Choice of Bearing Surface for Total Hip Replacement Affects Need for Repeat Surgery: A Canadian Perspective

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CAHSPR Conference 2014, Toronto, Ontario

20 YEARS • ANS 1994 • 2014

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Authors and Disclosures

- No disclosures

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Study Background

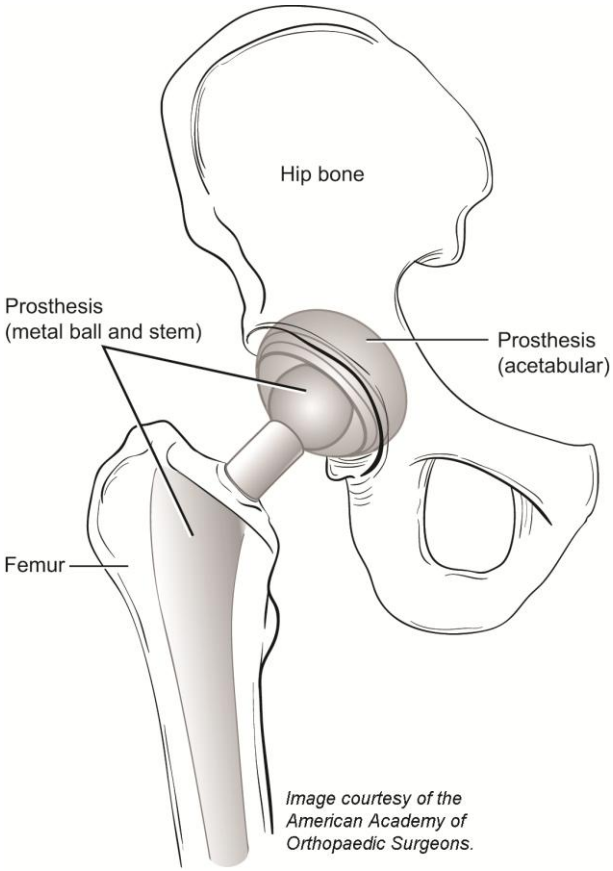
- In 2012-2013, there were 47,137 acute care hospitalizations in Canada for all hip replacements (5-year increase: 16.5%). Of these, 9.4% were revision procedures, which has remained stable over the years.
- Joint revision surgeries are more complex than primary procedures and place a heavier burden on the health care system.
- Hospital-related expenditure estimates: $12,802 for typical hip revision compared to $8,855 for a primary unilateral THA.*

* Based on CIHI's Patient Cost Estimator. Excludes other expenditures such as physician payments and rehabilitation.

Clinical Introduction

- A THA involves replacing the diseased or damaged hip joint with an artificial joint.
- The femoral head and the acetabular liner (and/or cup) make up the two articulating surfaces of the joint implant (bearing surfaces).
- Bearing surfaces can be made of a variety of materials: metal, ceramic and polyethylene (plastic).
- Surgeons carefully choose the types of bearing surface, considering: patient age, sex and level of physical activity, as well as previous clinical experience.

Example: metal ball/stem



Bearing Surface Types

- Many published studies have found associations between THA bearing surface and increased risk of revision:
  - Breakdown of polyetheylene acetabular cup leading to the loosening of the implant.
  - Metallic orthopedic implants generating metal debris from wear and corrosion over time, detectable in the blood, tissue and urine.
- Other international registries (Australia, England and Wales) have conducted similar analyses.
- Both the US FDA and Health Canada have also provided alerts regarding the safety of metal-on-metal hip replacements, leading to increased public awareness.

