



ORIGINAL ARTICLE

Doping control adverse results prevalence worldwide for 13 consecutive years Analysis of the season 2015 according to sports



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Abstract The presence of adverse results in doping controls is always bad news for the sport, as it reflects the moral and ethical absence of a clean competition. Its prevalence and evolution is important to know and have criteria on the relevance of this event.

Method: The results of doping controls from 2003 to 2015 at the global level, offered by the World Anti-Doping Agency on its website, have been revised.

Results: The presence of adverse results of the year 2015 as last reference, reached 0.83% in Olympic sports and 2.04% in the non-Olympic ones. It remains a similar level during the last 7 years, tending to decline in the Olympics and increase in the non-Olympics. The groups of predominant substances are, in order, anabolic steroids 50.3%, stimulants 15.4% and maskers 12.5%, being the rest diverse and variable. It should be noted that many treatments with therapeutic authorisation, i.e., beta agonists (3–4%), glucocorticosteroids (6–8%) or central nervous system (3–5%), are shown as adverse results, but are therefore not doping positive and in their case punishable. Similarly, the high number of anabolic positives is the result of fraud, but also the presence of repeated samples in the follow-up study of some athletes.

Conclusion: The data serve as a reference to have a more accurate criterion in reference to this field of sport.

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PALABRAS CLAVE

Dopaje;
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World AntiDoping
Agency (WADA)

Prevalencia de resultados adversos en los controles de dopaje a nivel mundial durante 13 años consecutivos Análisis de la temporada 2015 según deportes

Resumen La presencia de resultados adversos en los controles de dopaje son siempre una noticia nefasta para el deporte, pues refleja la ausencia moral y ética de una competición limpia. Su prevalencia y evolución es importante para conocer y disponer de criterio sobre la relevancia de este suceso.

Método: Se han revisado los resultados de los controles de dopaje del 2003 al 2015 a nivel mundial, ofrecidos por la Agencia Mundial Antidopaje en su web. Se ofrecen, además, los resultados por deportes del 2015.

Resultados: La presencia de resultados adversos, tomando de referencia ese año, alcanza un 0,83% de las muestras estudiadas en los deportes olímpicos y un 2,04% en los no olímpicos. Se mantiene un nivel similar en los últimos 7 años, tendiendo a disminuir en los deportes olímpicos y aumentar en los no olímpicos. Los grupos de sustancias predominantes son, por orden, anabolizantes (50,3%), estimulantes (15,4%) y enmascarantes (12,5%), siendo el resto diverso y variable. En el total de resultados debe tenerse en cuenta que muchos tratamientos con autorización terapéutica, por ejemplo para beta-agonistas (3-4%), glucocorticoides (6-8%) o del sistema nervioso central (3-5%), se muestran como resultados adversos, pero no son por tanto dopaje positivo ni en su caso sancionables. De igual manera, el elevado número de positivos en anabolizantes son fruto del fraude pero también de la presencia de muestras repetidas en los seguimientos de estudio de algunos deportistas.

Conclusión: Los datos sirven de referencia para disponer de un criterio más certero en referencia a este ámbito del deporte.

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Introduction

The true extent of the results and data on the fight against doping are not only unknown, as also the news about doping in successful sports personalities in the media gives a message that is very distant from the actual situation. Official analysis to detect banned substances in sportsmen and women has been practised since the 1960s, when the International Federation of Football Associations (FIFA) and the International Cycling Union (UCI) carried out the first determinations. The consolidation in 1999 of the World AntiDoping Agency (WADA-AMA) was a very important step, as it not only brought the majority of international sports federations together with the same aim, but also established an Antidoping Code listing banned substances in and outside competitions, together with all of the procedures and actions necessary to obtain samples correctly.¹ Since then and up to now the grouping together of regional and national antidoping agencies and Olympic and non-Olympic sports federations and associations has strengthened the commitment to clean competition.

However, it is not easy to communicate the message that this contest against fraudulent competitors is being won. It is habitual in different competitions, and above all those which attract the largest numbers of followers, for news to arise that a winning sportsman or woman cheated to gain an honour that does not correspond to them. Such news items are often the most widely broadcast, and they debase the references to the sports in question.

