

Racial Bias in FWA Identification and FWA Outcomes

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Section 59 Investigation

Introduction

My initial brief was relatively broad:

assist with the interpretation of the algorithms and data used by the various medical schemes and administrators to identify Fraud, Waste and Abuse (FWA) among medical service providers



Chronology of Actions

- ◆ A review of the initial submissions to the Panel
- ◆ Drafting a request for data from each of the parties
- ◆ Reviewing responses to the data request
- ◆ A draft report on (7 August 2019) on the methodological issues
- ◆ Revised brief:
 - Explicit racial bias in FWA systems
 - Racial bias in the **outcomes** of the FWA processes

Chronology of Actions (ctd)

- ◆ Interviews with the Health Forensics Management Unit (HFMU) of the Board of Healthcare Funders (BHF); and the analytics teams at Medscheme, Discovery Health and GEMS/Metropolitan Health.
- ◆ Data requests for PCNS numbers and PCNS Database
- ◆ Data analysis



Scope of Report

In this presentation I will deal with the two questions set by the Panel

1. *Is there an explicit racial bias in the algorithms and methods used to identify FWA?*
2. *Are the outcomes of the FWA process racially biased? In particular, were Black providers identified as having committed FWA at a higher than expected rate.*



Explicit Racial Bias in FWA systems

- ◆ **No explicit use of racial categories**

There is no evidence that race (or any obvious proxy for race) is used to identify potential cases of FWA by any of the three parties.

- ◆ **Geographic Information**

None of the systems uses any geographic information as part of their analysis.

The answer to the first question is therefore “**NO**”. There is no explicit racial bias in the analytics systems used to identify potential FWA cases.



Methodology: Identifying Racial Bias in Outcomes

In order to determine whether an outcome exhibits racial bias it is necessary to derive race-based data on the participants.

The PCNS database does not contain any information of this sort.

The question is therefore:

Can we construct a meaningful racial classifier using the data at our disposal?



Racial classification using surnames

Is it possible to construct a racial classification of PCNS data using only the surname of the practitioner?

“YES!”

The use of surnames to infer ethnic classification is widely used, and has been so for an extended period of time.

Fiscella and Fremont *“Use of Geocoding and Surname Analysis to Estimate Race and Ethnicity”* Health Service Research, Volume 41(4), August 2006



Racial classification using surnames

“[T]he U.S. Census Bureau has used Spanish surnames to the identify fHispanics for nearly 50 years. Surname analysis has been used to assess mortality, cancer incidence, rates of cancer screening among HMO enrollees, local concentrations of ethnic groups, the ethnic composition of homeowners, and the ethnicity of patients. Marketing and political consulting companies use variations of this technique to identify drace/ethnicity of potential consumers or voters.”

This method has also been used successfully in the USA, UK, Canada and Australia to classify Arabic and South-East Asian sub-populations [see e.g. Shah et al, “Surname lists to identify South Asian and Chinese ethnicity”, BMC Medical Research Methodology, 2010, 10(4)]



Racial classification using surnames

Assessments of Hispanic and Asian ethnicity based on surname analysis have been shown to be reasonably accurate across diverse populations that contain adequate numbers of the ethnic group being assessed. In particular more than 90% of cases identified as Hispanic or Asian actually fall into this category when assessed against self-identification.

In general the method has proved to be reasonably accurate when the sub-populations are relatively homogeneous and have distinct naming conventions. This is certainly the case with respect to at least African, Muslim and Indian groups in South Africa.



Racial classification using surnames

There appear to be no published cases using such methods in South Africa – most likely because the explicit collection of racial-identifiers is still widespread!



Method of Racial Classification of PCNS Data

The method is for a specific purpose rather than for general application, and goes as follows:

- 1 The default classification is “Not Black”. Any case with missing surname information is automatically classified as not-Black.
- 2 Where there is any doubt about about the correct classification the default is “Not Black”
- 3 Construct a database of African, Arabic and Indian names using existing web-based resources (including shipping manifests for Indian indentured labourers sent to South Africa).

Examples of these sources include:

<http://www.wakahina.co.za/>; <https://www.behindthename.com/..zulu>,
<http://zuluculture.co.za/>,
<https://briefly.co.za/...zulu-clan-names-list.html>,
<http://www.sesotho.web.za/names.htm>

Method of Racial Classification of PCNS Data

- 4 This is a completely external list and contains 89,609 names. This would, for our purposes, be the most conservative classification scheme.
- 5 An independent team of 3 researcher assistants reviewed the list of surnames in the PCNS database (consisting of approximately 30,000 unique surnames) and identified clear cases where the surnames referred to African, Arabic or Indian subgroups. This team was only supplied with a list of surnames and no other identifying information.
- 6 This list consisted of 11,332 names. This was added to the external list to provide the Race variable used in the analysis.



