

## **A systematic review of vaccination communications: can we reduce vaccine hesitancy and increase vaccination rates?**

James Ansell<sup>1</sup>

Australian National Centre for the Public Awareness of Science, Canberra, Australia

### *Abstract*

Vaccination has been inarguably beneficial to humanity, however recent decades have seen a rise in vaccine hesitancy and refusal. In particular the false connection of the Measles, Mumps, Rubella (MMR) vaccine with Autism by Wakefield et al in 1998 started a rigorous anti-vaccination movement. Since then vaccination rates in some areas have fallen below 'herd immunity' levels, allowing for vaccine preventable diseases to return and claim lives.

This research reviewed the literature of vaccination program communications and interventions conducted between 1998 and 2014 to determine if any had reduced vaccine hesitancy and improved vaccination rates. This review focused on two vaccines- the MMR vaccine which had been the subject of the Wakefield et al (1998) and the Human Papillomavirus vaccine which had been incorporated into vaccination schedules post-1998.

This systematic review identified a gap in existing science communication literature, with few studies specifically tracking vaccination rates. Most research looked only at vaccine attitudes or intentions. Overall there was insufficient data to show any specific communication or intervention strategy reduced vaccine hesitancy or increased vaccination rates to herd immunity levels.

Of the literature that did exist, there were indications that vaccine hesitancy potentially played an unexpectedly small role in decreasing vaccination rates, with logistical issues predominately causing non-vaccination. Additionally, most reviewed interventions relied on single interactions, so vaccines requiring multiple sessions e.g. booster shots could not have immunization rates determined at all.

This suggests that interventions and communication strategies that have multiple interactions and address logistical barriers may potentially be sufficient to attain herd immunity levels without needing to directly address vaccine hesitancy.

Recommendations for future research to fill this literature gap include designing studies that focus on directly tracking vaccinations rates rather than vaccination attitudes or intentions, as well as developing communications strategies that focus on logistical barriers and engage with audiences multiple times.

---

<sup>1</sup> Corresponding author, email: [james.ansell@anu.edu.au](mailto:james.ansell@anu.edu.au)

### *Introduction and background*

Vaccination is often considered one of the greatest modern developments, having vastly improved human living conditions and lifespans. But in recent decades it has come under pressure from some groups as a potentially unsafe and unnecessary practice (Allred, Shaw, Santibanez, Rickert and Santoli, 2005).

Some of the concerns around vaccination are legitimate- nothing is 100% safe and vaccines can have negative side effects. These can range from frequent but minor side effects such as sore arms and mild fevers to severe but rare effects such as anaphylactic reactions caused by allergies to components of the vaccine (Australian Department Health and Ageing, 2006). However other criticisms of vaccines are not as factual, often being caused by bad science, pseudoscience or incorrect understandings of scientific concepts. For example, the idea that vaccines cause autism was caused by a combination of bad research and confusing the concepts of correlation and causation (Plotkin, Gerber and Offit, 2009).

These concerns can contribute to people becoming hesitant to get themselves and their children vaccinated, potentially leading to an increase in rates of vaccine refusal and non-vaccination. Considering the far-reaching benefits of vaccination, it is important from a Science Communication perspective to determine what communication strategies, practices and interventions are effective at convincing people that the benefits of vaccination outweigh the risks and lead them to get vaccinated.

This review sought to synthesize the existing literature to examine how this hesitancy had been addressed in vaccination programs. For logistical reasons the scope of the project was limited to two particular vaccines- the controversial Measles, Mumps and Rubella vaccine and the recent Human Papillomavirus vaccine.

The Measles, Mumps and Rubella (MMR) was began widespread introduction in 1971 led to a rapid reduction in incidence of the three diseases it protects against. For example, in the USA measles infection rates went from hundreds of thousands per year in the 1960s to less than 200 a year by 1997 (Orenstein, Papania and Wharton, 2004). However MMR became a controversial vaccine after it was incorrectly linked with autism in a 1998 study by Wakefield et al that has since been retracted.