The WADA-AMA has published the worldwide results of these analyses annually since 2003 in its official website. This paper presents the results, classified and grouped according to sports, with the aim of offering those who study this subject resources that show the actual situation.

Method

The annual results from the last 13 years from 2003 to 2015 were obtained from the WADA-AMA web page. These results are classified according to sport, whether or not it is an Olympic sport and according to the banned substance detected by analysis. To break down the findings according to sport and to make a selection from them the results of the last year shown in the web page, 2015, are shown.

Adverse results are identified, i.e., the ones that are unexpected and indicate the presence in a urine sample of a substance considered to be doping according to the current antidoping code. By definition an "Adverse analytical Result" indicates the presence of banned substances or the use of banned methods in a certain sample. Adverse Analytical Results should not be confused with AntiDoping Rule Violations (ADRV) which are judged or punished due to several reasons. These figures may therefore contain findings that were subject to the process of Therapeutic Use Exemptions (TUE) Authorisation, or some adverse analytical findings may correspond to multiple measurements in a single sportsman or woman, such as cases of longitudinal studies to evaluate the presence of testosterone (i.e., monitoring the testosterone level in an individual over a period of time).

Results

The results are shown in Tables 1–5. Table 1 shows that the number of checks performed has doubled over these 13 years (by 200.6%). Although fewer checks have always been performed in non-Olympic sports than in Olympic ones, over somewhat more than a decade non-Olympic sports federations and the organisers of the sports events they participate in have committed themselves to clean competition and health protection. There has therefore been a major increase in the number of tests in non-Olympic sports or activities (by 284%).

The three columns on the right in Table 1 show the presence of adverse outcomes. In the samples evaluated these are really rare at less than 1% of those who practice Olympic sports and hardly above 2% for non-Olympic sports (Fig. 1) in the last recorded year.

Table 2 shows abnormal results according to substance. Anabolic steroids are the most used substance in all of the annual series, with values that are always close to or above 50% in comparison with the other substances. Different proportions of stimulants are in second place (Table 3), while masking agents are in third place, having risen since 2014. Although the latter products have no active effect themselves in sport terms, they are used to hinder or annul the

detection of a banned substance by the antidoping control laboratory. In Table 2 it must be underlined that glyocorticoids remain in a range from 4% to 7%. Like betagonists and some others, this medication must not always be considered to be doping. As was pointed out above, its presence in a sample may be justified by a current TUE, that does not eliminate the result of the quantification listed and must not be considered to be doping, so that it is not punishable.

Table 3 shows the results of the different stimulants used with the intent to cheat. Pseudoephedrine was once fully authorised. However, due to its reappearance at striking levels in certain sports it was banned once again. This ban did not take place because in certain countries it was evaluated again, after which it was understood that its reappearance was not due to expressly therapeutic reasons.² In the one-year evaluation its presence may be considered to stand at a low level, as it was found in fewer than 9 subjects. Nevertheless, it would be expected that it would not exist at all, not even as the result of a mistake or due to a poorly prescribed therapy.

The use of amphetamines as stimulants is especially interesting, given that detection of them not only does not fall, but increases in both absolute and relative terms. This is also the case for methylphenidate, which is used for learning

Table 1 Including ARISF, AIMS, the Paralympics committee, disabled sports, sports not included in ADAMS (North American leagues) and other sports.^a

Year ^a	Total checks	Total Olympic	Total No. Olympic	Ratio Ol./non Ol.	Total adverse R	Adverse R Olympic	Adverse R non Olympic ^a
2003	151,210	113,562	37,648	67%	2447	1710	737
					1.62%	1.51%	1.96%
2004	169,187	128,591	40,596	68%	2909	2145	764
					1.72%	1.67%	1.88%
2005	183,337	139,836	43,501	69%	3909	2958	951
					2.13%	2.12%	2.19%
2006	198,143	156,866	41,277	74%	3887	2915	972
					1.96%	1.86%	2.35%
2007	223,898	174,483	49,415	72%	4402	3375	1027
					1.97%	1.93%	2.08%
2008	274,615	202,067	72,548	64%	2956	1974	982
					1.08%	0.98%	1.35%
2009	277,928	187,029	90,899	51%	3091	1674	1417
					1.11%	0.90%	1.56%
2010	258,267	180,584	77,683	57%	2790	1624	1166
					1.08%	0.90%	1.50%
2011	243,193	167,820	75,373	55%	2885	1762	1123
					1.19%	1.05%	1.49%
2012	267,645	184,955	82,690	55%	3190	1831	1359
					1.19%	0.99%	1.64%
2013	269,878	176,502	93,376	47%	3529	1710	1819
					1.31%	0.97%	1.95%
2014	283,304	186,739	96,565	48%	3153	1440	1713
					1.11%	0.77%	1.77%
2015	303,369	196,581	106,788	46%	3809	1634	2175
					1.26%	0.83%	2.04%

