UCD Impact Case Study

Irish Prostate Cancer Risk Calculator: Reducing unnecessary biopsies

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ACADEMIC   ECONOMIC   SCIENTIFIC   HEALTH

SUMMARY

The most promising strategy for prostate cancer control is early detection. This involves the need for a prostate biopsy which is the gold standard for detection but which is also associated with significant side effects.

Determining the need for a biopsy is difficult. The development of our Irish Prostate Cancer Risk Calculator (IPRC) has shown a reduction of unnecessary biopsies, without affecting prostate cancer detection or significant diseases — which is outperforming the current approach.

This will reduce the number of men requiring biopsying and their exposure to its side effects, as well as decreasing pressure on our overburdened health care system and economic savings.

"The next improvement in the risk calculator will be the integration of current and novel biomarkers, increasing its sensitivity and specificity and further reducing the number of men needing to go for a biopsy"
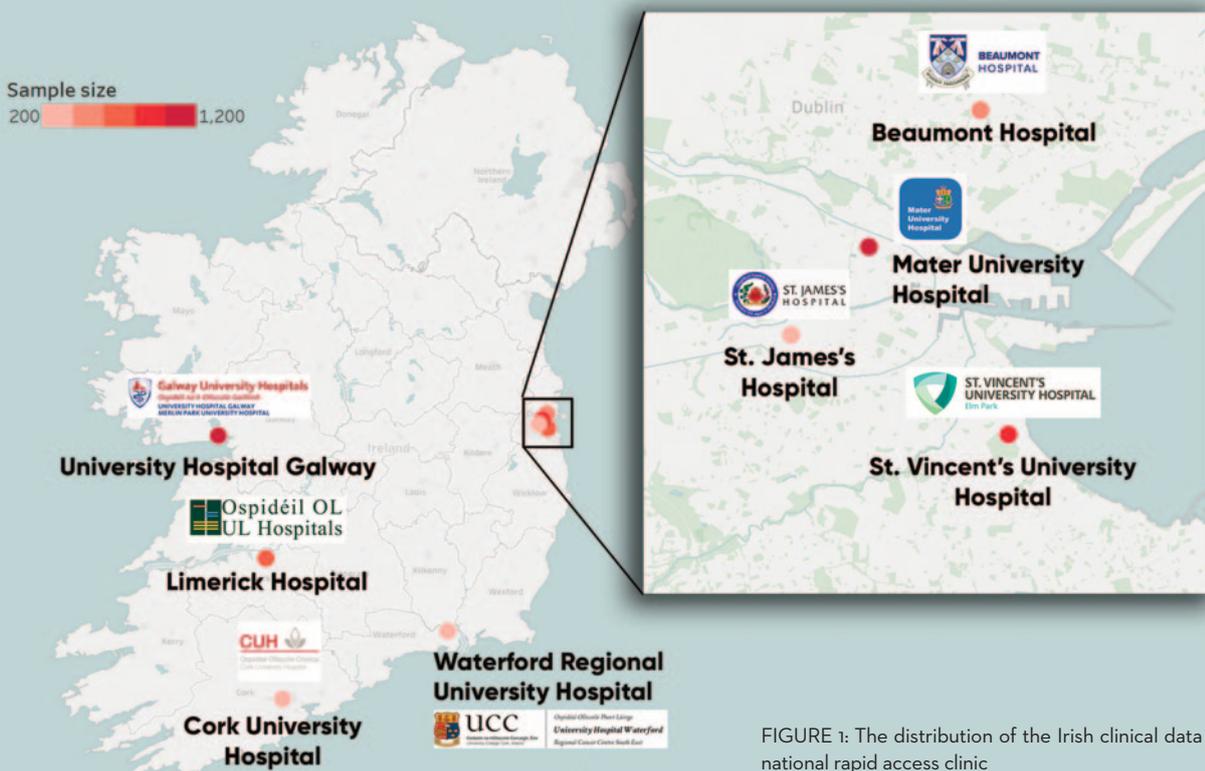

FIGURE 1: The distribution of the Irish clinical data from the national rapid access clinic

RESEARCH

Prostate cancer is the most common male solid organ cancer in Ireland [1]. Early detection remains the most promising strategy for cancer control. The gold standard for diagnosis is a biopsy. Risk factors such as PSA, digital rectal exam (DRE), family history, age and the patient's wishes inform the need for a biopsy. PSA is not always elevated nor indicative of cancer and can be raised in other conditions leading to overdiagnosis [2].