The Human Papillomavirus (HPV) vaccine refers to two different vaccines- Gardasil and Cervarix. They are made by different manufacturers and have slight differences but both protect against two strains of the Human Papillomavirus- HPV-16 and HPV-18 (Monie, Hung, Roden and Wu, 2008). These strains are responsible for 90% of genital warts, 70% of cervical cancers, 80% of anal cancers, 60% of vaginal cancers, 90% of vulva cancers and several other types of rare cancers (De Vuyst, Clifford, Nascimento, Madeleine and Francesch, 2009). The vaccines have been widely introduced since the mid-2000s, with a focus on vaccinating women given the types of cancers they can prevent (Centre for Disease Control, 2012). A particular focus has been placed vaccination of young adolescent girls on the cusp of sexual debut to ensure protection before they commence sexual activity and risk exposure to HPV (Centre for Disease Control, 2012).

It was hypothesized by the author of this systematic review that by comparing and contrasting the communication strategies employed for the controversial MMR and new HPV vaccines in their different societal contexts, broader conclusions could be reached about what the best strategies were at increasing vaccination rates.

## *Methods*

The decision was made by the author to focus on studies and reviews that documented behavioural change resulting from interventions i.e. vaccine uptake, rather than attitude changes e.g. vaccine acceptability or intention to vaccinate.

This was done because the discrepancy between reported attitudes and observed behaviour has been well documented for many decades, starting with LaPiere (1934). Attitudes are recorded through self-reporting, which can be affected by multiple types of response biases (Furnham, 1986). This can change the reported attitudes of an individual away from their actual attitudes and final behaviour, especially for activities which are considered a social norm (Furnham, 1986)

In the context of vaccines, where getting vaccinated may be perceived as a social norm, reported attitudes of individuals following a vaccine communication intervention may not give an accurate indication of the success of or issues with the intervention as respondents seek to give answers they perceive as acceptable.

Thus given the goal of this review, to discern what interventions did or did not lead to populations improving their vaccination uptake, it was decided to only analyze studies that reported on vaccine uptake behaviour rather than vaccine attitudes or intentions. This raised an additional question- if the end goal was vaccination uptake, what level of vaccination would be the target level for interventions to reach? A natural answer to this question was that of herd immunity levels.

While vaccination can confer the direct benefits of higher immunity to an individual, it also has a broader social benefit known as 'herd immunity'. Also known as 'herd effect' or 'community immunity' this is the point where a large enough proportion of the population has been vaccinated to confer indirect protection on individuals who haven't been vaccinated (Fine, Eames and Heymann, 2011).

Reaching herd immunity is important as there are multiple reasons why an individual cannot be vaccinated such as being too young, having immune disorders, allergies or being the recipient of an organ transplant (Immunize Action Coalition, n.d.). Fortunately these make up a very small percentage of the total population (Kimmel, 2002), meaning that herd immunity can be reached amongst the rest of the population and these individuals can still be protected against the infectious disease. Vaccination interventions centred around MMR often set a target level of 95% for full protection and levels between 80-95% are referred to as partial protection (Centre for Disease Control, 2004). The exact level of population immunity required for the HPV vaccine is not quite known, although in parts of the USA scientists have reported some evidence of partial herd immunity leading to speculation it could be as low as 40% (Donovan et al, 2011).

Consequently this review was centred around the following research question- what MMR and HPV vaccine interventions, if any, have successfully addressed vaccine hesitancy and achieved herd immunity levels of population vaccine?

## *Scoping*

To collect papers for this research, the databases Web of Science and Scopus were used. Key terms including 'MMR', 'HPV', 'Gardasil', 'Cervarix', 'vaccine', 'communication', 'strategy' and 'evaluation' were searched using the Web of Science database. Results were restricted to papers published since 1998 as this was when the Wakefield paper was published, meaning strategies for the MMR vaccine from earlier may no longer be relevant. In addition HPV vaccines began widespread deployment in 2006 meaning no papers analyzing their usage would have been published before then.

