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Review of global rotavirus strain prevalence data from six years post vaccine licensure surveillance: Is there evidence of strain selection from vaccine pressure?

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ABSTRACT

Comprehensive reviews of pre licensure rotavirus strain prevalence data indicated the global importance of six rotavirus genotypes, G1P[8], G2P[4], G3P[8], G4P[8], G9P[8] and G12P[8]. Since 2006, two vaccines, the monovalent Rotarix (RV1) and the pentavalent RotaTeq (RV5) have been available in over 100 countries worldwide. Of these, 60 countries have already introduced either RV1 or RV5 in their national immunization programs. Post licensure vaccine effectiveness is closely monitored worldwide. This review aimed at describing the global changes in rotavirus strain prevalence over time. The genotype distribution of the nearly 47,000 strains that were characterized during 2007–2012 showed similar picture to that seen in the preceding period. An intriguing finding was the transient predominance of heterotypic strains, mainly in countries using RV1. Unusual and novel antigen combinations continue to emerge, including some causing local outbreaks, even in vaccinated populations. In addition, vaccine strains have been found in both vaccinated infants and their contacts and there is evidence for genetic interaction between vaccine and wild-type strains. In conclusion, the post-vaccine introduction strain prevalence data do not show any consistent pattern indicative of selection pressure resulting from vaccine use, although the increased detection rate of heterotypic G2P[4] strains in some countries following RV1 vaccination is unusual and this issue requires further monitoring.

1. Introduction

From 2006 onward, two rotavirus vaccines, the monovalent Rotarix (RV1) and the pentavalent Rotateq (RV5) have been licensed in >100 countries worldwide and have been recommended by the World Health Organization (WHO) for routine immunization of all children worldwide (Dennehy, 2008; WHO, 2009a). As of May 2014, 60 countries worldwide have introduced either RV1 and/or RV5 into their national childhood immunization programs (PATH, 2014). RV1 is a monovalent vaccine composed of a single human-derived rotavirus strain of G1P[8] specificity, whereas RV5 is a pentavalent vaccine containing bovine-human reassortant rotaviruses expressing human surface antigens of G1–G4 and P[8] (Parashar et al., 2006; Cortese et al., 2009). Whereas the composition of RV1 and RV5 is different, the multiple vaccine doses administered a few weeks apart imitate the role of sequential natural rotavirus infections in infants and young children, which stimulate the development of both type specific (i.e. homotypic) and heterotypic protective immunity against a variety of group A rotavirus (RVA) strains (Velazquez et al., 1996).

Efficacy, safety and strain-specific effectiveness of RVA vaccines are being closely monitored in post licensure surveillance. Rotavirus strain surveillance targets the characterization of both neutralization antigens, VP7 or G and VP4 or P, of RVAs. Previous reviews on rotavirus strain prevalence (using G and P type data) focused on the pre vaccine licensure period. Three major reviews reported global prevalence data and several regional reviews summarized relevant information from a continent or a WHO

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Table 1
Countries reporting RVA strain prevalence in humans, 2007–2012.

