

# **Lead team presentation Ixazomib citrate in combination with lenalidomide and dexamethasone for relapsed or refractory multiple myeloma – STA**

1<sup>st</sup> Appraisal Committee meeting, 29 March 2017

Cost Effectiveness

Committee D

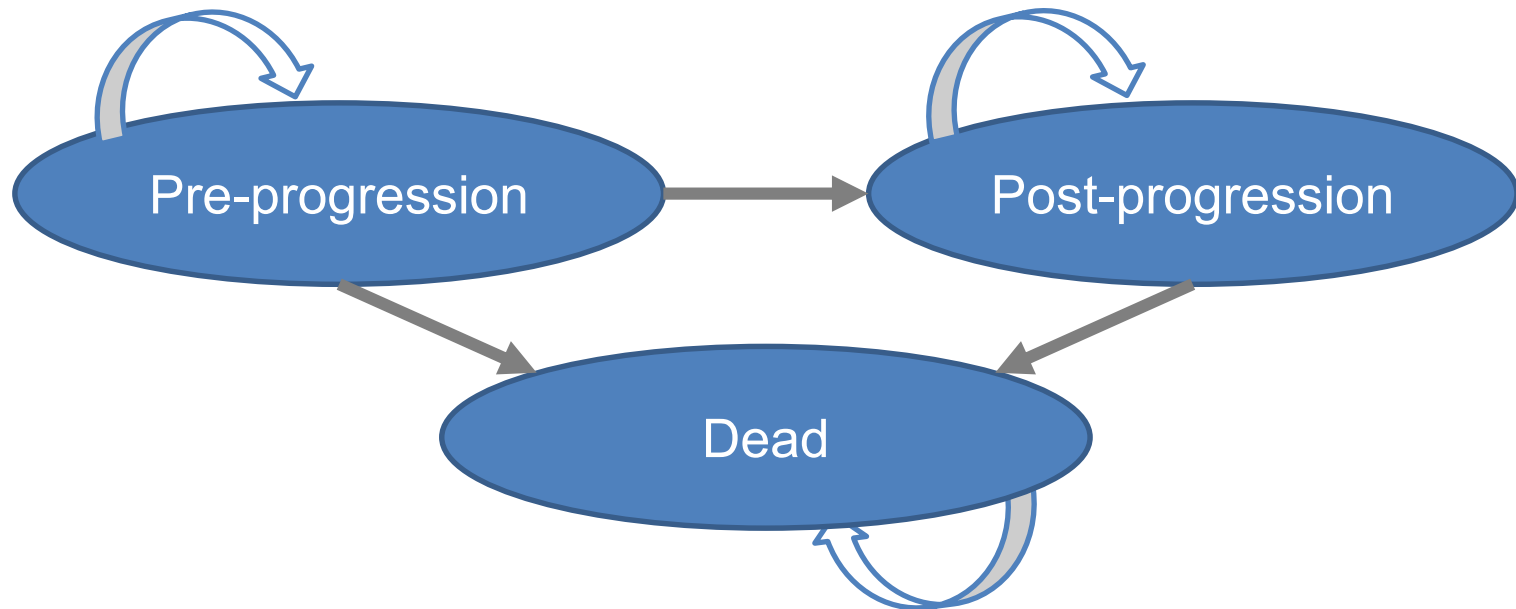
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ERG: Warwick Evidence

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Company: Takeda

# Company model: 3-state partitioned survival model



- 25 year time-horizon, because majority of patients aged 66 years and over at baseline
- Weekly cycle (with half cycle correction)
- Utilities and costs discounted at 3.5%
- NHS and personal and social services (PSS) perspective

# Clinical outcomes in the model: interim analyses of TMM1

## Company approach

- Base case model used data from first interim analysis of TMM1
- Scenario analysis using second data cut ↑ ICER by ~20% in 1 prior therapy group and ↓ ICER by ~10% in 2-3 prior therapies

