being hesitant – concerns about adverse reactions
Cody & Lerand (2013)	USA	Questionnaire for parent/carers Internet-based survey of health professionals	To describe acceptability of HPV immunization amongst parents of children with special health care needs Parent and provider barriers to HPV vaccine	17 parents of girls with special health care needs 9–16 yrs 130 providers (of 600) completed online survey	17% vaccinated against HPV 90% providers said they vaccinated against HPV, main reason why they didn't was parent refusal.
Cooney (2009)	Ireland	Qualitative grounded theory Semi-structured interviews (clients and managers) Questionnaires (care staff)	To identify factors that influenced client satisfaction with a vaccination program for Hep B	6 clients with ID who had completed 3 course Hep B dose and had follow up blood test, 41 care staff and 3 managers of disability services	High satisfaction with respect shown to clients and program delivery, mixed response to adequate information and lack of policies around restraint Adverse effects more likely to be reported by clients than staff
Cummings et al. (2016)	USA	Data linkage	To compare health services use among youth with ASD as compared with those without ASD.	8325 youth with ASD and 83,195 youth without ASD across the age range 3 yrs to 17 yrs	Youth with ASD are significantly less likely to receive immunizations.
Fisher, Audrey, Mytton Hickman & Trotter (2014)	UK	Retrospective audit	To investigate factors associated with HPV initiation and completion in South West England	14, 282 female students, 196 of these are in non-mainstream schooling	Relevant finding – girls attending non-mainstream schools HPV initiation only 55.7% compared with 88.6% overall
Greenwood, Crawford, Walstab & Reddihough (2013)	Australia	Retrospective audit using data linkage, ACIR and CP register	To compare immunization coverage of children with CP with the general population coverage	449 children with cerebral palsy under 7 years	19.2% of children with CP were not up to date with immunizations compared to 6.4–8% of general population
Groce, Ayora & Kaplan (2007)	Ecuador	Retrospective audit and parent interview	To compare immunization coverage of children with disabilities in remote parts of Ecuador with their non-disabled peers	32 children with disabilities and their siblings	31/32 children with disabilities were up to date with immunizations, as were their peers.
Haynes & Stone (2004)	Australia	Probabilistic data linkage	To determine the predictors of incomplete immunization status of Victoria children at 12 and 24 months.	60,491 Victorian children born in 1998	Congenital malformations not a significant predictor of incomplete immunization at 12 and 24 months.
Lin, Lin & Lin. (2010)	Taiwan	Cross-sectional questionnaire	To examine the Hep B coverage rate and its determinants of children with ID in Taiwan	495 primary caregivers of children with ID who attend 3 special education schools in Taiwan	74% had received the full Hep B immunization. Incomplete Hep B vaccination was twice the general population Main determinants were lower household income and older age of child
McRee, Maslow, G. and Reiter (2017).	USA	Cross sectional study. Secondary analysis of data from the Child Health Assessment and Monitoring Program	To compare adolescent vaccine coverage in youth with special health care needs as compared to youth without special health care needs.	2156 young people 11–17 years, 604 (28%) with special health care needs.	Similar rates of tetanus immunization (91% uptake) as general population lower uptake of meningococcal immunization (28% vs 72% in general population) and HPV immunization (32% one dose vs 40–60% in general population). Strongest correlate of immunization in the special health care needs group was a health care check in the last year.
O'Connor and Bramlett (2008)	USA	Data linkage – National Immunization Survey and National Survey of Children with Special Health Care Needs. 2000–2002 data	To compare vaccination coverage of children 19 to 35 months with and without special health care needs	17 994 children between 19 and 36 months, 1283 (7%) with special health care needs	Generally no difference between the immunization rates of children with special health care needs and those without. Under-immunization more likely in white affluent household

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Table 2. (Continued).

