

# Dynamic pricing in the context of cost-effectiveness modeling and willingness-to-pay thresholds

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## Background

- Dynamic pricing refers to the concept of modelling drug price adjustments over time within a cost-effectiveness model, driven by market, clinical, and policy signals, such as reimbursement renewals, competition, wholesale price cuts, and patent expiry.<sup>1,2</sup>
  - This approach is critical in countries like Finland, where health system cost-effectiveness thresholds, including willingness-to-pay thresholds ( $\lambda$ ), are applied as formalized decision-making criteria.
- HTA typically relies on cost-effectiveness analysis based on static price rather than accounting for real-world pricing dynamics and price regulation.<sup>1,3</sup>
- Dynamic pricing is increasingly being discussed in the context of cost containment and estimation of the ICER.
- Higher ICERs than  $\lambda$  at launch may be possible as prices decline over time and ICER improves, converging toward  $\lambda$ .
  - However, the extent of price reductions remains uncertain, due to variability in patent expiry and market competition.<sup>3,4</sup>

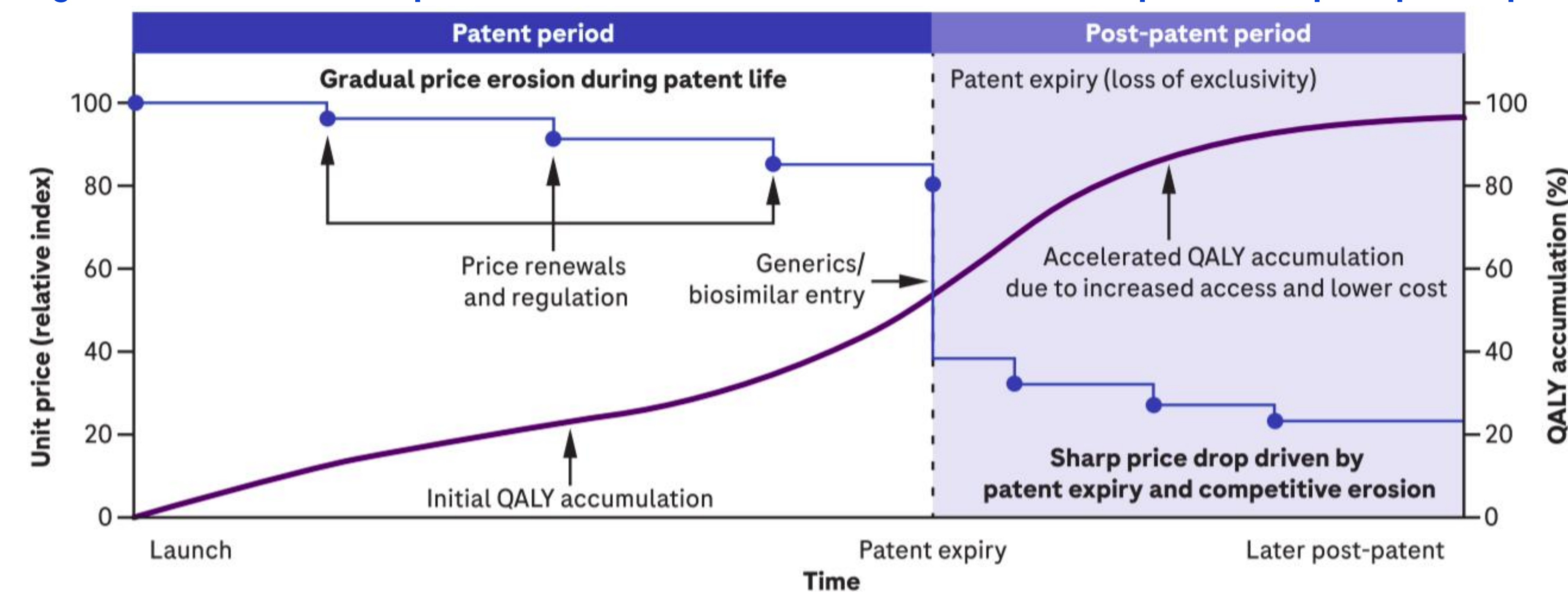
## Objectives

- Estimate the lifetime ICER of a hypothetical drug under various dynamic pricing scenarios, accounting for patent, price renewal, and generic entry price changes, as well as temporal QALY accrual.
- Determine the maximum acceptable ICER at launch, subject to  $\lambda$  constraints, given modeled assumptions for price and QALY distribution over time.