## ERG comments

- Base case should use second interim analysis of TMM1
- Unable to fully critique model accompanying scenario analysis, but several immediate concerns about its validity:
  - company extrapolated OS and ToT using different models (log logistic and log normal), which typically have long and clinically implausible tails
  - company incorporated second data cut for 2 prior therapies but did not update NMA informing ICERs for 1 prior therapy group
  - company did not update HRQoL regression analysis using second interim analysis, which is a key driver of the model

# Relative efficacy: 1 prior therapy

## Company approach

- Relative efficacy compared with BORT+DEX based on NMA
- NMA used proxy data from TMM1: people who had received  $\geq 1$  prior therapy (ITT population)

## ERG comments

- The company underestimated benefits of BORT+DEX:
  - Company NMA underestimated OS with BORT+DEX
  - Issues with distribution of best overall response (BoR) for BORT+DEX (% of people in the VGPR+, PR and SD health states)
    - used a trial of BORT monotherapy
    - erroneously used BoR for DEX instead of BORT+DEX
- Proxy data not ideal but ERG preferred company methods to its exploratory analyses in people with only 1 prior therapy

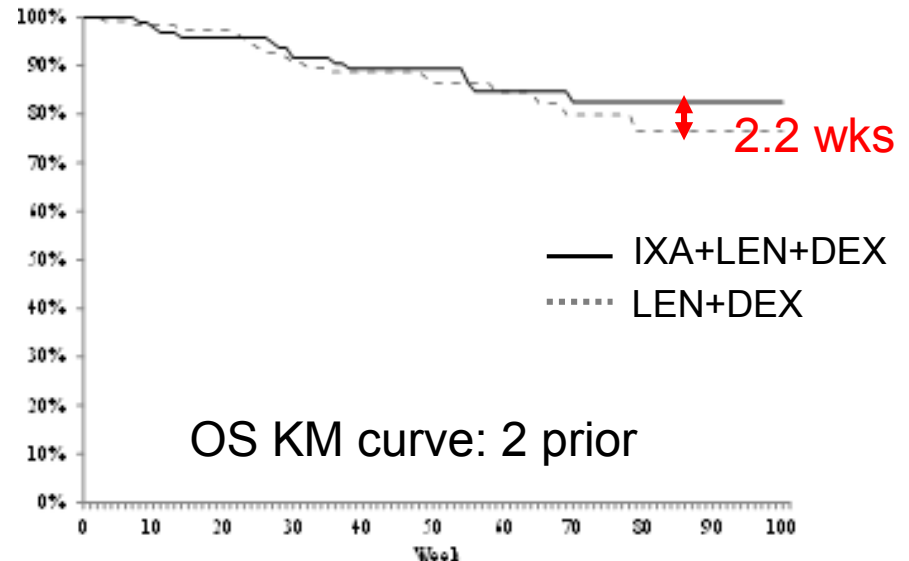
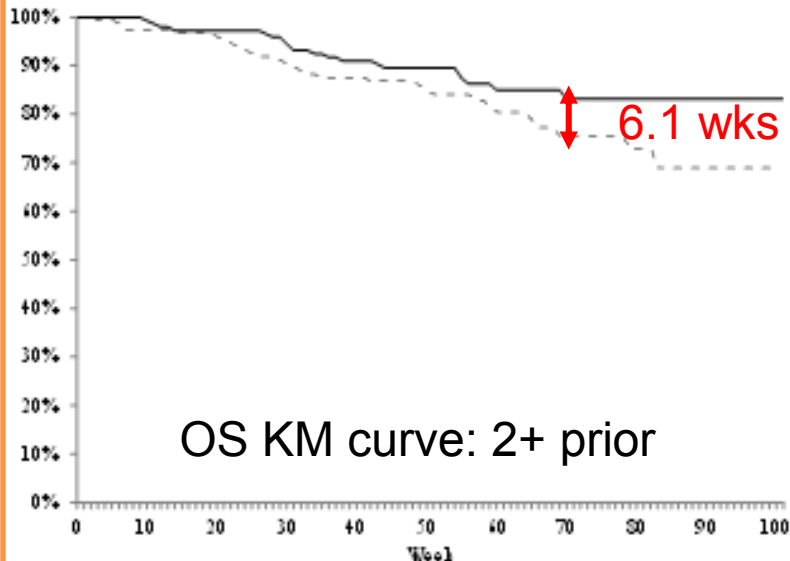
# Relative efficacy: 2 prior therapies