Study and Year	Country	Study design/Data collection method	Research aim	Participants and disability type	Relevant results
Okoro, Ojinnaka, N., Ikefuna & Onyenwe, (2015)	Nigeria	Cross sectional study, parent carer questionnaire and immunization records	To determine the influence of sociodemographic factors and type of neurological disability on the immunization status of children with chronic neurological conditions	168 families of children with chronic neurological conditions aged 6 months to 5 years	Mother's higher education and father's higher income were the factors that significantly increase the immunization coverage of children with neurological disorders. Those children with visually obvious were less likely to be fully immunized
O'Neill, Elia & Perrett (2017)	Australia	Retrospective audit	To determine the uptake of HPV in a cohort of adolescents with developmental disabilities as compared to the general population	72 adolescents aged 14 years who attended a pediatric outpatient clinic for developmental disabilities in the last year	44.1% of females and 39.5% of males in this population were fully vaccinated for HPV compared to 77.4% females and 66.4% males of 15 year olds in general population More likely to miss HPV vaccination if they had intellectual impairment irrespective of motor function
O'Neill, Newall, Antolovich, Lima & Danchin (2019)	Australia	Prospective cohort study	To determine the uptake of dTPa and HPV in young people with disabilities in specialist schools in Victoria	374 students aged 12–13 yrs in 28 specialist schools for young people with disability	DTPa was received by 63% of students in specialist schools compared to 89% in mainstream schools, and first dose of HPV was received by 66% of females and 67% of males compared with 75% for mainstream schools Main reasons for non-immunization was absence from school, lack of consent and inability to immunize due to anxiety/behavior
Pandolfi et al. (2012) ¹	Italy	Prospective survey	To examine the effect of physician recommendation regarding the influenza immunization to families of children with chronic illness and measure the frequency of immunization in this population	275 families with of children 6m-18y with chronic diseases	57.5% overall influenza coverage, only 25% in those with neurological diseases Higher (87–94%) who had physician recommendation for flu vaccine
Pandolfi et al. (2012) ¹	Italy	Cross-sectional study Audit of immunization record and parent interview	To measure immunization coverage and timeliness for children with Type 1 diabetes, HIV, Down syndrome, cystic fibrosis and neurological diseases	275 children 6m to 18y from 3 Italian regions with chronic illness/disability	Low rates of immunization at 12 months, increased by 24 months but below 90% for all immunizations MMR most likely to be delayed for children with neurological diseases. Most common reasons for delay was acute illness
Raddish, Goldman, Lawrence, Kaplan & Perrin (1993)	USA	Cross sectional survey Parent questionnaire, chart review, immunization record review	To determine immunization levels for among children with spina bifida compared to general population at 24 months and 7 yrs of age, and describe influencing factors	120 children seen in myelodysplasia clinic of Children's Hospital in Boston 4 months – 18 yrs	Children with spina bifida had lower uptake immunizations than general population – 24months 58% vs 79% 7 yrs 81% vs 97%
Remes et al. (2014)	Canada	Retrospective cohort study Used data linkage – 4 databases	To identify individual and regional level determinants of HPV vaccine refusal in Ontario's Grade 8 HPV Immunization program	144,047 girls in Grade 8 in Ontario 2007–2011,	49.3% refused HPV vaccination Associations with refusal – Down's syndrome, ASD, few physician visits, previous refusal of scheduled vaccinations, living in areas of high deprivation.
Rosenberg et al. (2012)	USA	Online questionnaire	To examine immunization beliefs and practices of families with a child with ASD	486 families with a child with ASD.	More likely to delay or omit vaccinations if believed they played a role in ASD development. Higher maternal education more likely to delay or omit vaccinations for younger sibling of child with autism irrespective of belief of autism-vaccination link.

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Table 2. (Continued).