Country	Year of sample collection	No. of strains	G1P[8]	G2P[4]	G3P[8]	G4P[8]	G9P[8]	G12P[8]	OTHERS	NT	Mix	Refs.
African region												
African Rotavirus Surveillance Network (Ghana, Kenya,Uganda, Zambia, Cameroon, Tanzania, Zimbabwe, Ethiopia)	JUN 2006–2012	4638	954	295	129	68	361	293	1330	609	599	Mwenda et al. (2010, 2014)
Burkina Faso	DEC 2009–MAR 2011	156	16	7			66		47	9	11	Nordgren et al. (2012a,b)
Cameroon	2010–2011	135		8	1		1	73	40	7	5	Ndze et al. (2013)
Ethiopia	AUG 2007–MAR 2012	215	44	23			9	37	67	11	24	Abebe et al. (2014)
Gambia	2008–2010	204	52	5					124	19	4	Kwambana et al. (2014)
Ghana	APR 2007–FEB 2011	1015	224	73	7		6	3	249	239	214	Breiman et al. (2012), Enweronu-Laryea et al. (2013)
Ivory Coast	DEC 2007–JUN 2010	90	22	9	8	16	0		19		16	Karamoko and Dabonne (2013), Akoua-Koffi et al. (2014)
Kenya	APR 2007–AUG 2011	246	76	1			62		56	38	13	Breiman et al. (2012), Kiulia et al. (2014)
Madagascar	FEB 2008–MAY 2009	104	15				51		13	25		Razafindratsimandresy et al. (2013)
Malawi	2006–2007	131	25	2			11	6	76	9	2	Cunliffe et al. (2010), Steele et al. (2012)
Mali	APR 2007–MAR 2009	370	201	16			4		127	22		Breiman et al. (2012)
Niger	APR 2010–MAR 2012	449	14	167			16	154	29	39	30	Page et al. (2014)
Nigeria	JUN 2010–JAN 2011	19		1				6	1	11		Japhet et al. (2012)
Réunion Island	AUG 2012–NOV 2012	20			15			4			1	Caillère et al. (2013)
South Africa	2012	123	2	16			7	54	38	2	4	Iyaloo et al. (2013)
Tanzania	JAN 2010–JUN 2012	309	161	2			1		107		38	Hokororo et al. (in press), Moyo et al. (2014)
Total		8224	1806	625	160	84	595	630	2323	1040	961	
American region												
Argentina	JAN 2007–DEC 2011	912	67	168	232	23	188	143	9	57	25	Esteban et al. (2010), Mandile et al. (2014), Stupka et al. (2009, 2012)
Bolivia	JAN 2007–JUN 2011	740	16	134	52		253		167	55	63	Patel et al. (2013), Rivera et al. (2013)
Brazil	MAR 2006–MAR 2012	980	87	521	11		64		117	111	69	Assis et al. (2013), Borges et al. (2011), Carvalho-Costa et al. (2009), Cilli et al. (2011), Nakagomi et al. (2008), Dulgheroff et al. (2012), Gómez et al. (2013), Gurgel et al. (2009), Luchs et al. (2012, 2013), Luchs and Timenetsky (2014), Nozawa et al. (2010), Sáfadi et al. (2010), Soares et al. (2012, 2014)
Canada	2007–2011	323	192	26	45	5	32		6	5	12	Chetrit et al. (2013), McDermid et al. (2012), Ward et al. (2013)
Chile	JUL 2006–MAR 2010	238	12	14			177		15	20		Lucero et al. (2012), O'Ryan et al. (2009)
Colombia	2008–2012	467	1	191	5		26		103	61	80	Peláez-Carvajal et al. (2014)
Cuba	2007–2008	29	14				13		1		1	Ribas et al. (2011)
Guatemala	2007–2010	147	91				15		37		4	Cortes et al. (2012), Quaye et al. (2013)
Honduras	2009–2010	50	25						25			Quaye et al. (2013)
Mexico	MAR 2010–MAY 2010	16							16			Yen et al. (2011)
Nicaragua	FEB 2007–OCT 2009	1095	336	341	39	42			68	266	3	Bányai et al. (2009a,b), Becker-Dreps et al. (2011), Khawaja et al. (2013)
Paraguay	2006–2007	143		69			37		6	23	8	Martínez et al. (2010)
Peru	JAN 2010–DEC 2012	42				2	5	4	19	12		Espejo et al. (2014)
USA	2007–2011	1574	342	230	489	35	157	153	97	29	42	Abdel-Haq et al. (2011), Boom et al. (2010), Cardemil et al. (2012), Clark et al. (2011), Hull et al. (2011), McDonald et al. (2012), Payne et al. (2009, 2013), Staat et al. (2011), Weinberg et al. (2012, 2013)
Total		6756	1183	1694	873	107	967	300	686	639	307	
Western pacific region												
Australia	JUL 2006–SEP 2011	1715	543	635	167	37	106		46	149	32	Cowley et al. (2013), Kirkwood et al. (2007, 2008, 2009, 2010, 2011)
China	2006–2011	2516	534	78	1245	6	103		137	299	114	Chen et al. (2013), Dong et al. (2013), Li et al. (2009), Shen et al. (2013), Wang et al. (2009, 2011, 2013), Zeng et al. (2010), Zhang et al. (2012)

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