Current rapid access clinic data from around Ireland have shown only about 1/3 of men have cancer detected. This invasive procedure is associated with morbidity including urosepsis, urinary retention and hospitalisation [3].

What clinicians seek is a method that will inform them of the need for a biopsy. Risk calculators are guiding clinical decision making [4]. They would allow us to identify those at most risk. These individuals can then be targeted, saving many men from unnecessary biopsies, their side-effects and alleviating the pressures on our overburdened healthcare sector. The American PCPT-RC [5] and European ERSPC-RC exist, but previous work by our group has not validated these in an Irish population [6].

We collected clinical data from 4801 men across the rapid access clinics (Figure 1) and applied novel statistical approaches to build the IPRC. This outperformed the standard PSA blood test and reduced by 6% the number of men needing a biopsy, without impacting cancer detection or significant disease (Figure 2). Receiver operating curves demonstrated improvements over PSA and PCPT-RC (Figure 3).
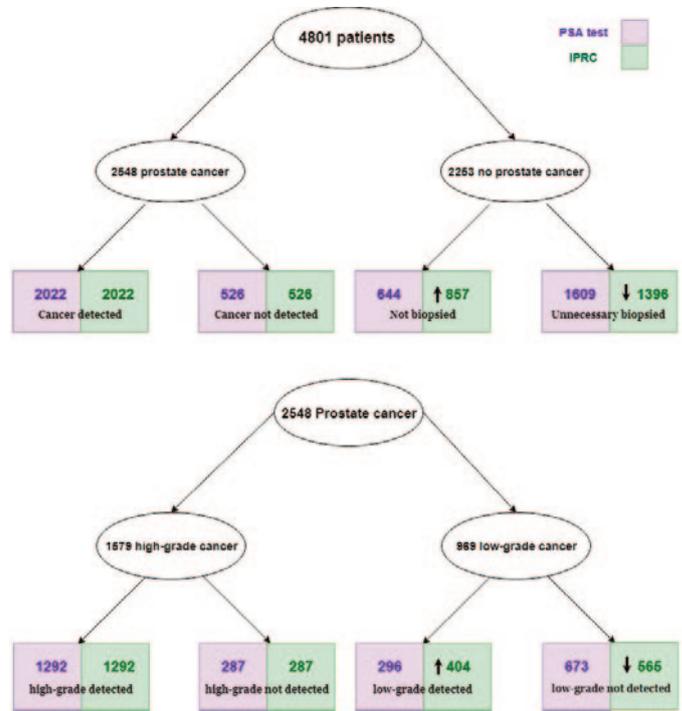

