Patterns of HIV Testing Among Ontario Physicians

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ABSTRACT

Objective: HIV testing is important for HIV prevention and control. Nevertheless, approximately 35% of HIV infections in Ontario remain undiagnosed. We examined patterns of HIV testing among physicians to determine provider-related factors associated with HIV testing in Ontario.

Methods: Providers identified from HIV test requisitions submitted to the Ontario Public Health Laboratory in 2006 were linked to a database of Ontario physicians using probabilistic matching. We examined HIV testing frequency by demographic characteristics and physician specialty. In multivariate logistic regression, we assessed factors associated with high testing frequency (20+ tests).

Results: 12,477 physicians (59.3% of Ontario physicians) prescribed at least one HIV test in 2006; the proportion was highest in Central East/other (72.4%) and Northern (69.4%) regions compared to others (53.7-58.7%), and highest among the most recent graduates (68.4% versus 59.0% among earlier graduates). A substantial proportion of physicians in family medicine/general practice (83.6%), obstetrics/gynecology (82.1%) and internal medicine (47.7%) prescribed HIV testing. Overall, most physicians (67.5%) prescribed fewer than 20 tests. High testing frequency was significantly associated with practice in Toronto (AOR 2.95), Central East/other (AOR 2.02), or Ottawa region (AOR 2.28), and specialty in family medicine/general practice (AOR 11.47), obstetrics/gynecology (AOR 6.31) or internal medicine (AOR 1.37). Physician sex and graduation country were not associated with high testing in multivariate regression. Of 361,609 tests, 1,048 (0.29%) were HIV-positive; 436 physicians (3.5%) had at least one HIV-positive result.

Conclusion: HIV testing among Ontario physicians varied substantially by health region, graduation year and specialty. These factors should be considered when delivering continuing medical education on HIV testing.

Key words: HIV serodiagnosis; physicians; Ontario; data linkage

La traduction du résumé se trouve à la fin de l'article.

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Voluntary HIV testing is an essential component of public health programs aiming to prevent and control HIV. Growing evidence suggests that HIV-infected persons aware of their serostatus are less likely to transmit HIV compared to those unaware of their HIV infection.^{1,2} In recent years, Ontario Public Health Laboratories (OPHL) carried out over 400,000 HIV tests annually and diagnosed approximately 1,100 persons with HIV each year, representing almost 45% of HIV cases reported in Canada.³ Uptake of HIV testing in Ontario has increased substantially over the past decade; however, an estimated 35% of HIV infections in Ontario remain undiagnosed.⁴

National recommendations on HIV testing and counselling are available;⁵ however, no guidelines exist that specifically address issues related to HIV testing of populations at risk and appropriate frequency of testing. While studies on HIV testing have focused on patient risk factors,^{6,7} little is known about provider-related patterns of HIV test prescribing. Such information is needed to develop HIV testing policy and continuing medical education. The objective of this study was to characterize HIV testing patterns among physicians in Ontario. Ontario physicians account for approximately 40% of physicians practising in Canada.⁸ Our specific aims were to examine demographic characteristics, specialty and frequency of HIV testing, as well as factors independently associated with high testing frequency.

METHODS

Data sources

Providers were identified from HIV test requisitions received at OPHL from January 1, 2006 to December 31, 2006. Physicians were

matched by name and postal code to a database of physicians practicing in Ontario (MD Select Ontario version 2006; available from: MD Select, 12 Concorde Place, Suite 800, Toronto, ON). Data linkage was carried out using probabilistic matching software (LinkPlus; Centers for Disease Control and Prevention, Atlanta, GA, USA).