The Bold results are the rate of the absolute number in relation out of the total.

Table 2 Number of samples identified as adverse results in each group for the sports included in ADAMS. They should not be confused with violations punished by the regulations (ADRVs) given that some may be covered by a TUE or may correspond to several tests in the same subject.

Year	AR+AT	Anabolic S.		Stimulants		Canabinoids		B ₂ agonists		GlycoCTC		Masking A.		H.Pept		Others	
2003	2716	872	32.1%	516	19.0%	378	13.9%	297	10.9%	286	10.5%	142	5.2%	79	2.9%	64	2.4%
2004	3305	1191	36.0%	382	11.6%	518	15.7%	381	11.5%	548	16.6%	157	4.8%	78	2.4%	50	1.5%
2005	4298	1864	43.4%	509	11.8%	503	11.7%	609	14.2%	325	7.6%	246	5.7%	162	3.8%	80	1.9%
2006	4332	1966	45.4%	490	11.3%	553	12.8%	631	14.6%	282	6.5%	290	6.7%	42	1.0%	78	1.8%
2007	4850	2322	47.9%	793	16.4%	576	11.9%	399	8.2%	288	5.9%	359	7.4%	41	0.8%	72	1.5%
2008	5523	3259	59.0%	472	8.5%	496	9.0%	350	6.3%	316	5.7%	436	7.9%	106	1.9%	88	1.6%
2009	5084	3297	64.9%	325	6.4%	399	7.8%	303	6.0%	265	5.2%	273	5.4%	100	2.0%	122	2.4%
2010	5546	3374	60.8%	574	10.3%	533	9.6%	209	3.8%	234	4.2%	396	7.1%	86	1.6%	140	2.5%
2011	5600	3325	59.4%	718	12.8%	445	7.9%	225	4.0%	274	4.9%	368	6.6%	125	2.2%	120	2.1%
2012	4500	2279	50.6%	697	15.5%	406	9.0%	131	2.9%	365	8.1%	322	7.2%	181	4.0%	119	2.6%
2013	5271	3320	63.0%	530	10.1%	188	3.6%	138	2.6%	330	6.3%	393	7.5%	202	3.8%	170	3.2%
2014	3079	1479	48.0%	474	15.4%	73	2.4%	122	4.0%	252	8.2%	389	12.6%	91	3.0%	199	6.5%
2015	3432	1728	50.3%	528	15.4%	127	3.7%	115	3.4%	215	6.3%	428	12.5%	98	2.9%	193	5.6%

RA: adverse results, AT procedural alterations, B2 agonists: Beta agonists or beta2 adrenergics, GlycoCTC: glycocorticoids, H.Pept.: peptide hormones.

Table 3 Adverse results for the presence of S1 category stimulants.

Year	Pseudoephedrine		Ephedrine		Cocaine		Amph/Meth		Caffeine		Methylphenidate		MDA	
2003	189	36.6%	100	19.4%	48	9.3%	50	9.7%	39	7.6%	9	1.7%		
2004		0.0%	102	26.7%	75	19.6%	135	35.3%			7	1.8%		
2005		0.0%	93	18.3%	85	16.7%	214	42.0%			17	3.3%		
2006		0.0%	66	13.5%	85	17.3%	216	44.1%			32	6.5%		
2007		0.0%	50	6.3%	101	12.7%	452	57.0%			38	4.8%		
2008		0.0%	54	11.4%	77	16.3%	177	37.5%			40	8.5%		
2009		0.0%	44	13.5%	60	18.5%	37	11.4%			31	9.5%	31	9.5%
2010	17	3.0%	32	5.6%	65	11.3%	125	21.8%			73	12.7%	123	21.4%
2011	9	1.3%	33	4.6%	40	5.6%	153	21.3%			59	8.2%	283	39.4%
2012	13	1.9%	12	1.7%	59	8.5%	98	14.1%			47	6.7%	320	45.9%
2013	6	1.1%	10	1.9%	52	9.8%	69	13.0%			66	12.5%	169	31.9%
2014	8	1.7%	25	5.3%	46	9.7%	88	18.6%			71	15.0%	76	16.0%
2015	9	1.7%	19	3.6%	70	13.3%	107	20.3%			96	18.2%	56	10.6%