FIGURE 2: Flowchart of patients from the rapid access clinic categorised using the PSA blood test (purple) and IPRC (green) to inform the risk of prostate cancer (top) / high-grade prostate cancer (bottom). The IPRC reduces the number of unnecessary biopsies (far right-hand box) with no impact on cancer detection (far left-hand box)
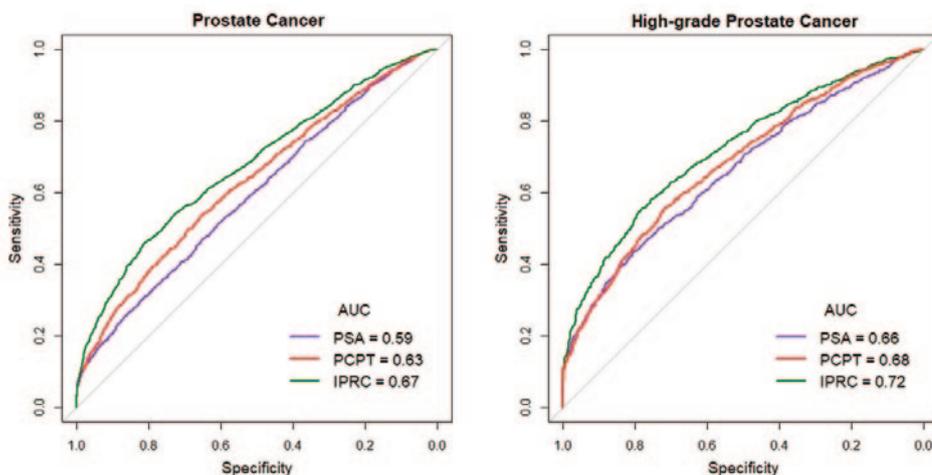

FIGURE 3: The graphical comparison of PSA test, the American risk calculator (PCPT) with IPRC to inform the risk of prostate cancer (left graph) / high-grade prostate cancer (right graph)

RESEARCH IMPACT

Prostate biopsies are a painful, invasive procedure with significant morbidity including urosepsis, urinary retention and hospitalisation. This multidisciplinary group has built the IPRC with a population of Irish men to reduce the number needing a biopsy without impacting on the detection of cancer or significant disease.

This represents an important impact on men by lowering their exposure to the side effects of biopsy as well as having to deal with the associated morbidity.

This reduction of men going for a biopsy will also lighten the burden on our already overburdened healthcare system. "Roll out of this new risk calculator will reduce the number of biopsies and free up time and resources to see more patients," says Mr David Galvin; consultant Urologist, St Vincents and Mater Misericordiae University Hospitals and Chair of the Prostate Cancer Group of the National Cancer Control Programme.

In 2010, 3,287 men were diagnosed with prostate cancer, but this represents only 23% of men who went for a biopsy [7]. This indicates the 11,004 men had biopsies with no detected cancer. Our test could have reduced the number of biopsies by 858. This reduction in annual biopsies will also result in a significant economic savings of about €371,000 as the cost for a biopsy was €432 per patient in 2010; this does not include the cost of dealing with biopsy complications.

We are currently working with the urologists of the rapid access clinics to embed the IPRC into the national guidelines and clinics, with the development of a user interface application.

This can be used at an early stage by the clinicians, and the results presented in a way that can be interpreted by them and their patients. "The IPRC demonstrates the importance of statistical modeling in medical decision making." says Prof Brendan Murphy, Professor of Statistics, UCD School of Mathematics and Statistics.

This work was also lead to a series of international publications leading up to the IPRC which have been cited over 75 times to date. For example, we investigated the use of two well-known risk calculators, PCPT and ERSPC and evaluated them on the Irish population [F]. We also studied the integration of new biomarkers into a clinical prediction model (e.g. Prostate Health Index) [E].

We are currently investigating the integration of Serum and Urine biomarkers into the risk calculator as part of our HRB grant and as part of an Enterprise Ireland Innovation Partnership Programme award in collaboration with RANDOX Teoranta. "The next improvement in the risk calculator will be the integration of current and novel biomarkers, increasing its sensitivity and specificity and further reducing the number of men needing to go for a biopsy," stated Professor William Watson, Professor of Cancer Biology in the UCD School of Medicine and Conway Institute, lead PI of the project.

We have designed a simple, interactive risk calculator to present to clinicians, patients and policymakers. This will contribute towards the reduction of unnecessary prostate biopsies in the future.

REFERENCES

Publications

[A] Oon, S. F., Fanning, D. M., Fan, Y., Boyce, S., Murphy, T. B., Fitzpatrick, J. M., & Watson, R. W. (2012). The identification and internal validation of a preoperative serum biomarker panel to determine extracapsular extension in patients with prostate cancer. The Prostate, 72(14), 1523-1531.