Statistical analysis

All analyses were performed in SAS version 9.1 (SAS Institute Inc., Cary, NC, USA). We examined the distribution of physicians and HIV testing frequency by sex, graduation year (<1960, 1960-1974, 1975-1989, 1990-1999 or 2000-2003), country of graduation (Canada vs. elsewhere), health region and primary specialty (see Table 1) using chi-square tests, t-tests and analysis of variance. Health region was assigned from the public health unit corresponding to the physician's postal code using the Ontario public health units to postal code correspondence table (Available at: http://www.chass.utoronto.ca/datalib/other/referenc.htm#geog_ont). Although rare, when a postal code was assigned to more than one region, the region with the higher

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Table 1. Ontario Physicians Prescribing at Least One HIV Test and HIV Testing Frequency, by Demographic Characteristics, 2006

	Physicians			p-value*	Mean Tests	p-value†
	Total	HIV Testing	(%)			
Total	21,041	12,477	59.3		29.0	
Sex						
Female	6559	4073	62.1		26.2	
Male	14,471	8397	58.0	<0.0001	25.9	0.33
Graduation country						
Canada	15,964	9592	60.1		25.2	
Other	5077	2885	56.8	<0.0001	29.1	0.02
Health region‡						
Central East/other	3475	2517	72.4		25.6	
Central West	3643	2139	58.7		23.3	
Eastern/other	1196	665	55.6		15.9	
Northern	1117	775	69.4		16.6	
Ottawa	2369	1271	53.7		28.8	
Southwest	2280	1319	57.9		23.7	
Toronto	6961	3791	54.5	<0.0001	41.1	<0.0001
Graduation year						
<1960	836	354	42.3		26.4	
1960-1974	5087	2849	56.0		31.6	
1975-1989	9203	5605	60.9		31.5	
1990-1999	5178	3165	61.1		23.8	
2000-2003	737	504	68.4	<0.0001	20.5	0.01
Specialty						
Family Medicine	5099	4402	86.3		28.2	
General Practice	4907	3966	80.8		35.5	
Internal Medicine	2418	1153	47.7		18.8	
Psychiatry	1604	483	30.1		3.8	
Pediatrics	979	364	37.2		7.7	
Anesthesia	839	166	19.8		16.1	
Diagnostic Radiology	745	158	21.2		3.5	
General Surgery	704	240	34.1		5.8	
Obstetrics/Gynecology	661	543	82.1		64.7	
Orthopedic Surgery	421	132	31.4		3.8	
Ophthalmology	372	94	25.3		4.7	
Anatomical Pathology	267	57	21.3		37.9	
Otolaryngology	219	61	27.9		9.0	
Urology	217	91	41.9		10.8	
Neurology	204	97	47.5		3.1	
Plastic Surgery	169	52	30.8		25.1	
Emergency Medicine	157	67	42.7		13.9	
Community Medicine	89	30	33.7		295.9	
Medical Microbiology	25	15	60.0		582.3	
Other	937	304	32.4	<0.0001	18.1	<0.0001

Physicians with unknown characteristics are not shown.

* Chi-square test.

† T-test or F-test, as appropriate.

‡ Health regions were modified to reflect the heterogeneity of the HIV epidemic in Ontario and highlight the differences between larger urban centres and other parts of the province. The regions included were as follows: Central East/other (area around Toronto); Central West (Hamilton and Niagara); Eastern/other (area around Ottawa); Northern (Thunder Bay to Kenora); Southwest (London to Windsor).

Table 2. Number and Proportion of Physicians Prescribing HIV Tests in Ontario, by Number of HIV Tests per Physician

HIV Tests per Physician	Physicians		HIV Tests		
	N	(%)	N	(%)	Median (IQR)
1-4	4424	(35.5)	8123	(2.3)	1 (1 – 2)
5-19	3994	(32.0)	44,435	(12.3)	11 (7 – 15)
20-99	3547	(28.4)	139,791	(38.7)	33 (25 – 48)
100-999	483	(3.9)	113,534	(31.4)	157 (121 – 269)
1,000+	29	(0.23)	55,726	(15.4)	1579 (1260 – 2142)
Total	12,477	(100)	361,609	(100)	10 (2 – 26)

IQR = interquartile range

proportion of corresponding postal codes was chosen. We carried out backward selection multivariate logistic regression modeling to determine factors associated with high testing frequency. High testers were physicians who prescribed 20 or more tests in 2006, representing one third of physicians testing for HIV in Ontario.

RESULTS

Of 21,041 Ontario physicians (Table 1), the majority were male (68.8%), graduated in Canada (75.9%), and graduated in 1975 or later (71.9%). One third were located in Toronto; the most common specialties were family medicine (24.2%), general practice (23.3%), internal medicine (11.5%) and psychiatry (7.6%).