Amph: amphetamine, Meth: methamphetamine, MDA: dymethylamine.

deficit pathologies. The detection of this substance should always be accompanied by a TUE accepted by the relevant body. However, this is not always the case, as it is known to be used as doping substance in sport. On the other hand, the use of dimethylamylamine or methylhexanamine seems to be falling since the 2012 London Olympic Games. This is an amphetamine derivative that has no therapeutic profile or format, so that its conscious use (or unconscious use, as it is found in some sports supplement products) is considered to be doping.³

Tables 4 and 5 show the results according to sport in the year 2015. The first of these, Table 4, refers to summer Olympic sports (ASOIF) and winter Olympic sports (AIOWF). Table 5 shows non-Olympic sports corresponding to several sports federations and associations. The latter shows the data from sports that may belong to different associations together, combining them to make them easier to understand. To reduce this table to a size suitable for publication, it has been restricted to sports with adverse results or 1% or greater.

Discussion

Based on these results, it seems that fewer sports men and women use doping that could previously have been guessed.

Although it is correct that the presence of only one case should be considered despicable, it is also true that the presence of a single positive result would not correspond to one individual of every hundred analyses performed in Olympic sports, and hardly to two in non-Olympic sports. The other reading of this datum, from the ethical and moral point of view in sport, is that of every 100 sports men and women, 98.99 in Olympic sports behave correctly and follow the rules.

These tables contain numbers and may look worthy of a stock market broker. Some points should be raised to ensure that these results are interpreted broadly and correctly. As was pointed out above as well as in the table legends, although adverse results are shown they are not always punishable, as they may be due to a TUE. On the other hand, the positive results for some substances such as anabolic steroids may correspond to several samples from a single individual who was being monitored. Thus although it is correct that anabolic steroids have to be monitored as they are the most widely used doping substances, the result respecting them is somewhat amplified due to the range of additional samples arising from the above-mentioned cause.

On the other hand, it is interesting to observe the increased use of masking agents, products used with the aim of hiding the use of another prohibited substance or perhaps

Table 4 The presence of adverse results (AR) in Olympic sports according to Association or Committee.

Association	Sport	Tested	RA	%
ASOIF	Weightlifting	10,262	272	2.7%
ASOIF	Golf	417	10	2.4%
ASOIF	Horse riding	419	9	2.1%
ASOIF	Boxing	4842	85	1.8%
ASOIF	Basketball	5504	64	1.2%
ASOIF	Wrestling	5381	62	1.2%
ASOIF	Cycling	22,652	244	1.1%
ASOIF	Taekwondo	2184	21	1.0%
ASOIF	Rugby	8451	80	0.9%
ASOIF	Athletics	30,308	265	0.9%
ASOIF	Archery	928	7	0.8%
ASOIF	Shooting	2849	21	0.7%
ASOIF	Rowing	5288	37	0.7%
ASOIF	Judo	5104	35	0.7%
ASOIF	Canoeing	4547	31	0.7%
ASOIF	Handball	3739	25	0.7%
ASOIF	Football	32,362	160	0.5%
ASOIF	Triathlon	4130	20	0.5%
ASOIF	Tennis	4451	21	0.5%
ASOIF	Volleyball	4502	21	0.5%
ASOIF	Hockey	1432	6	0.4%
ASOIF	Water sports	12,973	54	0.4%
ASOIF	Gymnastics	2416	10	0.4%
ASOIF	Table tennis	1019	4	0.4%
ASOIF	Sailing	815	3	0.4%
ASOIF	Fencing	1818	6	0.3%
ASOIF	Badminton	1285	2	0.2%
ASOIF	Pentathlon M.	642	0	0.0%
	<i>Total</i>	180,720	1575	0.9%
AIOWF	Ice hockey	3359	36	1.1%
AIOWF	Curling	265	1	0.4%
AIOWF	Bobsleigh	854	2	0.2%
AIOWF	Skiing	5555	10	0.2%
AIOWF	Skating	3605	6	0.2%
AIOWF	Biathlon	1920	3	0.2%
AIOWF	Luge	303	0	0.0%
	<i>Total</i>	15,861	58	0.4%
Disabled sports		3235	54	1.7%
Int. Paralympics Comm.		3687	64	1.7%