Papers were then analyzed to determine if they were relevant to the goals of the research project. Relevancy was determined by whether the paper was a study or review paper that dealt specifically with the MMR or HPV vaccine and the system(s) used to encourage people to get the vaccines. Papers that were deemed relevant then had their reference lists and citations examined for additional papers that may have been missed, with the Scopus database used to track citation maps. Papers in the reference lists and citation maps were further analyzed to see if they were within the scope of this research, with papers deemed relevant having the process repeated with their own reference lists and citation maps. This process was repeated until all no new relevant papers could be found, thus producing an exhaustive collection of the literature of 245 that was within the initial scope for this research.

The collected literature was catalogued using EndNote software into distinct categories: Evaluation, Aspirational and Other. A paper was deemed 'evaluation' if it evaluated specific measures or strategies used in the communication of these vaccines. It was deemed 'aspirational' if it instead recommended strategies that should be used to communicate the vaccines. Papers that were neither of these were deemed as 'other'. As the goal of this review was to evaluate the success of trialed interventions, non-evaluation papers were excluded.

A further sub-distinction was observed between evaluation papers that evaluated changes in attitudes towards vaccinations versus those that evaluated changes in uptake of vaccinations. As the stated purpose of this project was to discern what interventions had affected vaccine behaviours, papers evaluating only attitude changes were excluded.

This then left a total of 35 relevant papers for the review, six for MMR and 29 for HPV. These papers are included in the reference list for this review.

## *Results*

This systematic review of the literature found no clear answer to the question of what communications successfully reduced vaccine hesitancy and promoted uptake of vaccines. However some common themes and trends were identified across the 35 papers in the MMR and HPV uptake evaluation literature.

Of principle note was the general lack of examination of vaccine hesitancy, its effect on vaccine uptake and if interventions were able to address this hesitancy to improve uptake of vaccinations. The primary communication method evaluated was the Reminder-Recall system which depended on people already having pro-vaccine attitudes.

The small amount of literature that did address hesitancy indicated that interaction and engagement were key. Engaging target groups directly, allowing them to interact with the communication and answering questions appeared to reduce hesitancy and increase vaccination

rates. Similarly engaging trusted third parties such as health care professionals and community leaders appeared to have positive effects. Conversely, simply providing one way communications such as information pamphlets was not shown to increase vaccination and had some indications they may have increased vaccine hesitancy.

An unexpected finding was that logistical issues such as what times a vaccination was available, where it was available and how much it cost appeared to have a noticeable effect on uptake rates. If these barriers have as much of an effect on overall vaccine uptake as the MMR and HPV literature suggest, it may be possible to attain high levels of vaccination without addressing other causes of vaccine hesitancy.

Another finding was a focus in the literature on single session communications- such as conversations with health care professionals, pamphlets and seminars. As many vaccines, including both the HPV and MMR, are multiple doses over an extended period of time, it was noted across the literature that a single session intervention may not be enough to increase vaccination rates.

A consistent issue identified in the literature was flawed study design, leading to poor controls or compromised target populations. This affected many study results and led to underpowered studies that could only identify correlations to communications without demonstrating causal links. The issue of inaccurate or insufficient records preventing measurement of final uptake rates of participants was another common problem shared across the two vaccines, further limiting the ability to measure the effect of communications on vaccination rates.

One positive common theme was that both the MMR and HPV literature included studies that evaluated both initial vaccination programs and catch up programs. This indicated the importance of having multiple arms in a broad vaccination communication campaign to allow people multiple opportunities to vaccinate.

Finally, a temporal effect was observed in the literature. While the initial search parameters started in 1998, of the 35 papers reviewed 30 of them were published in 2011 or later. Revisiting the excluded literature provided an explanation for this gap in the timeline. The early 2000s had a dominance in 'aspirational' papers which transitioned in the mid-2000s to a dominance of 'evaluation' papers that measured changes in vaccination attitudes. Which in turn started to shift to the dominance of vaccination uptake 'evaluation' papers in the 2010s. This suggests an evolution in research priorities over time, particularly for the MMR post-autism controversy. From initially developing new communication strategies to evaluating the effects of those communications on vaccine attitudes and then shifting to evaluating the effects on vaccination uptake.

### *Conclusions and Next Steps*

This systematic review was unable to identify if any communication strategies are the effective at reducing vaccine hesitancy and raising vaccination rates from the existing MMR and HPV vaccination intervention literature.