Of the 413,048 HIV tests submitted in 2006, 361,609 (87.5%) were linked to a physician. We identified 12,477 physicians who prescribed at least one HIV test (59.3% of Ontario physicians). The number of HIV tests per physician varied from 1 to 5,152 (mean 29.0, median 10 [IQR (interquartile range) 2-26]).

A significantly higher proportion of female physicians (62.1% vs. 58.0% of males) and physicians trained in Canada (60.1% vs. 56.8% of those trained elsewhere) prescribed at least one HIV test (Table 1). The proportion testing for HIV was highest among physicians in Central East/other (72.4%) and Northern (69.4%) compared to other regions (53.7-58.7%, $p<0.0001$); the mean number of HIV tests per physician was highest in Toronto (41.1) and low-

Table 3. Physician Characteristics Associated with Prescribing 20 or More HIV Tests

Variable	Physicians (%)	OR (95% CI)	AOR‡ (95% CI)
Sex			
Female	1422/4073 (34.9)	1.17 (1.08, 1.27)*	NS
Male	2634/8397 (31.4)	1.00 (referent)	
Graduation country			
Canada	3104/9592 (32.4)	0.97 (0.89, 1.06)	NS
Other	955/2885 (33.1)	1.00 (referent)	
Health region			
Toronto	1503/3791 (39.6)	2.11 (1.92, 2.31)*	2.95 (2.67, 3.27)*
Central East/other	950/2517 (37.7)	1.94 (1.75, 2.16)*	2.02 (1.81, 2.25)*
Ottawa	441/1271 (34.7)	1.70 (1.49, 1.95)*	2.28 (1.97, 2.64)*
Other	1165/4898 (23.8)	1.00 (referent)	1.00 (referent)
Specialty			
Family Medicine/GP	3602/8368 (43.0)	9.90 (8.42, 11.63)*	11.47 (9.74, 13.5)*
Obstetrics/Gynecology	172/543 (31.7)	6.07 (4.78, 7.71)*	6.31 (4.95, 8.04)*
Internal Medicine	114/1153 (9.9)	1.44 (1.12, 1.84)*	1.37 (1.07, 1.75)†
Other	171/2411 (7.1)	1.00 (referent)	1.00 (referent)

OR = odds ratio, AOR = adjusted odds ratio, CI = confidence interval

* Statistically significant (p<0.0001).

† Statistically significant (p<0.05).

‡ Model adjusted for graduation year.

Table 4. Number and Proportion of Physicians with at Least One Positive HIV Test; Number of HIV Tests, Positive Tests (P) and Positivity Rate (%), by Physician Characteristics

	Physicians			HIV Tests		
	N	P	(%)	N	P	(%)
Total	12,477	436	3.5%	361,609	1048	0.29%
Sex						
Female	4073	105	2.6%	124,745	238	0.19%
Male	8397	331	3.9%	236,738	810	0.34%
Graduation country						
Canada	9592	325	3.4%	262,426	786	0.30%
Other	2885	111	3.8%	99,183	262	0.26%
Health region						
Central East/other	2517	51	2.0%	64,531	146	0.23%
Central West	2139	56	2.6%	49,840	114	0.23%
Eastern/other	665	18	2.7%	10,543	32	0.30%
Northern	775	13	1.7%	12,840	20	0.16%
Ottawa	1271	59	4.6%	36,635	129	0.35%
Southwest	1319	29	2.2%	31,322	49	0.16%
Toronto	3791	210	5.5%	155,898	558	0.36%
Graduation year						
<1960	354	12	3.4%	9347	73	0.78%
1960-1974	2849	85	3.0%	89,939	370	0.41%
1975-1989	5605	218	3.9%	176,813	413	0.23%
1990-1999	3165	106	3.3%	75,190	167	0.22%
2000-2003	504	15	3.0%	10,320	25	0.24%
Specialty						
Family Medicine	4402	147	3.3%	124,273	312	0.25%
General Practice	3966	176	4.4%	140,904	423	0.30%
Internal Medicine	1153	63	5.5%	21,723	158	0.73%
Obstetrics/Gynecology	543	8	1.5%	35,119	11	0.03%
Psychiatry	483	6	1.2%	1858	6	0.32%
Pediatrics	364	3	0.82%	2806	3	0.11%
General Surgery	240	4	1.7%	1393	8	0.57%
Anesthesia	166	3	1.8%	2671	10	0.37%
Anatomical Pathology	57	3	5.3%	2159	6	0.28%
Emergency Medicine	67	2	3.0%	932	15	1.61%
General Pathology	35	3	8.6%	1769	3	0.17%
Community Medicine	30	5	16.7%	8877	21	0.24%
Medical Microbiology	15	3	20.0%	8735	62	0.71%
Other	954	10	1.0%	8388	10	0.12%
HIV tests/physician						
1-4	4424	40	0.90%	8123	43	0.53%
5-19	3994	77	1.9%	44,435	89	0.20%
20-99	3547	163	4.6%	139,791	219	0.16%
100-999	483	132	27.3%	113,534	329	0.29%
1000+	29	24	82.8%	55,726	368	0.66%