Study Methodology

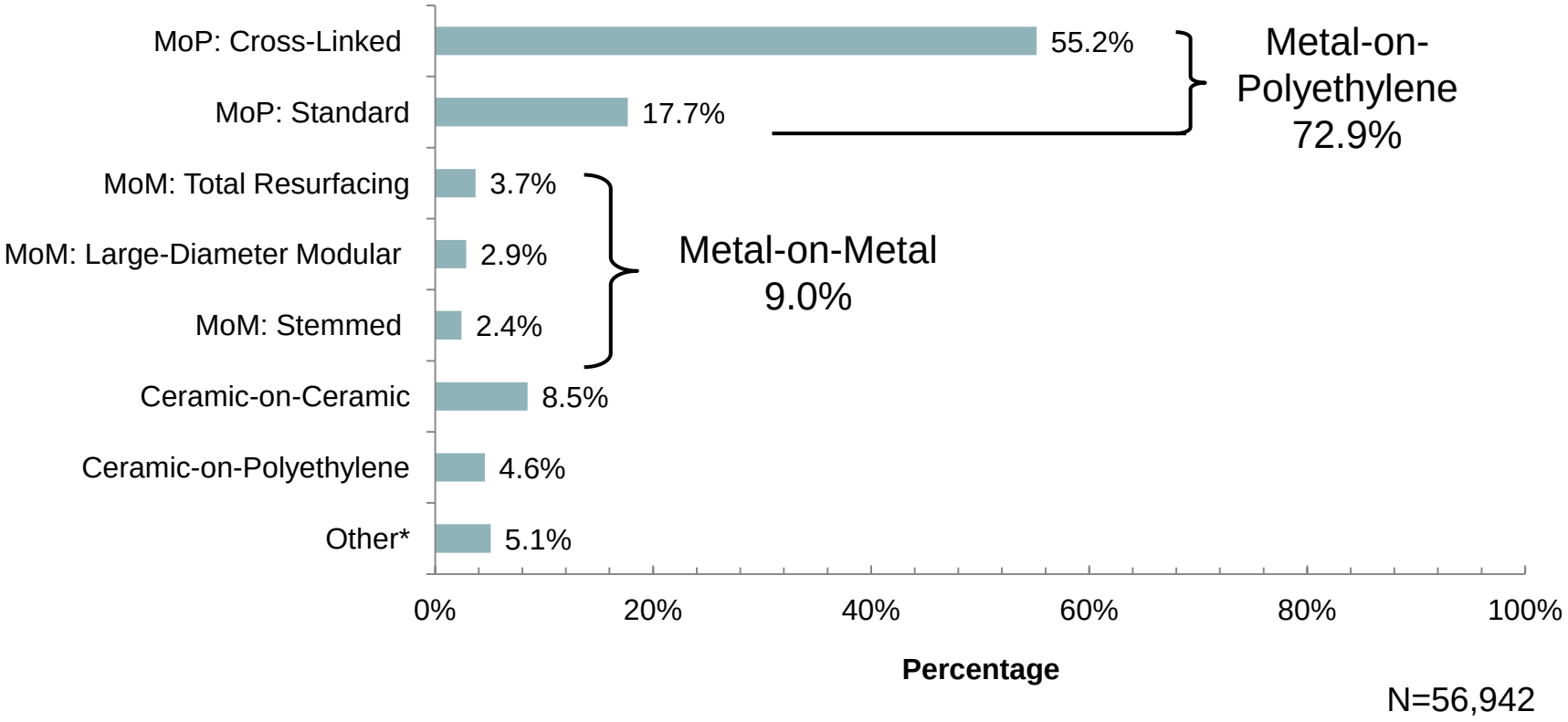
- Data sources:
  - Canadian Joint Replacement Registry (CJRR), CIHI
    - Pan-Canadian database that collects data on hip and knee replacement procedures performed across the country. CJRR coverage during study period ranged from 37% to 41%, excluding Quebec.
    - Used to identify primary study cohort and bearing surface material used.
  - Discharge Abstract Database (DAD), CIHI
    - Captures administrative, clinical and demographic information on hospital discharges. Select jurisdictions also use the DAD to capture day surgery.
    - Used to identify revision surgeries among study cohort.
- THA primary cohort linked to DAD to identify any revision surgeries within five years of the primary surgery.
- Covariates: patient sex, age group, bearing surface, procedure year, geographic region and presence of comorbidities at time of primary procedure.

Results – THA Study Cohort

- Cohort: 56,942 primary THAs performed across Canada* between 2003–2004 and 2010–2011.
- Cohort attributes:
  - Most common type of bearing surface material used was metal-on-polyethylene (73%).
  - Metal-on-metal hip replacements (total resurfacing, large-diameter modular or stemmed) made up 9% of all THAs.
  - Patients receiving metal-on-metal THAs were more likely to be younger and male.

* Study did not include procedures from Northwest Territories, Nunavut, Prince Edward Island and Quebec.

