Appendices (as supplied by the author)

Appendix 4. Basic description of shortages

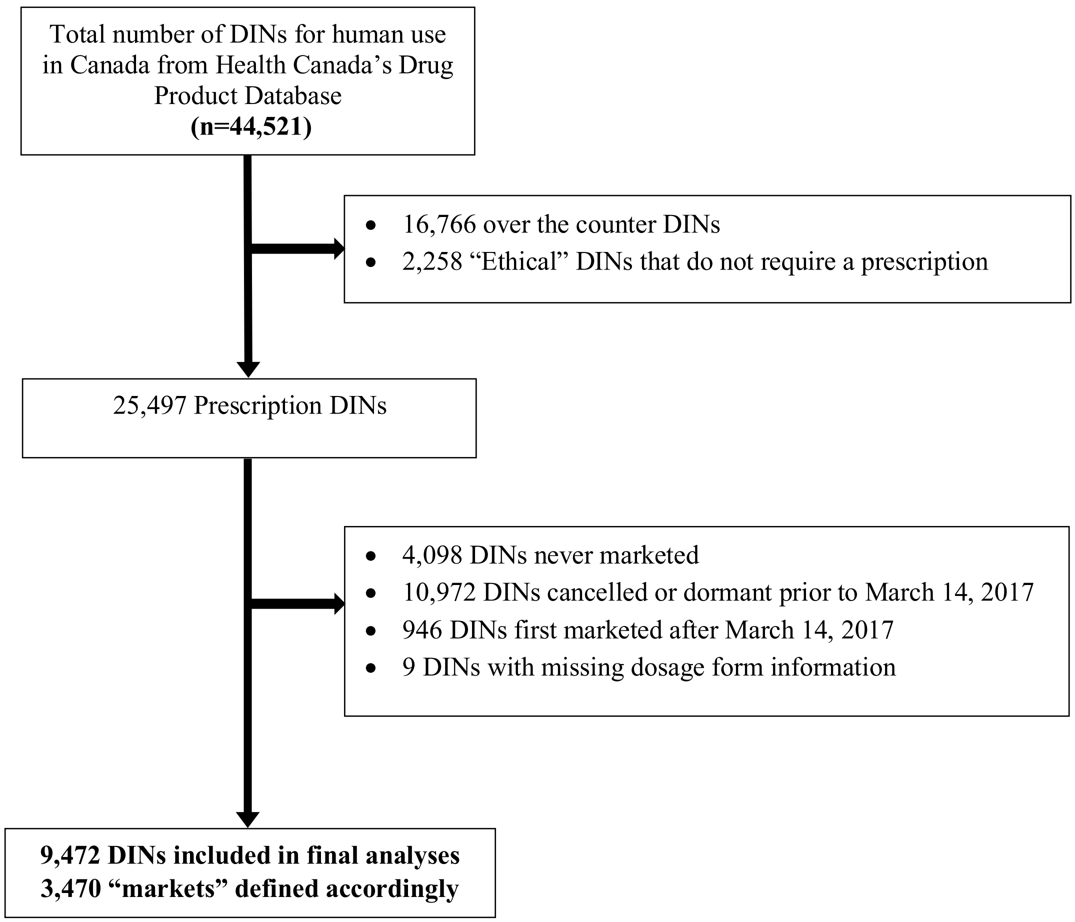
Our analysis consisted of 3,470 markets (9,472 DINs including 2,322 branded DINs, 6,527 generic DINs and 623 biologic DINs) (flow diagram in Supplementary Figure 1). These DINs were prescription DINs that have been actively marketed prior to March 14, 2017 and have non-missing information on dosage form in Canada. About 13.3% markets (n=462) were reported in shortage and their average number of days in shortage was 136.6 (standard deviation (SD): 149.2) during our study period (Supplementary Table 1). Markets with a single generic manufacturer (n=124, 27.35), “other complex route/form” (n=120, 22.3%) and “oral non-solid” (n=44, 23.3%), or for sensory organs (n=47, 34.1%) had a higher probability of being in shortage.

Among all 9,472 DINs, 2,212 (23.4%) DINs were reported in shortage and their average number of days in shortage was 155.3 (SD: 146.2). Generic DINs had a higher probability of being in shortage and longer shortage duration than branded DINs (n=1,730 (26.5%) vs. 426 (18.3%) in shortage ($p<0.01$) and 167.6 (SD: 149.1) vs. 99.9 (SD: 111.7) days ($p<0.01$), Supplementary Table 1). DINs in markets with branded manufacturers and a single manufacturer (34.1% for generic DINs and 27.2% for branded DINs), with “other complex route/form” (35.6% and 25.1%), older age (28.6% and 20.2%), large manufacturers (27.7% and 22.6%), and for sensory organs (45.3% and 37.2%) had a higher probability of being in shortage.