Physicians and tests where characteristics were unknown are not shown.

est in Eastern/other (15.9) and Northern (16.6) regions. The proportion testing for HIV increased significantly by graduation year, from 42.3% of physicians who graduated before 1960 to 68.4% of most recent graduates (p<0.0001). A substantial proportion of physicians in family medicine (86.3%), obstetrics/gynecology (82.1%), general practice (80.8%) and internal medicine (47.7%) prescribed HIV testing.

Among HIV testing physicians, the majority (8,418; 67.5%) prescribed fewer than 20 tests. A small proportion of physicians (4.1%) prescribed 100 or more HIV tests; however, a substantial proportion of tests (169,260; 46.8%) were submitted by 4,059 physicians who prescribed 20 or more tests (Table 2).

In multivariate analyses adjusted for graduation year (Table 3), high testing frequency was significantly associated with location

Table 5. Number and Proportion of Physicians with HIV-positive Tests and Number of HIV Tests per Physician, by Number of HIV-positive Tests per Physician, 2006

HIV-positive Tests per Physician	Physicians		Tests per Physician	
	N	(%)	Mean	Median (IQR)
1	311	71.3	77.9	31.0 (12 – 82)
2	49	11.2	228.5	104.0 (46 – 162)
3	24	5.5	257.7	197.0 (78.5 – 390.0)
4	11	2.5	615.6	415.0 (116 – 1,200)
5-9	27	6.2	704.3	298.0 (169 – 1,074)
10-29	11	2.5	1,692.5	1,579.0 (477 – 2,235)
30-79	3	0.69	2,606.0	1,772.0 (1,535 – 4,511)
Total	436	100	215.2	51.0 (18 – 151.5)

IQR = interquartile range

in Toronto (AOR 2.95), Central East/other (AOR 2.02) or Ottawa region (AOR 2.28), and specialty in family medicine/general practice (AOR 11.47), obstetrics/gynecology (AOR 6.31) or internal medicine (AOR 1.37).

Overall, 1,048 tests (0.29%) were HIV-positive (Table 4); HIV positivity rate was higher among tests prescribed by physicians who graduated before 1960 (0.78%) and internists (0.73%). When analyzed by testing frequency, HIV-positivity followed a U-shaped distribution where the rate was higher among physicians with lowest (1-4) and highest ($\geq 1,000$) number of tests (0.53% and 0.66%, respectively) compared to others (0.21%). Obstetrician/gynecologists prescribed 9.7% of HIV tests overall; however, HIV-positivity among their tests was low (0.03%). 436 physicians (3.5% of HIV testing physicians) had at least one HIV-positive result; this proportion was highest among physicians in Toronto (5.5%) and Ottawa (4.6%) compared to other regions (1.7-2.7%), and increased by testing frequency. Physicians with at least one HIV-positive test had from 1 to 79 HIV-positive tests each (Table 5). The majority (311; 71.3%) had only one HIV-positive test; 88.1% had up to three HIV-positive tests.

DISCUSSION

We linked routinely collected HIV testing data to an external database of Ontario physicians and found a substantial proportion (59.3%) of physicians prescribing at least one HIV test in 2006. The proportion testing for HIV was higher among more recent graduates and physicians located in Northern or Central East/other health regions. HIV testing was predominantly carried out by family/general practitioners, internists and obstetrician/gynecologists; these specialties had a substantial proportion of high testers and prescribed the majority (89.1%) of tests. Most physicians (67.5%) prescribed fewer than 20 HIV tests, but higher testing frequency was also associated with physicians located in Toronto, Ottawa or Central East/other regions.