More research is needed to answer the research question posed for this review but some future directions can be suggested from this review's findings.

There is a relative abundance of literature for both the MMR and HPV vaccines on developing communications and investigating the effects of these communications on participant's vaccine attitudes and vaccine intentions. This literature should be examined closely to identify what communications have proven successful at improving vaccine attitudes and how they dealt with

hesitancy. These communications can then be retested with a focus on measuring a behavioural change of vaccine uptake. Future research should have appropriate experimental design and controls. Additionally, both vaccine series commencement and completion should be reported in future studies.

By doing this, paying particular attention to the effects in context of the broader population, a communication intervention or combination of interventions successful in reducing hesitancy and increasing vaccination could be identified and potentially be implemented widely.

### *References*

Allred, N. J., Shaw, K.M., Santibanez, T.A., Rickert, D.L. and Santoli, J.M., (2005). "Parental vaccine safety concerns - Results from the National Immunization Survey, 2001-2002." *American Journal of Preventive Medicine* 28(2): 221-224. DOI: <http://dx.doi.org/10.1016/j.amepre.2004.10.014>

Australian Government Department of Health and Ageing (2006), "National Health and Medical Research Council. Adverse events following immunisation", *The Australian Immunisation Handbook*, 9th edn.

Bartlett, J. A. and Peterson, J.A. (2011). "The Uptake of Human Papillomavirus (HPV) Vaccine Among Adolescent Females in the United States: A Review of the Literature." *The Journal of School Nursing* 27(6): 434-446.

Brown, K., Fraser, G., Ramsay, M., Shanley, R., Cowley, N., van Wijgerden, J., Toff, P., Falconer, M., Hudson, M., Green, J., Kroll, J.S., Vincent, C. and Sevdalis, N., (2011). "Attitudinal and Demographic Predictors of Measles-Mumps-Rubella Vaccine (MMR) Uptake during the UK Catch-Up Campaign 2008–09: Cross-Sectional Survey." *PLoS ONE* 6(5): e19381.

Cassidy, B., Braxter, B., Charron-Prochownik, D., and Schlenk E.A., (2014). "A Quality Improvement Initiative to Increase HPV Vaccine Rates Using an Educational and Reminder Strategy With Parents of Preteen Girls." *Journal of Pediatric Health Care* 28(2): 155-164. DOI: <http://dx.doi.org/10.1016/j.pedhc.2013.01.002>

Cates, J. R., Shafer, A., Diehl, S.J., and Deal, A.M., (2011). "Evaluating a County-Sponsored Social Marketing Campaign to Increase Mothers' Initiation of HPV Vaccine for Their Preteen Daughters in a Primarily Rural Area." *Social Marketing Quarterly* 17(1): 4-26. DOI: 10.1080/15245004.2010.546943

Centers for Disease Control and Prevention (2013), "AFIX (Assessment, Feedback, Incentives, and eXchange- Overview of AFIX)", Division of STD Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, U.S. Department of Health & Human Services, <http://www.cdc.gov/vaccines/programs/afix/>

Centers for Disease Control and Prevention (2014), "HPV Vaccine Information For Young Women - Fact Sheet", Division of STD Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, U.S. Department of Health & Human Services, <http://www.cdc.gov/std/hpv/stdfact-hpv-vaccine-young-women.htm>

De Vuyst, H., Clifford, G.M., Nascimento, M.C., Madeleine, M.M. and Francesch, S. (2009). "Prevalence and type distribution of human papillomavirus in carcinoma and intraepithelial neoplasia of the vulva, vagina and anus: A meta-analysis." *International Journal of Cancer* 124(7): 1626-1636. DOI: 10.1002/ijc.24116

Donovan, B., Franklin, N., Guy, R., Grulich, A.E., Regan, D.G., Ali, H., Wand, H. and Fairley, C.K. (2011). "Quadrivalent human papillomavirus vaccination and trends in genital warts in Australia: analysis of national sentinel surveillance data." *The Lancet Infectious Diseases* 11(1): 39-44. DOI: 10.1016/S1473-3099(10)70225-5

Dorell, C., Yankey, D., Kennedy, A. and Stokley, S., (2013). "Factors That Influence Parental Vaccination Decisions for Adolescents, 13 to 17 Years Old: National Immunization Survey–Teen, 2010." *Clinical Pediatrics* 52(2): 162-170.