## Company approach

- Relative efficacy compared with LEN+DEX based on TMM1 directly
- Model used proxy data from TMM1: people who had received 2–3 prior therapies (pre-specified subgroup & stratification factor)

## ERG comments

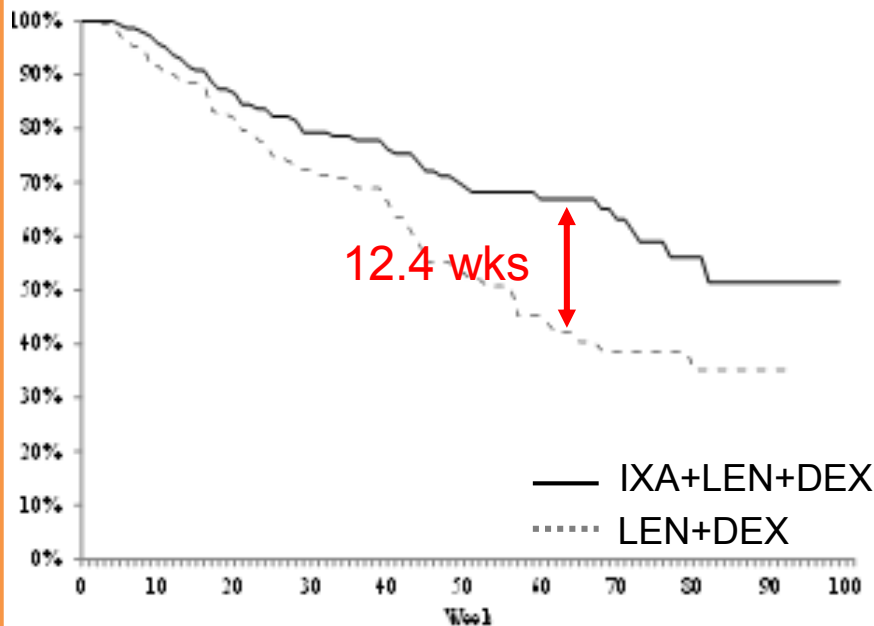
- Proxy data overestimates benefits of IXA+LEN+DEX at third line: **OS**



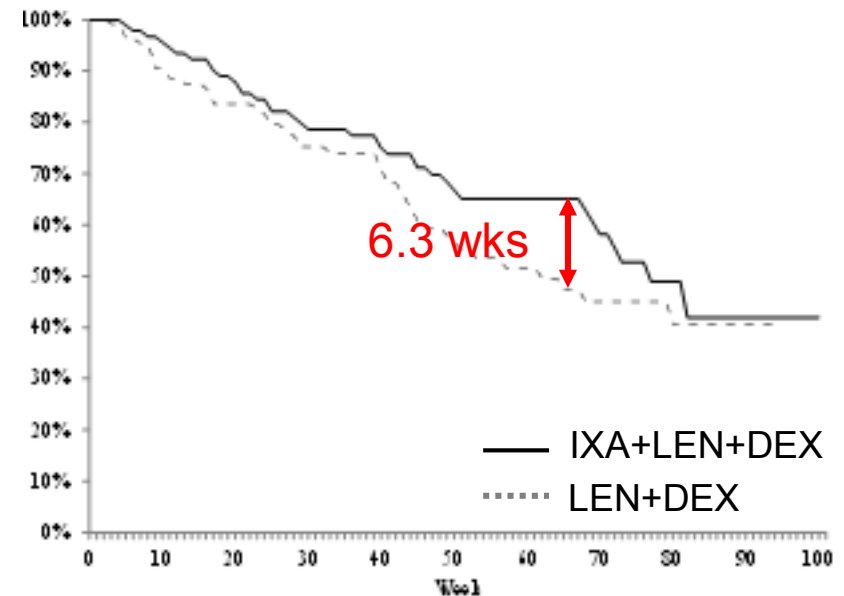
# Relative efficacy: 2 prior therapies cont.