Figure 1: Distribution of Bearing Surface Group, THA, 2003–2004 to 2010–2011



Notes:

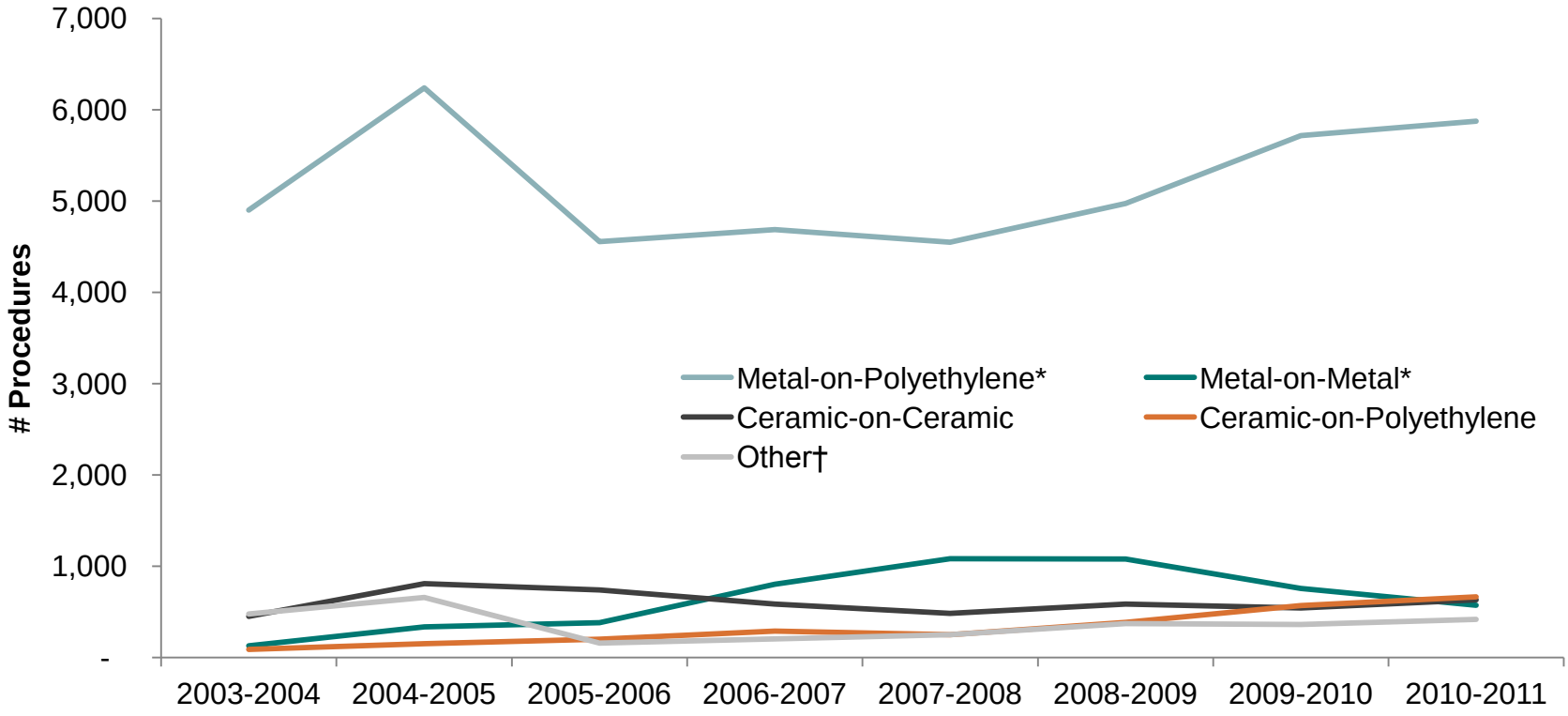
* Other includes bearing surfaces that were reported as “other”, as well as materials each reported <5% (e.g. ceramic-on-metal and metal-on-ceramic).

MoP: metal-on-polyethylene; MoM: metal-on-metal

Sources:

Canadian Joint Replacement Registry and Discharge Abstract Database, 2003–2004 to 2010–2011, CIHI

Figure 2: Distribution of Bearing Surface Group Over Time, THA, 2003–2004 to 2010–2011