Fiks, A. G., Grunfmeier, R.W., Mayne, S., Song, L., Feemster, K., Karavite, D., Hughes, C.C., Massey, J., Keren, R., Bell, L.M., Wasserman, R. and Localio, A.R., (2013). "Effectiveness of Decision Support for Families, Clinicians, or Both on HPV Vaccine Receipt." *Pediatrics* 131(6): 1114-1124.

Fine, P., Eames, K. and Heymann, D. L., (2011), "Herd immunity": A rough guide". *Clinical Infectious Diseases* 52(7): 911–6. DOI:10.1093/cid/cir007

Fu, L.Y., Bonhomme, L.A., Cooper, S.C., Joseph, J.G. and Zimet, G.D., (2014). "Educational interventions to increase HPV vaccination acceptance: A systematic review." *Vaccine* 32(17): 1901-1920.

Fujiwara, H., Takei, Y., Ishikawa, Y., Saga, Y., Machida, S., Taneichi, A. and Suzuki, M., (2013). "Community-Based Interventions to Improve HPV Vaccination Coverage among 13- to 15-Year-Old Females: Measures Implemented by Local Governments in Japan." *PLoS ONE* 8(12): e84126. DOI: 10.1371/journal.pone.0084126

Furnham, A. (1986), "Response bias, social desirability and dissimulation", *Personality and Individual Differences* 7(3): 385:400. DOI:10.1016/0191-8869(86)90014-0

Galagan, S.R., Paul, P., Menezes, L. and LaMontagne, D.S., (2013). "Influences on parental acceptance of HPV vaccination in demonstration projects in Uganda and Vietnam." *Vaccine* 31(30): 3072-3078.

Gargano, L. M., Herbert, N. L., Painter, J. E., Sales, J. M., Morfaw, C., Rask, K., Murray, D., DiClemente, R. and Hughes, J.M., (2013). "Impact of a physician recommendation and parental immunization attitudes on receipt or intention to receive adolescent vaccines." *Human Vaccines & Immunotherapeutics* 9(12): 2627-2633. DOI:10.4161/hv.25823

Gilkey, M.B., Dayton, A.M., Moss, J.L., Sparks, A.C., Grimshaw, A.H., Bowling, J.M and Brewer, N.T. (2014). "Increasing Provision of Adolescent Vaccines in Primary Care: A Randomized Controlled Trial." *Pediatrics* 134(2): e346-e353.

Hopfer, S. (2012). "Effects of a Narrative HPV Vaccination Intervention Aimed at Reaching College Women: A Randomized Controlled Trial." *Prevention Science* 13(2): 173-182. DOI: 10.1007/s11121-011-0254-1

Immunize Action Coalition, (n.d.), Measles: Questions and Answers, accessed 9/9/14, <http://www.immunize.org/catg.d/p4209.pdf>

Jacobson, V.J. and Szilagyi, P., (2005), "Patient reminder and patient recall systems to improve immunization rates", *Cochrane Database Syst Rev* (3), p. CD003941

Kharbanda, E.O., Stockwell, M.S., Fox, H.W., Andres, R., Lara, M., and Rickert, V.I., (2011). "Text message reminders to promote human papillomavirus vaccination." *Vaccine* 29(14): 2537-2541. DOI: 10.1016/j.vaccine.2011.01.065

Kimmel, R.S., (2002) "Vaccine Adverse Events: Separating Myth from Reality, *Am Fam Physician*. 66(11):2113-2121.

Ladner, J., Besson, M.H., Hampshire, R., Tapert, L., Chirenje, M. and Saba, J. (2012). "Assessment of eight HPV vaccination programs implemented in lowest income countries." *BMC Public Health* 12(1): 370. DOI: 10.1186/1471-2458-12-370

Ladner, J., Besson, M.H., Rodrigues, M., Audureau, E. and Saba, J., (2014). "Performance of 21 HPV vaccination programs implemented in low and middle-income countries, 2009-2013." *BMC Public Health* 14(1): 670. DOI: 10.1186/1471-2458-14-670

LaPiere, R. T. (1934). Attitudes vs. Actions. *Social Forces*, 13, 230-237.