Method of Racial Classification of PCNS Data

- 7 The final database contains approximately 98,000 names. This database was then used to classify the PCNS entries as either Black or Not Black.
- 8 Based on a battery of 10 tests on samples of 100 names classified as Black this method falsely classifies names as Black when they are, using strict classification likely not Black, in less than 1% of cases.
- 9 PCNS entries were classified as Black if their name matched any of the names on this master list.
- 10 All conflicts were resolved by setting the value to Not Black.



Random List of Names Classified Black

MOODLEY; RAMNARAIN; SEKHUKHUNE; MDAKA; MAMA; THABETHE;
NICHOLAS; MOEPI; PATHER; MOAGI; MUSEKENE; LEEUW; MTHOMBENI;
NAIDOO; PILLAY; RAMLAUL; PARSHOTAM; DEVCHAND; MATODZI; KANTANI;
NKOATSE; LAKHOO; DESAI; MOOLA; JOSHI; HLANYARE; SAFEDA; NAIDOO;
KAUCHALI; MATSHINGANE; CELE; NSUBUGA; FAKROODEEN; NAVSARIA;
CHETTY; MVAKALI; MADHANPALL; KABANE; NAFTE; MYEZA; SHEIK; MUDELY;
AMOD; WADEE; MOTALA; MOLOI; EBRAHIM; MUTOMBO; REHMAN; RABULA;
CADER; AMUANYENA; MUTSENGA; THUSI; OGUELI; NYANDENI; MOSIKARE;
TSHIPUKE; MOODLEY; GIYAMA; TAU; MASEKO; MAZIBUKO; LEGARI;
DEVCHAND; ZIBI; PHASHA; MASHABA; LATIB; MANABILE; OMAR GANI; KHAN;
MOODLEY; MALESA; LINGANISO; CHUMA; RANCHOD; HARICHAND
SOOKRAJ; MPONGOMA; MSIMANGO; CHETTY; SHEZI; PHAKATHI;
RABOOBEE; BHOOLA; MANAMELA; MOKWELE; ADESANMI; NUKERI;
NAIDOO; MITHI; SEWRAM; SOOMAR; MOOSA; TIMOL; DADOO; MKOSANA;
DLAMINI; THAMANNA; PHOKO



Random List of Names Classified Black

GOVENDER; BALOYI; ISMAIL SEEDAT; LILA; KEKANA; KHUMALO; CHORN;
MANGENA; MARUMO; RAMATLO; NAIDOO; MODEBEDI; BHIKHA; TSHWAKU;
DUBA; MUNISAMY; MUYANGA; RAMDASS; PARBHOO; RAJAH; BEJA; CASSIM;
MAHLASE; CHETTY; JOSHUA; AMAFU-DEY; MWANGA; MAHOMET; BHIKOO;
PITSO; KUNENE; MAHOMED; NAIDOO; MARIVATE; KARIM; BENGIS;
RIKHOTSO; MALAPANE; MAFOLE; RAMAKGOAKGOA; SELEPE; MUDHOO;
SIMELANE; MBUYANE; MACHABA; MAFONGOSI; MAKINTA; MASOKO; JALI;
MKHIZE; MATHYE; CHHIBA; NGUBANE; SELEKA; MOKOENA; BALBADHUR;
MNTUNGWANA; CASSIMJEE; MALOPE; SONI; NZAMA; MHLUNGU;
NARISMULU; NTULI; MOKGALAOTSE; SECHUDI; NTAMEHLO; KHOABANE;
GAIBIE; MASANGO; HASSAN; GOVENDER; OMAR; THAKUR; BRIJLALL;
SIBIYA; MODISANE; GAMA; DIAB; XABA; ESSOP; NONGOGO; MOYIKWA;
NXUMALO; KANDASAMY; PUTTER; MOFOKENG; MOHAMED ALLY; PILLAY;
MOREMEDI; NTUNUKA; CHIBA; PERUMAL; NDLOVU; MWANZA; HOPE;
MODISELLE; RAMETSE; KHOMONGOE



Potential Pitfalls

- ◆ Differential vs Non-Differential mis-classification.
- ◆ Smith and Jones; Mokoena and Mofokeng
- ◆ No contamination of classification procedure with FWA data sets



List of Names Classified Black

- ◆ We now have, I believe, a good proxy for race which we can apply to the data provided by Discovery Health, GEMS and Medscheme.
- ◆ The complete list of names used in the classification scheme will be made available for inspection and use, if required.