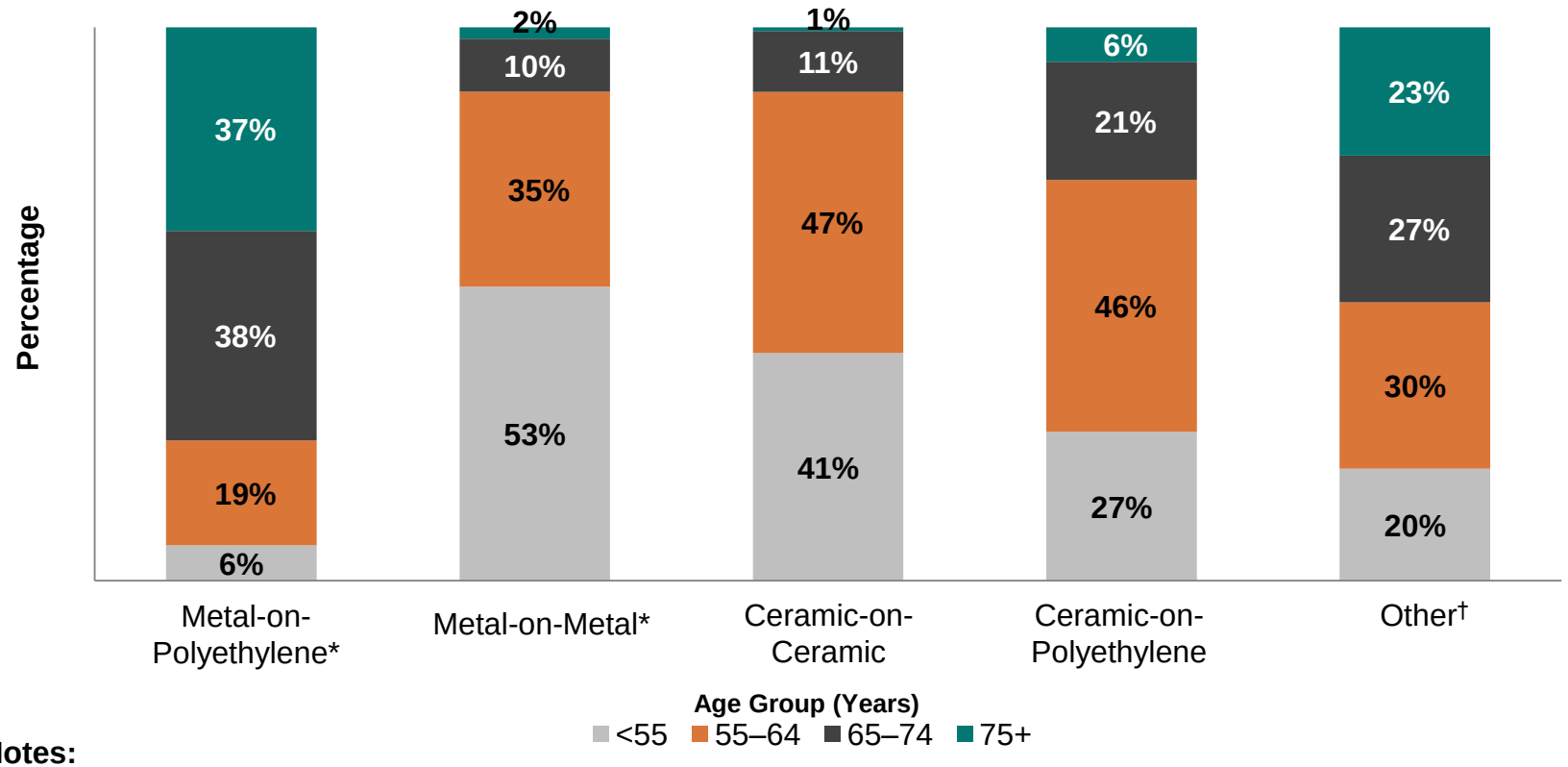
Notes:

* Metal-on-metal include: total resurfacing, large-diameter modular and stemmed subgroups. Metal-on-polyethylene include: standard and cross-linked polyethylene subgroups.

† Other includes bearing surfaces that were reported as “other”, as well as materials each reported <5% (e.g. ceramic-on-metal and metal-on-ceramic).

Sources: Canadian Joint Replacement Registry and Discharge Abstract Database, 2003–2004 to 2010–2011, CIHI

Figure 3: Distribution of Bearing Surface Group by THA Patient Age Group, 2003–2004 to 2010–2011



Notes:

* Metal-on-metal include: total resurfacing, large-diameter modular and stemmed subgroups. Metal-on-polyethylene include: standard and cross-linked polyethylene subgroups.

† Other includes bearing surfaces that were reported as "other", as well as smaller groups (for example, ceramic-on-metal and metal-on-ceramic).