Le Menach, A., Boxall, N., Amirthalingam, G., Maddock, L., Balasegaram, S. and Mindlin., M., (2014). "Increased measles–mumps–rubella (MMR) vaccine uptake in the context of a targeted immunisation campaign during a measles outbreak in a vaccine-reluctant community in England." *Vaccine* 32(10): 1147-1152.

Mbabazi, M.B., Tabu, C.W., Chemirmir, C., Kisia, J., Ali, N., Corkum, M.G. and Bartley, G.L., (2014). "Innovations in communication technologies for measles supplemental immunization activities: lessons from Kenya measles vaccination campaign, November 2012." *Health Policy and Planning*. DOI: 10.1093/heapol/czu042

Minkovitz, C., Strobino, D., Hughart, N., Scharfstein, D., Guyer, B. and the HS Evaluation Team, (2001), "Early Effects of the Healthy Steps for Young Children Program." *Arch Pediatr Adolesc Med*. 2001; 150: 470-479.

Monie, A., Hung, C.F., Roden, R. and Wu, T.C., (2008). "Cervarix(™): a vaccine for the prevention of HPV 16, 18-associated cervical cancer." *Biologics : Targets & Therapy* 2(1): 107-113.

Moss, J. L., Reiter, P.L. and Dayton, A., (2012). "Increasing adolescent immunization by webinar: A brief provider intervention at federally qualified health centers." *Vaccine* 30(33): 4960-4963.

Orenstein, W. A., Papania, M.J. and Wharton, M.E.. (2004). "Measles Elimination in the United States." *Journal of Infectious Diseases* 189(Supplement 1): S1-S3.

Patel, A., Stern, L., Unger, Z., Debevec, E., Roston, A., Hanover, R. and Morfesis, J., (2014). "Staying on track: A cluster randomized controlled trial of automated reminders aimed at increasing human papillomavirus vaccine completion." *Vaccine* 32(21): 2428-2433. DOI: 10.1016/j.vaccine.2014.02.095

Paul, P. and Fabio, A., (2014). "Literature review of HPV vaccine delivery strategies: Considerations for school- and non-school based immunization program." *Vaccine* 32(3): 320-326.

Plotkin, S., Gerber, J.S. and Offit, P.A., (2009), "Vaccines and Autism: A Tale of Shifting Hypotheses", *Clin Infect Dis*. 48 (4): 456-461. DOI: 10.1086/596476



Porter-Jones, G., Williams, S., Powell, C., Pusey, L. and Roberts, R.J., (2009). "Impact of a novel way to communicate information about MMR on uptake of MMR vaccine: A randomized controlled trial." *Public Health* 123(1): 78-80. DOI: 10.1016/j.puhe.2008.10.011.

Priest, H. M. and Knowlden, A.P., (2014). "Systematic Review of Primary Prevention Human Papillomavirus Interventions Targeting College Students." *International Journal of Sexual Health*: 00-00. DOI:10.1080/19317611.2014.945631

Reeve, C., Rue, S.D.L., Pashen, D., Culpan, M. and Cheffins, T., (2008). "School-based vaccinations delivered by general practice in rural north Queensland: an evaluation of a new human papilloma virus vaccination program." *Communicable diseases intelligence* 32(1): 94-98.

Shourie, S., Jackson, C., Cheater, F.M., Bekker, H.L., Edlin, R., Tubeuf, S., Harrison, W., McAleese, E., Schweiger, M., Bleasby, B. and Hammond, L., (2013). "A cluster randomised controlled trial of a web based decision aid to support parents' decisions about their child's Measles Mumps and Rubella (MMR) vaccination." *Vaccine* 31(50): 6003-6010. DOI: 10.1016/j.vaccine.2013.10.025

Stubbs, B.W., Panozzo, C.A., Moss, J.L., Reiter, P.L., Whitesell, D.H. and Brewer, N.T., (2014). "Evaluation of an Intervention Providing HPV Vaccine in Schools." *American Journal of Health Behavior* 38(1): 92-102. DOI: 10.5993/AJHB.38.1.10.