DOI:10.9778/cmajo.20200036.

Supplementary Figure 1. Flow diagram of final study market and drug selection

DIN: drug identification number; “Ethical” products are those that do not require a prescription but are generally prescribed by medical practitioner for unscheduled professional use (e.g., hemodialysis solution) and emergency use (e.g., nitroglycerine)[4]; A “market” is a group of DINs with the same active ingredients, dosage form, route of administration and strength.



DOI:10.9778/cmajo.20200036.

Supplementary Table 1. Markets and DINs in shortage and shortage duration

Variable	Markets			Branded DINs			Generic DINs		
	Total N	Markets in Shortage N (%)	Shortage Duration* Mean Days (SD)	Total N	DINs in Shortage	Shortage Duration* Mean Days (SD)	Total N	DINs in Shortage	Shortage Duration* Mean Days (SD)
All	3470	462 (13.3%)	136.6 (149.2)	2322	426 (18.3%)	99.9 (111.7)	6527	1730 (26.5%)	167.6 (149.1)
Market structure									
B/G Single	208	31 (14.9%)	134.5 (131.2)	235	64 (27.2%)	120.4 (124.7)	214	73 (34.1%)	163.2 (160.9)
B/G Multiple	620	13 (2.1%)	126.5 (142.3)	681	131 (19.2%)	100.0 (109.9)	4423	1169 (26.4%)	162.5 (144.9)
G single	454	124 (27.3%)	187.2 (169.2)				464	127 (27.4%)	188.2 (169.3)
G multiple	387	36 (9.3%)	130.0 (158.1)				1426	361 (25.3%)	177.9 (152.2)
BIO	484	49 (10.1%)	192.1 (184.6)						
B only	1317	209 (15.9%)	95.6 (112.7)	1406	231 (16.4%)	94.1 (108.7)			
Route form									
Injection	991	119 (12.0%)	168.5 (170.3)	323	59 (18.3%)	105.3 (108.1)	640	151 (23.6%)	181.8 (163.1)
Oral non-solid	189	44 (23.3%)	159.4 (170.8)	123	23 (18.7%)	108.6 (123.2)	134	40 (29.9%)	188.4 (164.7)
Oral solid regular release	1513	154 (10.2%)	132.6 (149.8)	1195	198 (16.6%)	104.3 (119.2)	4789	1239 (25.9%)	165.3 (145.7)
Oral solid special release	238	25 (10.5%)	84.0 (108.8)	254	39 (15.4%)	75.2 (108.3)	526	144 (27.4%)	179.6 (160.0)
Other	539	120 (22.3%)	112.5 (115.1)	427	107 (25.1%)	95.8 (97.9)	438	156 (35.6%)	156.0 (147.4)
Essential medicine									
No	2981	388 (13.0%)	136.5 (149.0)	1945	361 (18.6%)	103.3 (114.7)	4923	1277 (25.9%)	167.5 (149.6)
Yes	489	74 (15.1%)	137.2 (151.1)	377	65 (17.2%)	80.9 (91.5)	1604	453 (28.2%)	167.9 (147.9)
On formulary [a]									
No	878	107 (12.2%)	153.6 (168.0)	512	83 (16.2%)	116.8 (131.7)	1171	222 (19.0%)	154.8 (142.6)
Yes	2592	355 (13.7%)	131.5 (142.9)	1810	343 (19.0%)	95.8 (106.1)	5356	1508 (28.2%)	169.5 (150.0)
DIN Age									
<3 years				250	8 (3.2%)	102.4 (105.7)	1154	193 (16.7%)	183.1 (153.7)
≥3 years				2072	418 (20.2%)	99.8 (111.9)	5373	1537 (28.6%)	165.7 (148.5)
Top 50 manufacturers [b]									
No				520	85 (16.3%)	119.2 (105.8)	1942	358 (18.4%)	173.7 (149.1)
Yes				1802	341 (18.9%)	95.1 (112.8)	4585	1372 (29.9%)	166.1 (149.2)
Manufacturer size [c]									
Small				731	78 (10.7%)	115.8 (111.3)	322	43 (13.4%)	189.6 (186.8)
Medium				682	143 (21.0%)	112.4 (128.3)	636	146 (23.0%)	135.6 (119.5)
Large				909	205 (22.6%)	85.0 (97.1)	5569	1541 (27.7%)	170.1 (150.2)