Statistical References

- ◆ **Agresti, A.**
2002. Categorical Data Analysis. 2nd ed.
- ◆ **Rothman, K and Greenland, S.**
1998. Modern Epidemiology, 2nd ed.



Combined Data, 2012 - June 2019

- ◆ Data from Discovery Health, GEMS and Medscheme for 2012 to June 2019
- ◆ 65,280 unique providers (as measured by PCNS numbers) paid by these parties
- ◆ 16,453 providers (25.2% of total) identified as FWA cases by at least one party in at least one year during this period
- ◆ 19,903 (30.4% of all providers) are Black



Race and FWA outcomes, 2012 - June 2019, All Data

	FWA	Not FWA	Total
Black	6,314	13,589	19,903
Not Black	10,139	35,238	45,377
Total	16,453	48,827	65,280

- ◆ **Black/Not Black**
Independent variable
- ◆ **FWA/Not FWA**
Dependent variable



Race and FWA outcomes, 2012 - June 2019, All Data

	FWA	Not FWA	Total
Black	6,314	13,589	19,903
Not Black	10,139	35,238	45,377
Total	16,453	48,827	65,280

◆ Risk Rate (Black)

$$6314/19903 = 0.317 = 31.7\%$$

The risk that, over the 7.5 years, a Black provider is identified as a FWA case



Race and FWA outcomes, 2012 - June 2019, All Data

	FWA	Not FWA	Total
Black	6,314	13,589	19,903
Not Black	10,139	35,238	45,377
Total	16,453	48,827	65,280

◆ **Risk Rate (Black)**

$$6314/19903 = 0.317 = 31.7\%$$

◆ **Risk Rate (Not Black)**

$$10139/45377 = 0.223 = 22.3\%$$

◆ **Risk Rate (Population)**

$$16453/65280 = 0.252 = 25.2\%$$



Race and FWA outcomes, 2012 - June 2019, All Data

	FWA	Not FWA	Total
Black	6,314	13,589	19,903
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Total	16,453	48,827	65,280

- ◆ **Risk Ratio**

Compare risk rate for
Black vs Not Black

- ◆ Divide the risk for Black by the
risk for Not Black

- ◆ Risk Ratio

$$31.7/22.3 = \mathbf{1.42}$$



Race and FWA outcomes, 2012 - June 2019, All Data

	FWA	Not FWA	Total
Black	6,314	13,589	19,903
Row %	31.7	68.3	100.0
Not Black	10,139	35,238	45,377
Row %	22.3	77.7	100.0
Total	16,453	48,827	65,280
Row %	25.2	74.8	100.0

◆ **Risk Ratio = 1.42**

Black providers are **1.42** times more likely to be identified as an FWA case than Not Black providers.

Race and FWA outcomes, 2012 - June 2019, All Data

	FWA	Not FWA	Total
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Row %	25.2	74.8	100.0

◆ χ^2 P-value

A measure of the probability that this table, or a table more extreme, will occur by chance under the assumption that our racial classification is not related to FWA status

Risk Ratio = 1.42

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◆ **P-value**
p-value = 2e-142

Risk Ratio = 1.42



Short Diversion: P-values

- ◆ Badly understood (even by practitioners)
- ◆ Badly taught (the ubiquitous use of $P < 0.05$)
- ◆ *“The smaller the p-value, the greater the statistical incompatibility of the data with the null hypothesis, if the underlying assumptions used to calculate the p-value hold. This incompatibility can be interpreted as casting doubt on or providing evidence against the null hypothesis or the underlying assumptions.”*

The American Statistical Association Statement on p-Values,
The American Statistician, 70:2, 2016



Short Diversion: Improbability

Some sense of really large numbers

8e10 Number of stars in the Milky Way

1e13 Approximate diameter (in meters) of the Solar System

4e17 Estimated age (in seconds) of the universe

7e22 Estimate of the number of stars in the observable universe

1e80 Estimate of the total number of fundamental particles in the observable universe



When is a result meaningful?