Suh, C.A., Saville, A., Daley, M.F., Glazner, J.E., Barrow, J., Stokley, S., Dong, F., Beaty, B., Dickinson, L.M. and Kempe, A., (2012). "Effectiveness and Net Cost of Reminder/Recall for Adolescent Immunizations." *Pediatrics* 129(6): e1437-e1445. DOI: 10.1542/peds.2011-1714

Szilagyi, P.G., Albertin, C., Humiston, S.G., Rand, C.M., Schaffer, S., Brill, H., Stankaitis, J., Yoo, B.Y., Blumkin, A. and Stokley, S., (2013). "A Randomized Trial of the Effect of Centralized Reminder/Recall on Immunizations and Preventive Care Visits for Adolescents." *Academic Pediatrics* 13(3): 204-213. DOI: <http://dx.doi.org/10.1016/j.acap.2013.01.002>

Vanderpool, R. C., Cohen E., Crosby, R.A., Jones, M.G., Bates, W., Casey, B.R. and Collins, T., (2013). "'1-2-3 Pap" Intervention Improves HPV Vaccine Series Completion Among Appalachian Women." *Journal of Communication* 63(1): 95-115. DOI: 10.1111/jcom.12001

Wakefield, A. J., Murch, S.H., Anthony, A., Linnel, J., Casson, D.M., Malik, M., Berelowitz, M., Dhillon, A.P., Thomson, M.A., Harvey, P., Valentine, A., Davies, S.E. and Walker-Smith, J.A., (1998). "RETRACTED: Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children." *The Lancet* 351(9103): 637-641. DOI: [http://dx.doi.org/10.1016/S0140-6736\(97\)11096-0](http://dx.doi.org/10.1016/S0140-6736(97)11096-0)

Watson, M., Shaw, D., Molchanoff, L. and McInnes, C., (2009). "Challenges, lessons learned and results following the implementation of a human papilloma virus school vaccination program in South Australia." *Australian and New Zealand Journal of Public Health* 33(4): 365-370. DOI: 10.1111/j.1753-6405.2009.00409.x

Watson-Jones, D., Baisley, K., Ponsiano, R., Lemme, F., Remes, P., Ross, D., Kapiga, S., Mayaud, P., de Sanjose, S., Wight, D., Changalucha, D. and Hayes, R., (2012). "Human Papillomavirus Vaccination in Tanzanian Schoolgirls: Cluster-Randomized Trial Comparing 2 Vaccine-Delivery Strategies." *Journal of Infectious Diseases* 206(5): 678-686. DOI: 10.1093/infdis/jis407

Wegwarth, O., Kurzenhäuser-Carstens, S. and Gigerenzer, G., (2014). "Overcoming the knowledge–behavior gap: The effect of evidence-based HPV vaccination leaflets on understanding, intention, and actual vaccination decision." *Vaccine* 32(12): 1388-1393. DOI:10.1016/j.vaccine.2013.12.038

Whelan, N. W., Steenbeek, A., Martin-Misener, R., Scott, J., Smith, B. and D'Angelo-Scott, H., (2014). "Engaging parents and schools improves uptake of the human papillomavirus (HPV) vaccine: Examining the role of the public health nurse." *Vaccine* 32(36): 4665-4671. DOI:10.1016/j.vaccine.2014.06.026

Wright, J. D., Govindappagari, S., Pawar, N., Cleary, K., Burke, W.M., Devine, P.C., Lu, Y.S., Tsai, W.Y., Lewin, S.N. and Herzog, T.J., (2012). "Acceptance and Compliance With Postpartum Human Papillomavirus Vaccination." *Obstetrics & Gynecology* 120(4): 771-782. DOI: 10.1097/AOG.0b013e31826afb56

### *Acknowledgements*

The author would like to acknowledge Dr Rod Lamberts and Dr Lindy Orthia from the Australian National Centre for the Public Awareness of Science for their assistance and support in completing this research.