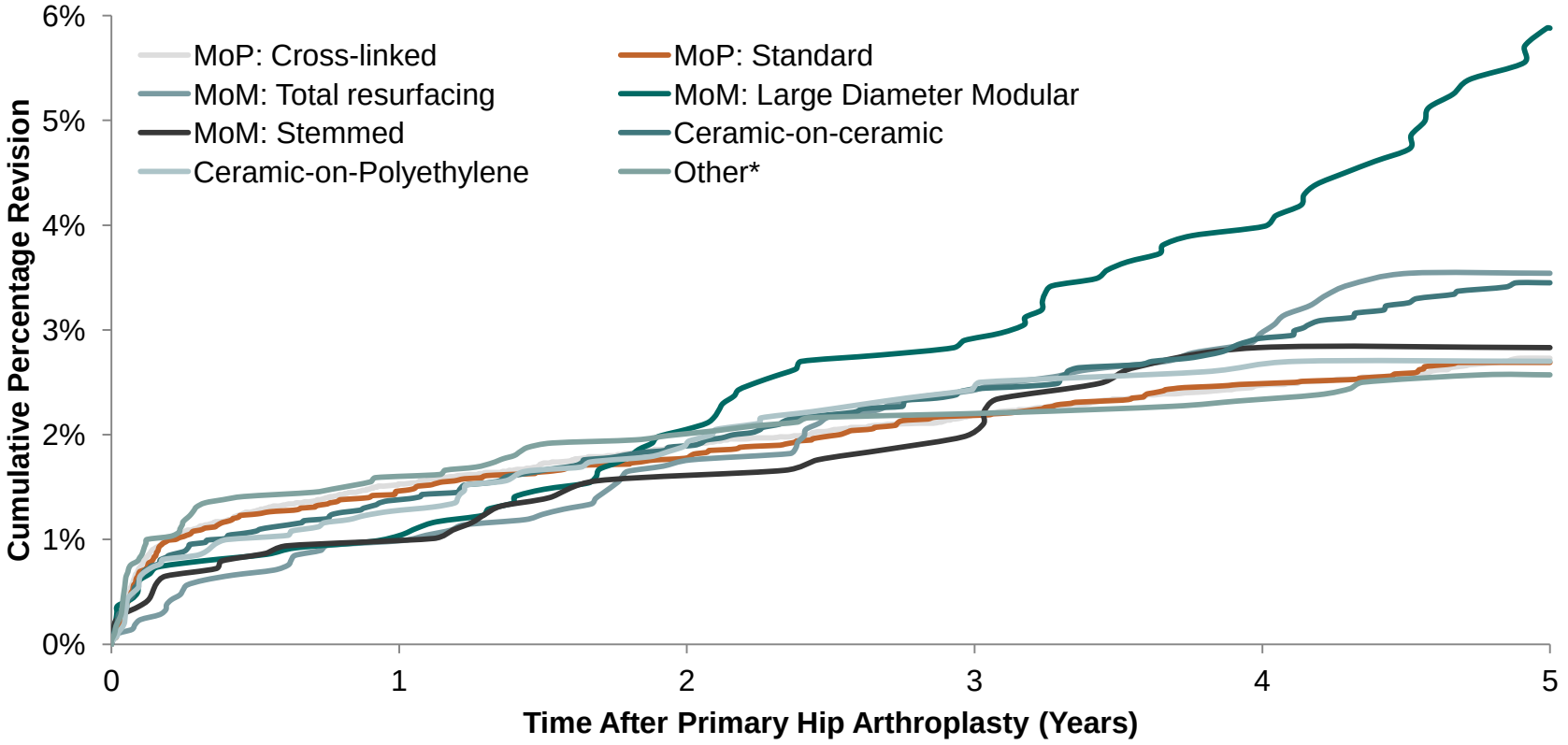
Excludes 12 cases of unknown patient age.

Sources: Canadian Joint Replacement Registry and Discharge Abstract Database, 2003–2004 to 2010–2011, CIHI

Results – Early Revisions (Within 5 Years)

- A total of 1,438 first-revision procedures were identified.
- In the years following primary THA, most bearing surfaces had similar cumulative revision rates up until the two-year mark, after which a distinct pattern emerged.
- By the five-year mark, large-diameter metal-on-metal THA had the highest cumulative percentage revision among all groups (5.9%).
- Revisions within one year: primarily issues not related to the mechanics of the implant but rather to medical complications (such as infection, traumatic injury and arthrosis).