## Methods

- Unlike traditional real-world evidence studies utilizing patient-level clinical or claims data, this analysis relied exclusively on theoretical modeling using parameters derived from policy and regulatory scenarios (Figure 1).
- A two-period hypothetical model was developed to evaluate dynamic pricing under predefined  $\lambda$  (Tables 1 and 2).
- The launch unit price was assumed to correspond to the initial ICER, which was set to equal the approximate maximum  $\lambda$  in Finland.
- QALY accumulation (%) was used as a proxy for drug consumption in the periods before and after patent expiry. Future costs and QALYs were discounted by 3%.
- During the patent period, price reductions were assumed to occur due to periodic reimbursement renewals and applications for new indications.
- The average ICER during the product life cycle (two periods) and the maximum ICER at launch were calculated across different scenarios, conditional on  $\lambda$ .

Figure 1. Illustrative unit-price evolution and QALY accumulation across patent and post-patent periods



The model utilizes launch ICER instead of a specific unit price. The ICER scales linearly with unit price.

## Methods (continued)

Table 1. Input parameters

Symbol	Parameter	Base-case value	Scenario analyses value
$\lambda$	Willingness-to-pay threshold (€/QALY)	70,000	35,000; 50,000
E	Launch ICER (€/QALY)	70,000	
s	QALY share (%) before generic entry, (0-1)	0.5	0.2; 1.0
f	Average generic-phase price factor (0-1), generic price level	0.3	0.5
r	Relative price cut per re-assessment (0-1)	0.03	0.0; 0.07
m	Number of re-assessments during patent (integer)	6	1; 10
d	Discount rate for costs and QALYs (0-1)	0.03	0.00; 0.05

Table 2. Formulae

Not discounted	
Average price (factor) during patent period (in relation to launch)	$P\_patent\_avg$
Relative price multiplier during the whole life cycle	$R\_total = s * P\_patent\_avg + (1-s) * f$
Cumulative ICER (€/QALY)	$E * R\_total$
Maximum ICER at launch (€/QALY)	$\lambda / R\_total$
Decision	If cumulative ICER < $\lambda$ = Acceptable
Discounted	
Discounted average price (factor) during patent period (in relation to launch)	$P\_patent\_avg$
Discounted pre-generic weight (assumption: uniform period weights)	$s\_disc\_pre$
Discounted relative price multiplier during the whole life cycle	$R\_total (discounted) = [s\_disc\_pre * P\_patent\_avg\_disc + s\_disc\_gen * f] / [s\_disc\_pre + s\_disc\_gen]$
Cumulative ICER (discounted)	$E * R\_total (discounted)$
Maximum ICER at launch (discounted)	$\lambda / R\_total (discounted)$
Decision	If cumulative ICER (discounted) < $\lambda$ = Acceptable

$P\_patent\_avg = (1 + (1-r) + \dots + (1-r)^m) / (m+1)$ ;  $R\_total = s * P\_patent\_avg + (1-s) * f$ ;  $ICER\_cum = E * R\_total$ .

## Results

- The launch ICER is sensitive to  $\lambda$  (70,000 €/QALY).
- Launch ICER may be 1.2-2 times higher than  $\lambda$  when accounting for variability in the input parameters.
- With a lower threshold value of €35,000/QALY, the cumulative lifetime ICER equals the threshold with the maximum ICER at launch of approximately €57,000 under the most plausible parameter values (Table 3).
- The most sensitive parameters were QALY accumulation during the pre- and post-patent periods (base-case: 50%:50%), and the launch ICER relative to the threshold.
- Discounting, the number of price renewals, price increase according to inflation, the length of patent and post-patent periods in years, and the generic price level were less sensitive parameters.

Table 3. Cumulative ICER and maximum ICER at launch in Finnish scenarios (discounted)

	Cumulative ICER, €/QALY	Maximum ICER at launch ICER, €/QALY
Base case	43,063	113,787
$\lambda=35,000$	43,063	56,894
$\lambda=50,000$	43,063	81,276
$s=0.20$	29,825	164,291
$s=1.0$	65,126	75,239
$f=0.5$	50,063	97,877
$r=0.0$	45,500	107,692
$r=0.07$	40,101	122,191
$m=1$	45,500	107,692
$m=10$	41,361	118,469
$d=0.00$	42,978	114,013
$d=0.05$	43,118	113,641

## Conclusions

- Results were most sensitive to  $\lambda$ , launch ICER, and QALY accumulation during the patent period compared with the post-patent period.
- The relevance of the results depend on a product's life cycle stage, with greater uncertainty at launch due to price evolution, utilization, and generic entry, than in the later stages of a product's patent-protected period.
- This research example illustrates that average ICER over a novel drugs market lifecycle is likely to be lower than the ICER generated at the time of launch.
- While it can be argued that unit prices are set close to the highest acceptable cost-per-QALY threshold, research has demonstrated that the ICER may be lower than the relevant reimbursement threshold.<sup>5</sup>

## Abbreviations

HTA, Health Technology Assessment; ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life years.

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## Disclosures

This work has been produced and funded by F. Hoffman-La Roche Ltd. JRL is an employee of Roche Oy. KR and DE are employees of Genentech, Inc.

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