to limit the concentration of another substance with a positivity threshold, as well as the use of certain stimulants (Table 3).

When the tables are evaluated according to sports, in some the level of adverse results is anecdotal, under 0.5% (1/200 subjects), while in others it is clearly higher. Moreover, some substances are stimulants rather than ergogenics, and they may be used to enhance performance or for so-called "social" purposes which, in any case, also modify qualities and abilities which, in sports events will raise subjects above their normal

state and make them better than would correspond to them.

The percentages are different in non-Olympic sports and activities. In some of them there may be a temptation to use an illicit extra aid due to their similarity to sports and competition. Comparisons may be drawn in this evaluation of non-Olympic sports and activities based on the percentages arising from the number of samples taken. When few samples are taken, as is the case in electronic sports, a single adverse result may ruin its reputation as a clean sport. We have wished to separate weight-lifting controlled by the AIMS from other weight-lifting sports or even body-building in the same association, given that the number of positive cases is not the same. This is indubitably because these groups of sports men and women compete in very different environments.

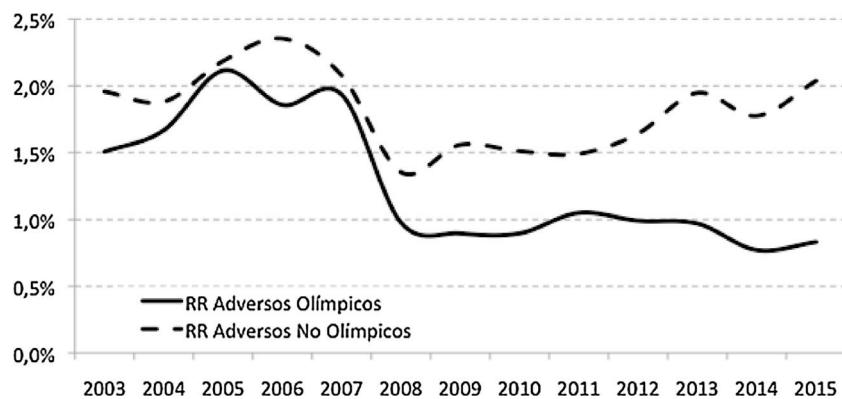
Respecting the stimulants, the reason why ephedra derivatives (ephedrine or pseudoephedrine, etc.) are detected in some controls is described above. However, the detection of cocaine is never justifiable, and it seems to be increasing. The use of some amphetamine derivatives is also increasing. These do not necessarily have anything to do with the treatment of learning disorders, such as dimethylamine, which is found in some sports-supplements. Use of this substance increased most especially from 2011 to 2013, and due to this it is shown in a separate column.³ 2.8% of samples were positive for methylphenidate in 2015, although when reading these results it must be taken into account that it is a therapeutic substance for attention disorder, with or without hyperactivity, and that its use in therapy always requires a TUE.

We therefore definitively consider that the data shown descriptively in this paper will aid updating and comprehension of the state of doping in sports around the world. This work does not aim to justify performing doping tests, as we believe the need for them to be unquestionable, but rather its purpose is to supply readers with a basis for their own decision. For example, if we translate the results of this evaluation into another field such as traffic, in 2015 and excluding the Basque Country and Catalonia there were 26,339,285 drivers in Spain. There were 4,826,246 traffic infractions during the year, i.e., one infraction for every 5 drivers, or 18.3% committed infraction. This datum is actually incorrect, as some subjects committed more than one infraction, as is also the case with doping. To express this in another way, some drivers committed more than one infraction while many others committed none. Although someone may disagree with the control and punishment, it is clear that infractions only fall in number after a punishment was set. This is the case for the points-based driving licence, as since it was introduced the percentages of deaths on city and intercity roads fell until 2016, when the tendency changed again.⁴ There can be no doubt that control is positive, even when it is not liked. This is why, and to return to our own context, it is not enough for clean sportsmen and women to fight to remain clean and give an example, as unfortunately controls must still be used, together with punishment when applicable, to further reduce the number of positive tests and permit clean competition without cheating. Nevertheless, we would be delighted if the percentage of

Table 5 The presence of adverse results (AR) in non-Olympic sports according to association or committee.