## ERG comments

- Proxy data overestimates benefits of IXA+LEN+DEX at third line: **PFS**



PFS KM curve: 2+ prior



PFS KM curve: 2 prior

Sources: figs 48 (OS) & 49 (PFS) ERG report

# Utility estimates

## Company approach

- EQ-5D data from TMM1 (based on best overall response; not response observed at time of EQ-5D assessment)
- Decrement of 0.025 to patients receiving subcutaneous bortezomib

## ERG comments

- Disutility for subcutaneous BORT overestimated by applying it for entire 3-week duration of each BORT+DEX cycle
- Assuming utility for progressed disease is greater than utility for stable disease (0.654 vs. 0.653) contradicts published literature and expert opinion
- No exploration of HRQoL decline with lines of therapy or age
- No adjustment for baseline EQ-5D despite potential association between baseline EQ-5D and best overall response
- Utility in PFS state may be overestimated because it is based on best overall response (not response at time of EQ-5D assessment)

# Utility estimates (cont.)

## ERG comments

- Different distributions of best overall response (BoR) result in different treatment-specific PFS utility values
- Applied for entire duration that patients remain in PFS

		1 prior subgroup			2 prior subgroup	
		IXA	LEN	BORT	IXA	LEN
	Utility	NMA	Trial	Trial	NMA	Trial
VGPR+	0.712	47%	48%	46%	3%	59%
PR	0.674	33%	34%	32%	86%	31%
SD	0.653	15%	14%	16%	10%	21%
PFS	-	0.690	0.690	0.689	0.674	0.694

Company chose trial distribution; ERG consider this reasonable and consistent with using trial data for survival extrapolation

Lower utilities because small % in VGPR+, which is incorrect for BORT+DEX



# Costs

## Company approach

- Included drug acquisition and administration costs (incl. concomitant treatment), resource use & end-of-life
- Included patient access scheme (PAS) for comparators

## ERG comments

BORT+DEX costs overestimated because company assumed:

- BORT+DEX treatment stops at progression and PAS applied only if disease progressed within 4 cycles, whereas TA129 includes a stopping rule and PAS based on failure to achieve at least a partial response at 4 cycles
  - resulted in no BORT+DEX costs being refunded as per the PAS, because no patients progressed before the 4<sup>th</sup> cycle
- maximum of 9 cycles, even in people with complete response (SmPC specifies max 8 cycles and only 2 after complete response)
- same ToT for BORT+DEX and LEN+DEX; should have used HR for PFS compared with LEN+DEX (1.06)

# Costs (cont.)

## Company approach

- One-off cost applied for subsequent treatment (distribution of treatment from TMM1, assumed 24.4% patients receive treatment)
- Included LEN+DEX PAS in intervention arm for both populations
- Assumed dose intensities based on trial data for IXA+LEN+DEX (93.10%) and LEN+DEX (94.90%)
- Assumed dose intensity of 100% for BORT+DEX (no trial data)

## ERG comments

- Cost of subsequent therapy underestimated
  - proportion of patients with subsequent treatment underestimated
  - one-off cost cancels out between arms; more reasonable to apply ongoing weekly cost
- LEN+DEX PAS not applicable in 1 prior therapy group
- More consistent to assume 100% dose intensity for all treatments

# Costs (cont.)

## Company approach

- Costs were determined by time on treatment (ToT) curves

## ERG comments

PFS curve more appropriate for modelling treatment costs than ToT

- Using ToT to model costs may underestimate treatment costs because ToT curves were consistently below PFS curves
  - Why? Patients lost to follow-up censored for PFS but counted as event for ToT → patients lost to follow up without disease progression retained treatment benefits but without incurring costs
- Treatment discontinuation before disease progression was high