Despite extensive HIV testing information in the OPHL database, our study had several limitations. We assigned tests to the primary prescribing physician on the requisition, yet physicians at some sites may submit tests on behalf of several providers. This may have underestimated the proportion of physicians testing for HIV and overestimated testing frequency among some groups, such as medical microbiologists and community medicine specialists. We assigned physicians to health regions based on their postal code in MD Select; however, physicians may have prescribed HIV tests from locations other than their primary address. We were unable to link 12.5% of HIV tests prescribed and did not capture most recent graduates because the physician database did not include those who

graduated after 2003; this also may have underestimated the number of testing physicians. Approximately 2% of HIV tests within the OPHL database are submitted by health care providers other than physicians. HIV tests submitted as part of prenatal screening (approximately 140,000 tests in 2006)⁴ were not analyzed because they are recorded in a different database. We found a high proportion (82.1%) of obstetrician/gynecologists testing for HIV with substantial frequency (64.7 tests per physician); nevertheless, exclusion of prenatal HIV tests likely underestimated HIV testing in this group. Finally, we were unable to account for patient load, clientele risk factors or testing venue. These factors would substantially influence physicians' likelihood and frequency of HIV testing, as well as HIV-positivity rate.

Prior to our study, little was known about HIV testing patterns among Ontario physicians. One survey found female physicians more likely to prescribe HIV testing.⁹ We found a slightly higher proportion of female and Canadian-trained physicians testing for HIV; however, in multivariate analyses, these factors were not associated with high testing frequency. Increased HIV testing among physicians located in Central East/other, Toronto and Ottawa regions may be due to high population and physician densities in these areas, as well as a greater number of physicians in specialties we found to be associated with HIV testing. Fewer HIV testing sites may be available to persons in the Northern region, which may explain the greater proportion of physicians testing for HIV in this area.

Increased HIV testing among more recent graduates may reflect updating of the undergraduate medical curriculum with respect to the evolving HIV epidemic in recent years. Recent graduates may be more comfortable providing HIV services or more likely to recommend HIV testing as part of routine sexual health care. Promotion of HIV testing should be included in continuing medical education and provider-related barriers to HIV testing should be explored. A review of HIV testing practices in the United States (US) identified lack of knowledge and training among several physician-related barriers to HIV testing.¹⁰ In Toronto, physicians who perform HIV screening of immigration applicants reported knowledge gaps related to facilitating linkage of newly diagnosed patients to treatment and community services.¹¹ Diagnosing a patient with HIV may reinforce HIV testing practices. As most physicians in our study (96.5%) did not receive an HIV-positive test result, strategies to encourage HIV testing may be useful. Interestingly, HIV-positivity rate was substantial among tests submitted by physicians with very low testing frequency (1-4 tests). Although this may indicate selective HIV testing, more importantly, this finding demonstrates that continuing education with respect to HIV testing should be aimed

at all physicians regardless of testing frequency. In early 2008, updated HIV testing and counselling guidelines were distributed to all providers who carried out HIV testing in Ontario.

Our study provides baseline data on HIV testing patterns for comparison to future estimates. Prior to updated HIV testing guidelines in the US, a national survey estimated that 24% of US physicians had ever prescribed an HIV test.¹² A similar study found that physicians who were female, Black or Hispanic, family/general practitioners in large urban settings, or had recent experience diagnosing HIV were more likely to provide HIV screening to all of their patients.¹³ HIV testing in acute-care settings also received considerable attention as a strategy to increase diagnosis of HIV infection.^{14,15} From 1993-2005, a substantial proportion (6%) of persons screened for HIV during an emergency department visit in the US were newly diagnosed.¹⁶ We found the HIV-positivity rate highest among tests submitted by emergency medicine physicians (1.6%) in comparison to other specialties. Although this represents a small number of physicians who did not exclusively submit HIV tests from an emergency department, HIV screening in this setting may be a useful approach to reach persons who may not otherwise access HIV testing. Several US studies have demonstrated that routine screening in emergency departments using rapid HIV tests is feasible, fairly acceptable, identifies a substantial number of persons unaware of their HIV infection, and is able to diagnose a considerable proportion of persons who would not have been tested using risk-based approaches.¹⁷⁻¹⁹ This strategy remains to be explored in Ontario; however, preliminary evidence suggests that the new provincial point-of-care HIV testing program is facilitating increased and earlier uptake of HIV testing.²⁰