[B] Boyce, S., Fan, Y., Watson, R. W., & Murphy, T. B. (2013). Evaluation of prediction models for the staging of prostate cancer. BMC medical informatics and decision making, 13(1), 126.

[C] Foley, R. W., Lundon, D. J., Murphy, K., Murphy, T. B., Galvin, D. J., & Watson, R. W. G. (2015). Predicting prostate cancer: analysing the clinical efficacy of prostate cancer risk calculators in a referral population. Irish Journal of Medical Science, 184(3), 701-706.

[D] Lundon, D.J., Kelly, B.D., Foley, R., Loeb, S., Fitzpatrick, J.M., Watson, R.W., Rogers, E., Durkan, G.C., Walsh, K. (2015). Prostate cancer risk assessment tools in an unscreened population. World journal of urology, 33(6), 827-832.

[E] Foley, R. W., Gorman, L., Sharifi, N., Murphy, K., Moore, H., Tuzova, A. V., Perry, AS., Murphy, TB., Lundon, DJ., Watson, R. W. G. (2016). Improving multivariable prostate cancer risk assessment using the Prostate Health Index. BJU international, 117(3), 409-417.

[F] Foley, R. W., Maweni, R. M., Gorman, L., Murphy, K., Lundon, D. J., Durkan, G., Power, R., O'brien, F., O'malley, KJ., Galvin, DJ., Brendan Murphy, T. (2016). European Randomised Study of Screening for Prostate Cancer (ERSPC) risk calculators significantly outperform the Prostate Cancer Prevention Trial (PCPT) 2.0 in the prediction of prostate cancer: a multi–institutional study. BJU international, 118(5), 706-713.

Other References

National Cancer Registry (2014). Cancer in Ireland 1994-2011: Annual report of the National Cancer Registry 2014. http://www.ncri.ie/sites/ncri/files/pubs/annual/ report 2014 .pdf. Accessed 2 Jul 2014

[2] Loeb S, Bjurlin MA, Nicholson J, Tammela TL, Penson DF, Carter HB, Carroll P, Etzioni R (2014). Overdiagnosis and overtreatment of prostate cancer. European urology, 65(6), 1046-1055.

[3] Loeb S, Vellekoop A, Ahmed HU, Catto J, Emberton M, Nam R, Rosario DJ, Scattoni V, Lotan Y (2013). Systematic review of complications of prostate biopsy. European urology, 64(6), 876-892.

[4] Van Vugt HA, Roobol MJ, Busstra M, Kil P, Oomens EH, de Jong IJ, Bangma CH, Steyerberg EW, Korfage I (2012). Compliance with biopsy recommendations of a prostate cancer risk calculator. BJU international, 109(10), 1480-1488.

[5] Ankerst DP, Hoefler J, Bock S, Goodman PJ, Vickers A, Hernandez J, Sokoll LJ, Sanda MG, Wei JT, Leach RJ, Thompson IM. (2014). Prostate Cancer Prevention Trial risk calculator 2.0 for the prediction of low-vs high-grade prostate cancer. Urology, 83(6), 1362-1368.

[6] Foley RW, Maweni RM, Gorman L, Murphy K, Lundon DJ, Durkan G, Power R, O'Brien F, O'Malley KJ, Galvin DJ, Murphy T, Watson RW. (2016). European Randomised Study of Screening for Prostate Cancer (ERSPC) risk calculators significantly outperform the Prostate Cancer Prevention Trial (PCPT) 2.0 in the prediction of prostate cancer: a multi–institutional study. BJU international, 118(5), 706-713.

[7] Burns RM, Leal J, Wolstenholme J, O'Neill C, Sullivan FJ, Drummond FJ, Sharp L. (2017). The burden of healthcare costs associated with prostate cancer in Ireland. Glob Reg Health Technol Assess 4(1): e28-e33.