	1 prior therapy	2-3 prior therapies	
	IXA+LEN+DEX	IXA+LEN+DEX	LEN+DEX
Area under curve: ToT curve as a % of PFS curve	82%	65%	75%

Treatment holidays accounted for separately in model (dose intensity)

# Extrapolating OS, PFS and ToT

## Company approach

	<b>1 prior therapy</b>	<b>2-3 prior therapies</b>
<b>PFS</b>	Generalised gamma	Generalised gamma
<b>OS</b>	Delayed exponential (from month 5; KM HRs observed in TMM1 applied for the first 5 months)	Weibull
<b>ToT</b>	Weibull	Exponential

## ERG comments

- OS (1 prior therapy): Weibull more clinically plausible: close to zero patients alive at end of time horizon (delayed exponential predicted 3% IXA+LEN+DEX arm and 5% LEN+DEX arm still alive)
- PFS (1 prior therapy): Weibull has lowest AIC & BIC. Negligible impact on ICER in company & ERG analyses; would impact ICER if PFS used for costs
- ToT (2 prior therapies): expect same distribution to be appropriate for ToT and PFS

# Summary of ERG critique (1)

ERG comment	Addressed in exploratory analyses?
<b>1 prior therapy</b>	
Underestimated benefits of BORT+DEX because:	
NMA underestimated OS (because of an error in hazard ratios plus other methodological issues)	Yes: ERG base case
Error in estimation of best overall response	Yes: ERG base case
Overestimated BORT+DEX cost because:	
Maximum 9 cycles (rather than 8)	Yes: ERG base case
Same ToT as LEN+DEX	Yes: ERG base case
Treatment discontinued at progression (TA129 stopping rule not included) and no PAS refunds given	No
People with complete response receive max # of cycles	No
Patients completed every treatment cycle that they start	No
Lenalidomide PAS not applicable for 1 prior therapy group	Yes: ERG base case
<i>ERG alternative base case for 1 prior therapy labelled as 'ERG analysis 4' in ERG report</i>	

# Summary of ERG critique (2)

ERG comment	Addressed in exploratory analyses?
<b>2 prior therapies</b>	
Clinical data from people with 2–3 prior therapies used as proxy for 2 prior therapies subgroup	Yes: ERG analysis 5
<b>Both populations</b>	
Should have used second interim analysis of TMM1	No
PFS better than ToT for modelling costs	Yes: SA08
Inappropriate extrapolation of OS, ToT and PFS	Yes: SA01-SA03
Cost of subsequent therapy underestimated	Yes: SA09
Concerns with utilities:	
disutility for sc injection overestimated	Yes: ERG base case
progressed disease utility > stable disease utility	Yes: SA06
no adjustment for baseline EQ-5D or declining QoL	No
HRQoL in PFS state may be overestimated	Partially: SA06
<i>ERG alternative base case for 2 prior therapies is labelled as 'ERG analysis 2' in ERG report</i>	

# Company base case model results

*(including all patient access schemes)*

## For people who have had 1 prior therapy

Treatment	Total costs	Total QALYs	Inc. costs	Inc. QALYs	ICER/QALY
BORT+DEX	£40,612	1.74			
IXA+LEN+DEX	£201,274	3.93	£160,662	2.19	£73,333

When the ERG corrected the error in NMA and removed the LEN+DEX PAS from the intervention arm: **BORT+DEX dominated IXA+LEN+DEX**, with incremental costs for IXA+LEN+DEX of £169,000 and incremental QALYs of -0.382.