Study and Year	Country	Study design/Data collection method	Research aim	Participants and disability type	Relevant results
Rowe, Pritt, Stratton & Yoost (2017)	USA	Retrospective audit and cross sectional survey Immunization record and phone survey with sample of parents	To evaluate if HPV vaccination rates are different between female adolescents with mental and physical limitations and those without.	1673 females presenting to pediatric or gynecology clinics in 2012, 72 (4%) with mental or physical limitations. 44 parents of control group and 21 parents of affected group	Of those with mental or physical limitation 43% initiated HPV schedule, compared with 57% of control group. The most common reasons for non-vaccination in the affected group was a belief the immunization was not needed and lack of recommendation by medical provider. The most common reasons for non-vaccination in the control group was safety concerns and lack of recommendation by medical provider.
Samuels, Liu, Sofis & Palfrey (2008)	USA	Audit of immunization rates before and after intervention and questionnaires to providers	To assess whether a medical model of care for children with special needs improves immunization rates	Six general pediatric practices and 150 children with special needs and 30 pediatricians	Immunization rates were already high, overall 83% and didn't change after intervention. Severity of illness, technologically dependent, non-English speaking background had no effect on immunization rates
Smith, Peacock, Uyeki & Moore (2015)	USA	Prospective survey	To document parental report of influenza vaccination or intent to vaccinate in families of children with neurodevelopmental disorders Provider survey – to document physician recognition of high risk influenza conditions	2138 parents of children with high-risk conditions, including 1143 with neurodevelopmental disorders	50% of parents of children with neurodevelopmental disorders vaccinated or were intending to vaccinate their child against flu Similar to general population Providers recognized CP as high risk condition (74%), less so epilepsy (51%) and ID (46%)
Tanabe et al. (2011)	Japan	Questionnaire sent to pediatricians	To determine factors influencing the advice from pediatricians about immunization for children with severe handicaps and/or epilepsy	359 (of 680) pediatricians Asked specifically whether they would vaccinate in cases for febrile seizure, epilepsy or severe handicap	Majority answered "occasionally refuse" to vaccinate in all 3 scenarios. Most common reason duration since last seizure, majority would advocate waiting 3 months since last seizure. For handicap group main reason for refusal was daily epileptic seizures
Tillmann, Tillman, Heininger, Lutschg & Weber (2005)	Switzerland	Retrospective case-control study	To examine the uptake and age of vaccination of children with chronic neurological deficits as compared to healthy children	100 children 1 to 16 yrs with neurological deficits and 200 age-matched controls	Children with chronic neurological deficits receive less childhood vaccinations than healthy controls and at a later age. Those who had congenital neurological deficits or a diagnosis in first 6 months of life were particularly at risk of missing or delayed vaccinations. Pertussis the most likely to be missed or delayed compared to controls
Tuffrey & Finlay (2001).	UK	Cross sectional survey of computer database of immunization records	To compare immunization status of children attending three special schools in Bath with age and sex matched controls	136 children attending 3 special schools from 4.5 to 16.5 years, with severe physical difficulties, severe or profound learning difficulties or both. 272 controls.	59% of children from special schools fully immunized vs 83% of controls. Significant difference found for pertussis, measles and rubella. No sex or age differences
Yen, Chen et al. (2011)	Taiwan	Cross-sectional survey, part of larger study	To identify factors influencing HPV vaccine acceptability among women with physical disabilities in Taiwan	438 women with physical disabilities aged 18–69 yrs	54% heard of HPV vaccine Only 3.2% would have if they have to pay 60% would have if subsidized
Yen et al. (2012).	Taiwan	Cross sectional survey, validated previously by authors, using parents/carers as proxies	To describe influenza vaccine uptake and determinants for children with ID living in the community.	Parents/carers of 1055 adolescents with ID 12–18yrs	23% had flu vaccine in last 3 years. Those with mod-severe disability with regular health exams more likely to be vaccinated.

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Table 2. (Continued).

Study and Year	Country	Study design/Data collection method	Research aim	Participants and disability type	Relevant results
Yen & Lin (2011).	Taiwan	Cross sectional survey, part of larger survey into health of people with ID, parent report as proxy	To determine Hep B vaccination coverage rates among community dwelling teenagers with an ID in Taiwan.	1111 teenagers 12–18 with ID	72.9% study participants immunized. Rate of non-immunization twice that of general population. Hep B immunization correlated with higher household income, previously oral health exams

immunization uptake figures do not generally identify small populations at risk for under-immunization³⁸ and therefore lower immunization coverage in people with disabilities can be missed. The studies suggested a likelihood of missed immunizations in people with disabilities, with 14/18 (78%) of the coverage studies finding that people with disabilities have lower rates of immunization uptake across a range of different vaccines than their typically developing peers.^{3,16,18–23,26–28,30,31,33}

Some studies measured immunization coverage indirectly. Three studies did not specifically explore a cohort of people with disabilities but instead found that disability predicted incomplete vaccination, including in girls in non-mainstream schools,³⁹ children with congenital malformations,⁴⁰ and Trisomy 21 and Autism Spectrum Disorders (ASD).⁴¹ One study did not specifically investigate immunization coverage, but explored overall health service use among youth with ASD and found that they were less likely to receive immunizations.¹⁷ Another assessed whether enhanced primary care in the form of a dedicated nurse practitioner to coordinate the child's care improved immunization rates for children with special needs²⁴ and found that it did not. However, immunization uptake for children with disability in these practices was already above the national average prior to the intervention.²⁴

In addition to vaccine uptake, other studies aimed to explore the acceptability of HPV vaccine among women with physical disabilities²⁵ and provider recommendation for vaccines in a cohort of children with disability.⁴² Two studies examined parental decision-making about vaccines after a diagnosis of ASD in their child.^{36,43} Both these studies concluded that parents were more likely to miss or delay immunizations after their child's diagnosis of ASD, suggesting persisting concerns about the disproved link between vaccinations and autism.^{36,43} One study used grounded theory to explore the satisfaction of adults with ID with an immunization program.⁴⁴

Qualitative data

Although there were a few studies that aimed to determine barriers to immunization in people with a disability,^{27,30,37} there was only one primary qualitative study to date.⁴⁴ This study explored the satisfaction of adults with ID with a program to immunize against Hepatitis B, with data collected directly from the individual with the disability rather than parents and/or care providers. This study used qualitative interviews from adult clients with intellectual disability and questionnaires with care staff to describe information in regards to the logistics of Hepatitis B delivery, use of restraint

and information needed about immunization for this population. This level of analysis, not present in the other studies, allows an understanding of the experience of immunization and barriers to immunization that may inform meaningful, effective and equitable policies. Both in-depth qualitative research and the perspective of people with a disability is largely missing from research. This information is pivotal to understanding the barriers to uptake and the experience of immunization in this population.