We found that HIV testing among Ontario physicians varied substantially by health region, graduation year and specialty. To allow efficient targeting of efforts to promote HIV testing, these patterns should be interpreted while taking into account the proportion of undiagnosed HIV-infected persons. Estimates differ by exposure category: approximately 70% of estimated HIV-infected MSM (men who have sex with men) and IDU (injection drug users) in Ontario appear diagnosed; this is lower among persons from African and Caribbean communities (56%) and others infected through heterosexual contact (47%).²¹ While national surveys suggest that the proportion of persons in the general population who have ever tested for HIV increased over the past decade (from 17% in 1996 to 32% in 2006),⁷ the estimated proportion of persons tested for HIV in Ontario varies substantially by exposure category and health region (from 3% of heterosexual groups to 21% of MSM and 43% of IDU).²¹ Clearly, HIV testing patterns among physicians need to be understood within the context of clientele risk factors. However, efforts to support HIV testing practices should aim to encourage providers to offer appropriate and non-stigmatizing HIV services to all persons, regardless of clinician-perceived risk.

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RÉSUMÉ

Objectif : Le test de sérodiagnostic du VIH est important pour prévenir et enrayer ce virus. Malgré cela, environ 35 % des infections à VIH en Ontario ne sont pas diagnostiquées. Nous avons examiné les schémas de sérodiagnostic du VIH par les médecins afin de déterminer les facteurs associés aux dispensateurs de soins dans le sérodiagnostic du VIH en Ontario.

Méthode : Les dispensateurs, identifiés à partir des demandes de test VIH présentées au Laboratoire central de santé publique de l'Ontario en 2006, ont été maillés par couplage probabiliste à une base de données de médecins ontariens. Nous avons examiné la fréquence de sérodiagnostic du VIH selon le profil démographique et la spécialité des médecins. Au moyen d'une analyse de régression logistique multivariée, nous avons évalué les facteurs associés à une fréquence de sérodiagnostic élevée (20 tests et plus).

Résultats : 12 477 médecins (59,3 % des médecins ontariens) ont prescrit au moins un test VIH en 2006; la proportion était plus élevée

dans la région du Centre-Est/autre (72,4 %) et dans la région du Nord (69,4 %) que dans les autres régions (53,7 à 58,7 %), et plus élevée chez les diplômés récents que chez les diplômés de plus longue date (68,4 % c. 59,0 %). Une proportion importante de praticiens de la médecine de famille/médecine générale (83,6 %), de l'obstétrique/gynécologie (82,1 %) et de la médecine interne (47,7 %) a prescrit des tests VIH. Globalement, la plupart des médecins (67,5 %) ont prescrit moins de 20 tests. Il y avait une corrélation significative entre une fréquence de sérodiagnostic élevée et l'exercice de la médecine à Toronto (RCa = 2,95), la région du Centre-Est/autres (RCa = 2,02), ou la région d'Ottawa (RCa = 2,28), et les spécialités de la médecine de famille/médecine générale (RCa = 11,47), de l'obstétrique/gynécologie (RCa = 6,31) ou de

la médecine interne (RCa = 1,37). Le sexe des médecins et leur pays de diplomation n'étaient pas associés à des niveaux élevés de sérodiagnostic selon l'analyse de régression multivariée. Sur 361 609 tests VIH, 1 048 (0,29 %) étaient séropositifs; 436 médecins (3,5 %) ont commandé au moins un test VIH s'étant révélé séropositif.

Conclusion : Le sérodiagnostic du VIH par les médecins ontariens varie considérablement selon la région sanitaire, l'année de diplomation et la spécialité. Il faudrait tenir compte de ces facteurs dans la formation médicale continue sur le sérodiagnostic du VIH.

Mots clés : sérodiagnostic du VIH; médecins; Ontario; maillage de données

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