## For people who have had 2-3 prior therapies

Treatment	Total costs	Total QALYs	Inc. costs	Inc. QALYs	ICER/QALY
LEN+DEX	£91,428	2.204			
IXA+LEN+DEX	£222,532	3.174	£131,104	0.9694	£135,237

# ERG alternative base case (incl. PAS)

**For people who have had 1 prior therapy ('ERG analysis 4')**

Treatment	Total costs	Total QALYs	Inc. costs	Inc. QALYs	ICER/QALY
BORT+DEX	£69,872	4.356			
IXA+LEN+DEX	£238,733	3.932	£168,861	-0.424	Dominated

**For people who have had 2-3 prior therapies ('ERG analysis 2')**

Treatment	Total costs	Total QALYs	Inc. costs	Inc. QALYs	ICER/QALY
LEN+DEX	£97,655	2.204			
IXA+LEN+DEX	£231,377	3.174	£133,722	0.969	£138,000

**For people who have had 2 prior therapies only ('ERG analysis 5')**

*Using data from post-hoc analysis of people who had received 2 prior therapies only (instead of people with 2–3 prior therapies) increased ICER*

Treatment	Total costs	Total QALYs	Inc. costs	Inc. QALYs	ICER/QALY
LEN+DEX	£115,334	3.592			
IXA+LEN+DEX	£232,973	4.222	£117,639	0.631	£186,000



# ERG sensitivity analyses

- SA01: Varying the OS curves functional forms
- SA02: Varying the PFS curves functional forms
- SA03: Varying the ToT curves functional forms
- SA06: Applying the utility values from TA171 and TA338
- SA07: Assuming a 5 week cycle for BORT+DEX
- SA08: Costing treatments using PFS curve rather than ToT curve
- SA09: Increasing the cost of post-progression treatment by:
  - increasing the proportion of patients receiving subsequent treatment after progression from 24% to 41%
  - applying ongoing weekly cost of £1,561 (instead of a one off cost)

*Note that this does not include the cost of pomalidomide, which is now NICE-recommended and could affect the ICER*

# ERG sensitivity analyses (incl. PAS)

	<b>ICER for IXA+LEN+DEX (£/QALY)</b>	
	<b>1 prior therapy (vs. BORT+DEX)</b>	<b>2 prior therapies (vs. LEN+DEX)</b>
ERG base case	IXA+LEN+DEX is dominated by BORT+DEX	£138,000–£186,000
SA01: OS curves		£93,024–£290,000
SA02: PFS curves		£138,000–195,000
SA03: ToT curves		£138,000–£336,000
SA06a: TA171 utilities		£127,000–£173,000
SA06b: TA338 utilities		£134,000–£180,000
SA07: 5 wk BORT cycle		N/A
SA08: PFS instead of ToT		£176,000–£265,000
SA09: post progression costs		£151,000–£202,000

The range of ICERs in the 2 prior therapies group reflects results using proxy data from people with 2–3 prior therapies (lower estimate) and post-hoc data from people with 2 prior therapies only (upper estimate)

# End-of-life criteria

- Company state that, based on current data, the ixazomib regimen does not meet all end-of-life criteria
- Median OS not reached in either treatment arm of TMM1 trial; data were 35% mature
- Further follow up is warranted to determine final benefit
  - third interim OS analysis expected in Q2 2017
  - final OS analysis expected in Q3 2019
- Company did not comment on the life expectancy of people with relapsed multiple myeloma
  - Note: end-of-life criteria specifies a short life expectancy of less than 24 months, and evidence of extension to life of at least 3 months

# Company comments on innovation

- IXA+LEN+DEX is an all oral treatment regimen
  - First oral proteasome inhibitor
  - Lower toxicity than other treatments (*Note: the ERG suggest that this claim is not supported by clinical data*)
  - Convenient administration; reduced travel is important because bone degradation, fractures and fatigue are common symptoms of the disease (*Note: LEN+DEX is also an all-oral regimen*)
- Triple combination: benefits of a proteasome inhibitor, immunomodulatory agent and steroid
- There are benefits not captured by the QALY calculations:
  - Unmet need in 2<sup>nd</sup> and 3<sup>rd</sup> line
  - Convenient all-oral treatment taken at home (*Note: company base-case model includes disutility for subcutaneous treatment; the ERG removed this disutility from exploratory analyses*)
  - Reduced carer burden
  - Benefits for people still in employment