Variable	Markets			Branded DINs			Generic DINs		
	Total N	Markets in Shortage N (%)	Shortage Duration* Mean Days (SD)	Total N	DINs in Shortage	Shortage Duration* Mean Days (SD)	Total N	DINs in Shortage	Shortage Duration* Mean Days (SD)
Interaction of manufacturer size and top 50 manufacturer									
large, top50=No							1096	201 (18.3%)	191.9 (155.0)
large, top50=Yes							4473	1340 (30.0%)	166.8 (149.3)
medium, top50=No							525	114 (21.7%)	135.6 (112.3)
medium, top50=Yes							111	32 (28.8%)	135.4 (144.2)
Small							322	43 (13.4%)	189.6 (186.8)
Manufacturer type [d]									
Generic				42	9 (21.4%)	139.0 (82.8)	6080	1620 (26.6%)	169.1 (149.0)
Mixed				509	134 (26.3%)	97.7 (110.1)	437	108 (24.7%)	148.1 (150.4)
Branded				1771	283 (16.0%)	99.6 (113.3)	10	2 (20.0%)	46.5 (38.9)
Interaction of manufacturer type and top 50 manufacturer									
Branded=No, Top50=No				121	37 (30.6%)	105.4 (92.0)			
Branded=No, Top50=Yes				430	106 (24.7%)	98.5 (114.4)			
Branded=Yes, Top50=No				399	48 (12.0%)	129.8 (115.1)			
Branded=Yes, Top50=Yes				1372	235 (17.1%)	93.5 (112.2)			
Anatomical Therapeutic Chemical Classification (Level 1)									
Alimentary tract and metabolism	276	21 (7.6%)	114.5 (118.3)	194	26 (13.4%)	124.0 (147.7)	486	109 (22.4%)	200.1 (168.4)
Blood and blood forming organs	170	6 (3.5%)	69.7 (33.2)	70	10 (14.3%)	67.6 (48.6)	64	8 (12.5%)	165.1 (165.1)
Cardiovascular system	386	50 (13.0%)	104.2 (109.5)	294	66 (22.4%)	99.8 (92.6)	1636	432 (26.4%)	171.2 (153.0)
Dermatologicals	148	25 (16.9%)	98.0 (125.5)	140	34 (24.3%)	94.1 (104.8)	115	35 (30.4%)	134.6 (122.7)
Genito-urinary system and sex hormones	192	35 (18.2%)	101.1 (128.6)	190	38 (20.0%)	91.8 (119.9)	292	69 (23.6%)	164.8 (146.7)
Systemic hormonal preparations, excluding sex hormones and insulins	162	22 (13.6%)	152.5 (186.6)	105	14 (13.3%)	53.1 (40.4)	80	22 (27.5%)	267.3 (177.6)
Anti-infectives for systemic use	452	77 (17.0%)	175.3 (163.2)	219	31 (14.2%)	115.8 (120.6)	636	182 (28.6%)	173.4 (138.3)
Antineoplastic and immunomodulating agents	361	27 (7.5%)	109.9 (113.9)	247	23 (9.3%)	77.5 (84.1)	270	60 (22.2%)	134.2 (133.3)
Musculoskeletal system	126	14 (11.1%)	169.1 (166.2)	60	16 (26.7%)	126.1 (93.0)	358	72 (20.1%)	130.6 (120.0)
Nervous system	727	81 (11.1%)	149.5 (154.5)	562	102 (18.1%)	110.9 (132.9)	2228	608 (27.3%)	161.4 (143.3)

Variable	Markets			Branded DINs			Generic DINs		
	Total N	Markets in Shortage N (%)	Shortage Duration* Mean Days (SD)	Total N	DINs in Shortage	Shortage Duration* Mean Days (SD)	Total N	DINs in Shortage	Shortage Duration* Mean Days (SD)
Antiparasitic products, insecticides and repellents	11	2 (18.2%)	62.0 (55.2)	7	2 (28.6%)	62.0 (55.2)	22	4 (18.2%)	130.5 (87.0)
Respiratory system	163	40 (24.5%)	137.0 (173.5)	113	28 (24.8%)	75.9 (85.5)	155	50 (32.3%)	196.5 (192.9)
Sensory organs	138	47 (34.1%)	117.3 (103.5)	86	32 (37.2%)	109.9 (115.8)	159	72 (45.3%)	180.2 (165.1)
Various	159	15 (9.4%)	244.3 (249.7)	35	4 (11.4%)	40.0 (20.7)	26	7 (26.9%)	67.9 (34.2)

DIN: drug identification number; B: branded manufacturers; G: generic manufacturer; BIO: biologic manufacturer; *shortage duration among those in shortage

[a] On provincial formulary in at least one of the provinces except Quebec;

[b] Top 50 manufacturers by drug cost from public drug plans in Canada in 2017/18;

[c] Manufacturer size was defined by the total number of DINs. Small: [1,40), Medium: [40,99], Large: 100+;

[d] Type of manufacturer was defined based on the proportion of branded DINs by each manufacturer. Branded if the proportion ≥95%; Generic if the proportion is ≤5%.