Association	Sport	Tested	AR	%	Association	Sport	Tested	AR	%
Others	Electronic DxT	4	1	25.0%					
Others	Weight lifting + WDFPF	81	12	14.8%	AIMS	Cheer	65	2	3.1%
AIMS + Others	Body building	1932	285	14.8%	AIMS + Others	Fistball	35	1	2.9%
Others	Combat DxT	24	2	8.3%	ARISF	Sumo	147	4	2.7%
AIMS	Muaythai	192	14	7.3%	Others	Kabaddi	154	4	2.6%
AIMS	Fishing	70	5	7.1%	ARISF + Others	Dancing + WDC	319	8	2.5%
Others	Rafting	28	2	7.1%	Others	Basque sports	40	1	2.5%
Others	Motoball	14	1	7.1%	Others	Mixed martial arts	484	12	2.5%
Others	Outrigger VA'A	44	3	6.8%	ARISF	Billiards	213	5	2.3%
Others	Arm wrestling	271	18	6.6%	AIMS	Sambo	352	8	2.3%
Others	Hockey	17	1	5.9%	ARISF	Gliding	139	3	2.2%
Others	Kurash (wrestling)	53	3	5.7%	ARISF	Motorcycling	435	9	2.1%
Others	Kung Fu	20	1	5.0%	AIMS	Lacrosse	49	1	2.0%
AIMS	Chinese chequers	20	1	5.0%	ARISF + Others	Karate	1.096	22	2.0%
AIMS	Sledging	20	1	5.0%	ARISF	Mountain skiing	102	2	2.0%
Others	Strongest man	21	1	4.8%	ARISF + Others	Baseball	1.809	35	1.9%
Others	Boxing (prof./mil.)	320	15	4.7%	ARISF	Wushu	397	7	1.8%
Others	Athletics	110	5	4.5%	Others	Football	176	3	1.7%
AIMS	Darts	66	3	4.5%	AIMS + Others	Savate/French boxing	61	1	1.6%
AIMS + Others	Kickboxing	545	23	4.2%	Others	Horse racing	191	3	1.6%
Others	Kettlebell	50	2	4.0%	Others	Volleyball	69	1	1.4%
ARISF	Motor racing	471	18	3.8%	ARISF + Others	Bandy, Ring/k ^a , broomball	283	4	1.4%
ARISF	DxT similar to petanque	163	6	3.7%	ARISF + Others	Chess	72	1	1.4%
ARISF + Others	American football	903	33	3.7%	ARISF	Squash	293	4	1.4%
ARISF	Pelota	138	5	3.6%	ARISF + Others	Surfing	159	2	1.3%
AIMS	Weight lifting	3194	106	3.3%	Others	UK Rugby and diverse	1.621	20	1.2%
Others	Cycling	127	4	3.1%	ARISF	Jet ski	170	2	1.2%
Others	Shooting	32	1	3.1%	ARISF	Tug of war	95	1	1.1%

^a Ring/k: rijette y Rinkball.

**Figure 1** Adverse results (AR) according to Olympic category.

cheats in other areas of life were 1%, 2% or even 5%.
Examples?

Conclusions

There are fewer than 1% of negative results in doping tests in Olympic sports, and somewhat more than 2% in non-Olympic sports.

The group of substances with the highest rate of negative results is the anabolic steroids, followed at a distance by stimulants and masking agents.

An adverse result is not always caused by doping, as it may be result of consuming a substance for which a TUE has been issued and which has to be taken for health reasons. Examples of such substances are terbutaline, insulin or corticoids administered in a prohibited way.

Conflict of interest

The authors have no conflict of interests to declare and have no personal economic interests in this paper.

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