Meaningful \neq Statistically Significant

In this context we will judge whether a result is meaningful based on the evidence as presented by three numbers:

1. The base risk rate for the population

Is the risk worth worrying about?

2. The risk ratio

Is the increase in risk worth worrying about?

3. The p-value

How unlikely are the observed results under the Null Hypothesis?



Race and FWA outcomes, 2012 - June 2019, All Data

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Total	16,453	48,827	65,280
Row %	25.2	74.8	100.0

- ◆ Base Risk: 25.2%
- ◆ Risk Ratio: 1.42
- ◆ P-value: 2e-142



Race and FWA outcomes, 2012 - June 2019, All Data

	FWA	Not FWA	Total
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Total	16,453	48,827	65,280
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- ◆ Base Risk: 25.2%
- ◆ Risk Ratio: 1.42
- ◆ P-value: 2e-142

Finding:

There is very strong evidence that a racial bias exists with respect to FWA outcomes. Black providers are 40% more likely to be identified as FWA cases than their Not Black counterparts.

Race and FWA outcomes, 2012 - June 2019, All Data

	FWA	Not FWA	Total
Black	6,314	13,589	19,903
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Total	16,453	48,827	65,280

- ◆ Base Risk: 25.2%
- ◆ Risk Ratio: 1.42
- ◆ P-value: 2e-142

Alternative Measure of Effect:

Either as a replacement for, or in combination with, the Risk Ratio

Estimate the **increased number** of Black FWA cases that are a result of the racial bias.

Over the 7.5 years, approximately **1,300** additional Black FWA cases have occurred.

Race and FWA outcomes, 2012 - June 2019, All Data

One additional finding:

- ◆ There are 618 providers that have been identified by all three parties (i.e. Discovery Health, GEMS and Medscheme). Black practices were **400%** (a risk ratio of 4, p-value = $8e-71$) more likely to be in this group (i.e. be identified by all three parties) than their Not Black counterparts.

Caveats and Questions

1. What do I mean when I say there is a racial bias?
2. Are these results an artifact of the racial classification scheme?
3. Can these results be reproduced/verified?



Racial Bias?

What does it mean when we have evidence of racial bias?

1. That this bias is meaningful with respect to the racial assignment scheme.
2. That the racial bias represents a **correlation** between our race classifier and FWA status. No claim is made about causality. It may be that the relationship is clarified by some intermediate confounding variable, and that the causal relationship is between that variable and the outcome.
3. We can only infer that this bias (as measured by our set of indicators) exists with respect to actual racial classification by assessing the robustness of the result with respect to the racial classification scheme.



How robust is this result?

There are two ways in which we can test how much the result will vary based on our racial classification scheme:

Firstly, we can revert to the more restrictive racial classification produced only by reference to external lists of Black names (i.e. the classification is completely independent of the PCNS data). The results are as follows:

Risk Ratio = 1.38; P-value = 2e-83; Population risk = 25%.

There is only a marginal difference in the risk ratio so the result will hold even if a more restricted racial classification method is used.

How robust is this result?

The **second** method would involve testing what the effect would be of classification errors in our method. We can do this, for example, by randomly classifying 5% of the Black providers as not Black, and simultaneously classifying 5% of the not Black providers as Black. If we do this several thousand times we find that the average risk ratio is **1.36**, with an average p-value of **2e-101**.

An even larger perturbation of the classification (15% of Black to not Black, and 15% not Black to Black) still results in an average risk ratio of **1.26** with a p-value of **3e-56**.

It is therefore unlikely that the main result is due to measurement or classification error.

Can the results be reproduced?

- ◆ Baking analogy – we will supply the detailed recipe and most of the ingredients
- ◆ There are some choices that have to be made, and these will introduce some variation
- ◆ I believe that, even with these variations, we will end up with a very similar product



Race and FWA outcomes, per year, All Data

	2012	2013	2014	2015	2016	2017	2018	2019*
No. Providers	39,650	38,730	40,605	42,266	43,311	44,714	46,259	45,619
Black	10,895	10,635	11,420	12,150	12,818	13,702	14,563	14,646
No. FWA Cases	2,756	3,180	3,282	3,081	3,173	3,472	3,932	2,299
Black	872	1,086	1,164	1,195	1,308	1,548	1,559	792
Risk Rate (per year)	7.0	8.2	8.1	7.3	7.3	7.8	8.5	5.0
Black	8.0	10.2	10.2	9.8	10.2	11.3	10.7	5.4
Not Black	6.6	7.5	7.3	6.3	6.1	6.2	7.5	4.9
Risk Ratio	1.22	1.37	1.4	1.57	1.67	1.82	1.43	1.11
p-value	1e-06	4e-18	7e-22	1e-36	3e-49	2e-75	5e-30	0.04

Race and FWA outcomes, by year, 2012-2019. Combined data.