Figure 4: Cumulative Percentage Revision by Bearing Surface Group



Notes:

* Other includes bearing surfaces that were reported as “other”, as well as smaller groups (for example, ceramic-on-metal and metal-on-ceramic).

MoP: metal-on-polyethylene

MoM: metal-on-metal

Sources: Canadian Joint Replacement Registry and Discharge Abstract Database, 2003–2004 to 2010–2011, CIHI

Results – Factors Affecting Risk of Revision

- Factors showing a significantly increased risk ($p<0.05$), after adjustment:
  - Patients under age 55 had a 1.22 times increased risk compared to those age 65–74.
  - Large-diameter modular metal-on-metal THA had a 1.61 times increased risk compared to metal-on-cross-linked-polyethylene THA.
  - Procedures from Eastern Canada had a 1.35 times increased risk compared to those from Central Canada.
  - Patients with at least one comorbid condition had a 1.47 times increased risk compared to those with none.

Table 1: Cox Proportional Hazards Model for Revision within Five Years After Total Hip Arthroplasty

Risk Factor	Hazard Ratio	95% Confidence Interval	p-value
Age Group [reference: 65–74]			
< 55	1.22	1.02 – 1.45	0.03*
55–64	1.09	0.94 – 1.27	0.24
75 +	1.03	0.90 – 1.18	0.67
Bearing Surface Group [reference: MoP Cross-Linked]			
MoP: Standard	1.02	0.88 – 1.19	0.79
MoM: Total Resurfacing	1.02	0.76 – 1.35	0.89
MoM: Large-Diameter Modular	1.61	1.23 – 2.07	< 0.01*
MoM: Stemmed	0.89	0.61 – 1.27	0.55
Ceramic-on-Ceramic	1.05	0.86 – 1.29	0.61
Ceramic-on-Polyethylene	0.96	0.72 – 1.25	0.74
Other‡	0.95	0.74 – 1.22	0.74

Table 1: Cox Proportional Hazards Model for Revision within Five Years After Total Hip Arthroplasty (cont'd)

Risk Factor	Hazard Ratio	95% Confidence Interval	p-value
Geographic Region§ [Reference: Central (Man. Ont.)]			
Eastern (N.B., N.S., N.L.)	1.35	1.16 – 1.58	< 0.01*
Northern and Western (B.C., Alta., Sask., N.W.T.)	1.02	0.90 – 1.15	0.8
Charlson Comorbidity Index Value [Reference: 0]			
> 0	1.47	1.11 – 1.91	< 0.01*

Notes:
Excerpt of table. Only risk factors that were found to be statistically significant were included in this table.
* Statistically significant at $p < 0.05$.
‡ Other includes bearing surfaces that were reported as "other", as well as smaller groups (for example, ceramic-on-metal and metal-on-ceramic).
§ Jurisdictions were combined into regional centres as follows: Western and Northern: British Columbia, Alberta, Saskatchewan and the Northwest Territories; Central: Manitoba and Ontario; Eastern: New Brunswick, Nova Scotia and Newfoundland and Labrador. This study does not include data from Quebec, Prince Edward Island, Yukon and Nunavut.
MoP: metal-on-polyethylene
MoM: metal-on-metal

Sources:
Canadian Joint Replacement Registry and Discharge Abstract Database, 2003–2004 to 2010–2011, CIHI

Conclusions

- Increased risk of revision for large-diameter metal-on-metal THAs and patients younger than 55.
  - Consistent with studies that have shown that the increased femoral head size in metal-on-metal implants may affect circulating metal ion levels.
  - May also suggest higher activity levels after primary procedure may contribute to early revision.
- Overall, findings from this study were consistent with those found in literature and by other international registries
- Largest study of its kind in Canada.
- Studies of implant attributes and other factors influencing revision rates important to reduce burden in health care system

Challenges Ahead

- Currently, lack of industry standardization in implant product labelling and barcoding
  - Difficult to accurately and systematically capture medical device product data
  - CJRR currently building product library and initiating work with stakeholders (manufacturers, GS1 Canada) to move towards more standardized labelling and product data capture.
- CJRR is the only national data source associating implant product with patient record.
  - Mandated in BC, MB, and ON (74% coverage nationally) but still voluntary in most regions
  - With increasing participation, more studies can be conducted to help improve the outcomes of hip and knee replacement patients

Thank you!

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