Location of the research

The location also influences the definition and cultural understandings of disability and immunization policy and practice. The majority of studies were from the USA,^{17,21–24,32,34,36,43} with other high income countries represented, including Australia,^{3,27,31,40} Taiwan,^{18–20,25} UK,^{26,39} Italy,^{29,30} France,¹⁶ Ireland,⁴⁴ Canada,⁴¹ Japan⁴², and Switzerland.²⁸ Two studies were from low and middle income countries (LMICs). The first was a small study from Ecuador,³⁷ and the second was a cross-sectional study of families with children with chronic neurological conditions in Nigeria.⁴⁵

The Ecuadorian study was one of the four studies which found that children with disabilities did not have lower immunization rates than their typically developing peers. The authors suggested that the culture of the local society in valuing children with disabilities influenced immunization practices despite the poverty, isolated locations and difficulty accessing healthcare. This contrasts with the Nigerian study,⁴⁵ in which children with more obvious neurological deficits were less likely to be immunized. The environmental and cultural context is important in attitudes towards disability. More research in LMICs may improve our understanding of how different contexts impact health-care decision-making and act as a barrier to delivering equitable preventive health care for people with disability.

Age and types of vaccination

Only two studies include adults with disability,^{25,44} reflecting the weight of immunization research concentrating on childhood and adolescent funded vaccinations. The majority of research on childhood immunization focuses on a number of vaccines or the concept of being “up-to-date” with the current schedule. This contrasts with the studies on adolescent immunization, where five studies focus specifically on HPV immunization. These studies were divided between

Australia,^{27,31} which offers a school-based immunization program for adolescent immunization, and the USA,^{22,23,33} which offers adolescent vaccinations through local health-care providers. This is reflected in the lower rates of HPV uptake in the USA, but relative to their peers, adolescents with disabilities in all these studies had lower rates of initiating and completing the HPV course.

Acknowledging the need to optimize uptake of the HPV vaccine for young people with disabilities requires recognition that sexual health is important and relevant for this population. Indeed, one of the barriers that are reported by parents is that the HPV vaccination is “not needed”.³³ Other barriers to HPV acceptance are the lack of recommendation by a medical provider, and safety concerns. O’Neill et al.²⁷ also list reasons for non-vaccination for HPV, with the main reasons being absence from school, lack of consent and anxiety of the student. This study found no significant difference between dTPa and HPV uptake, suggesting that concerns about individual vaccines may be less of a barrier than logistical issues, which is a finding not previously explored for this population. The differences in barriers reported between these two studies may reflect the parent perspective as compared to the school perspective, establishing the value of multiple viewpoints.

Three studies specifically examine influenza immunization uptake for children and adolescents with disabilities.^{18,29,32} Influenza is an annual immunization which is funded and recommended for at-risk groups in many countries. This includes people with impaired respiratory health, which is often present in children with cerebral palsy, epilepsy and other neurological conditions. Nevertheless, immunization rates in those with disabilities in all three studies are lower than, or similar to, the general population.^{18,29,32}

Provider recommendation

Several studies found that predictors of immunization in children with disabilities were regular health checks,^{18,22} or recommendation to immunize by a health-care provider.^{29,33,42} The importance of health-care provider recommendation is mirrored in the literature regarding interventions to improve confidence and uptake in immunizations in the general population.⁴⁶ Given this, the paucity of research exploring opinion and behavior of health professionals giving advice about immunizations to families with children with disabilities highlights the need for further exploration. Two studies included pediatrician perspectives on immunization as to whether they recommended vaccination in children with epilepsy or severe handicap.⁴² It is unknown what beliefs and concerns other health professionals, such as GPs and immunization nurses, have about recommending vaccination to people with disability. This limits the current level of understanding of the many factors that may influence immunization decision-making, as well as the interventions that may be needed on a health professional level.

Conclusion

Drawing clear conclusions from the currently available research on immunization in people with disabilities is

challenging, due to the different contexts, methodologies, definitions, age groups, and vaccines studied. Published studies are limited primarily to exploring immunization coverage in high-income settings. These knowledge gaps do not allow the development of strategies to ensure improved immunization rates in this vulnerable population. Research is needed to develop a greater understanding of the barriers to immunization for people with disabilities and their families, including the perspective of people with disability and the advice and attitudes of health professionals and immunization providers. Immunization in people with disabilities is an important issue of both health and equity and deserves further research and discussion. Future research will provide opportunities to impact on the provider and parental attitudes and policy recommendations with a view to improving immunization rates in this population.

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

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