P-values adjusted for multiple tests.



Race & FWA, By Discipline, 2012-June 2019, All Data

	Providers			Risk			RR	p-value
	N	FWA	Black	All	Black	Not Black		
GP	13,289	3,649	5,929	27.5	34.6	21.7	1.6	2e-60
Pharmacy	4,476	2,308	604	51.6	44.0	52.7	0.84	0.0003
Optometrist	3,860	912	1,483	23.6	28.7	20.5	1.4	4e-08
Physiotherapist	4,474	845	1,069	18.9	31.9	14.8	2.16	2e-34
Dentist	3,982	811	1,517	20.4	20.4	20.4	1.0	1
Independent Specialist	1,436	609	529	42.4	46.5	40.0	1.16	0.07
Psychologist	5,391	629	1,091	11.7	26.1	8.0	3.27	2e-60
Anesthetist	1,473	473	312	32.1	31.1	32.4	0.96	1
Obstetrics	1,110	457	443	41.2	50.6	34.9	1.45	1e-06
Social Worker	1,552	305	742	19.7	33.0	7.4	4.46	2e-35
Registered Counsellor	857	241	327	28.1	48.6	15.5	3.14	1e-24
Dietician	1,684	228	574	13.5	26.3	6.9	3.79	6e-27



Racial Bias by Administrator

- ◆ The total number of providers is specific to each Administrator, and consists of all providers who have serviced members of the scheme or schemes falling under the administrator in the period 2012 to June 2019.
- ◆ The number of FWA cases for each Administrator is a count of all providers who have been identified FWA cases by that Administrator over the period 2012 to June 2019. If a provider appears more than once in this period (for example if they appear in two separate years) they will count as 1 case.



FWA & Race, by Administrator, 2012 - June 2019

	Providers			Risk			RR	p-value
	N	FWA	Black	All	Black	Not Black		
Discovery Health	57,718		17,251				1.35	7e-85
GEMS	55,718		18,327				1.80	8e-90
Medscheme	56,064		17,819				3.31	3e-205

The FWA outcomes for each of the Administrators exhibits clear racial bias, with Black providers significantly more likely to be identified as FWA cases.



Race and FWA outcomes, by Administrator and Year

	2012	2013	2014	2015	2016	2017	2018	2019*
Discovery Health								
Providers (N)	35,010	36,073	37,007	38,191	39,691	40,880	41,925	40,862
Black Providers (N)	9,127	9,561	10,058	10,606	11,385	12,095	12,649	12,402
Risk Ratio	1.09	1.12	1.25	1.38	1.36	1.61	1.21	0.911
p-value	0.06	0.02	1e-07	9e-15	6e-13	9e-37	6e-07	0.07
GEMS								
Providers (N)	15,550	26,925	35,081	36,557	37,060	37,860	38,624	38,651
Black Providers (N)	5,513	8,672	10,765	11,374	11,954	12,575	13,161	13,495
Risk Ratio	1.37	1.5	1.85	2.25	2.41	2.49	1.98	1.98
p-value	0.0004	3e-12	2e-20	5e-28	4e-34	4e-22	4e-14	0.0008
Medscheme								
Providers (N)	35,662	35,655	36,390	37,471	38,702	48,382	41,684	39,200
Black Providers (N)	10,184	10,181	10,601	11,255	11,897	16,601	13,619	13,047
Risk Ratio					4.4	3.93	2.92	3.08
p-value					8e-49	2e-70	9e-51	4e-24



Conclusions

- 1 There is no evidence of explicit racial profiling in the design or implementation of systems used to identify potential FWA cases by Discovery Health, GEMS or Medscheme.
- 2 There is clear and strong evidence of racial bias with respect to the outcomes of FWA processes as implemented by Discovery Health, GEMS and Medscheme.
- 3 This bias is not restricted to only a limited time period, nor is it located within only particular disciplines. The bias may vary in scale across these factors, but it is widespread and consistent.
- 4 I have carefully examined the assumptions that underpin these findings and I am convinced that the results are robust, i.e. that similar findings will result from the use of any reasonable classification schema.

End

Thank You