# Equalities

- No equalities issues were identified in evidence submissions from consultees

# Key cost-effectiveness issues (1)

- Is using data from the 1st, rather than 2nd, interim analyses of TMM1 sufficiently robust?
- When modelling 3<sup>rd</sup> line (2 prior therapies) positioning of IXA+LEN+DEX, is it more appropriate to use data from the pre-specified subgroup of people who had 2–3 prior therapies in TMM1 as a proxy, or data specific to people with 2 prior therapies (a post-hoc analysis)?
- The SmPC for LEN+DEX and IXA+LEN+DEX state that treatment should be continued until disease progression or unacceptable toxicity. Time on treatment (ToT) might therefore be shorter than PFS
  - How many people stop treatment before disease progression? Did the model overestimate this? In practice, would the ToT to PFS ratio for IXA+LEN+DEX be similar or different than for LEN+DEX?
  - More appropriate to use the ToT curve or the PFS curve to model treatment costs?
- Which is the most plausible method to extrapolate OS in the 1 prior therapy group? (company base case uses delayed exponential and the ERG are in favour of the Weibull). And for PFS - Weibull or generalised gamma?

# Key cost-effectiveness issues (2)

- Did the company overestimate the cost of BORT in its base case model?
  - Are the restrictions in the SmPC applied in practice? That is, a maximum of 8 cycles, with only 2 cycles given after a complete response?
  - Is the stopping rule in TA129 applied in practice (treatment stops in people who do not have a complete or partial response after 4 cycles)?
  - Do patients complete every treatment cycle that they start?
- Quality of life
  - Was it appropriate for the company to assume a higher utility for progressed disease than stable disease?
  - How do subcutaneous injections affect HRQoL? Does the model accurately reflect this?
  - Is there an association between baseline HRQoL and response? Does HRQoL decline with each relapse and age?
- Should post-progression treatments be modelled as a one-off or ongoing cost?
- CDF: does IXA+LEN+DEX have plausible potential to be cost-effective at the current price?

# Key clinical issues

- Does the company's placement of ixazomib (restricted to 2nd and 3rd line) reflect its anticipated use in clinical practice?
- Have all relevant comparators been included?
  - Is panobinostat used 3<sup>rd</sup> line?
  - What are the current established treatment options in England for people who have received 1<sup>st</sup>-line BORT (either as induction before ASCT, or in people ineligible for ASCT)?
- Does IXA+LEN+DEX improve clinical outcomes — including PFS, OS and response rates — compared with LEN+DEX?
  - Are these benefits maintained long-term?
  - Are there any subgroups in whom IXA+LEN+DEX is more effective? For example, based on number of prior therapies
- In the network meta-analysis, is it appropriate to:
  - use the Montefusco study? (as in the company NMA)
  - use TTP as a proxy for PFS? (as in the ERG exploratory NMA)
- Does IXA+LEN+DEX improve clinical outcomes compared with BORT+DEX?



Back up slides

# Adverse events in TMM1

Adverse events, n (%)	IXA+LEN+DEX (n=361)	LEN+DEX (n=359)
Any AE	355 (98)	357 (99)
Any grade $\geq$ 3 AE	267 (74)	247 (69)
Any serious AE	168 (47)	177 (49)
AE resulting in dose reduction of any drug in the regimen	203 (56)	181 (50)
AE resulting in discontinuation of any drug in the regimen	91 (25)	73 (20)
AE resulting in discontinuation of full drug regimen	60 (17)	50 (14)
On-study death	15 (4)	23 (6)
<b>Most common AEs</b>		
Neutropenia	118 (33)	111 (31)
<b>Thrombocytopenia</b>	<b>112 (31)</b>	<b>57 (16)</b>
<b>Diarrhoea</b>	<b>164 (45)</b>	<b>139 (39)</b>
<b>Rash</b>	<b>131 (36)</b>	<b>82 (23)</b>
<b>Peripheral neuropathy</b>	<b>97 (27)</b>	<b>78 (22)</b>
<b>Red bold denotes differences of <math>\geq</math>5% between the 2 treatments</b>		

# Common adverse events in TMM1 (second interim analysis)

	IXA+LEN+DEX (n=361)			LEN+DEX (n=359)		
	Any grade	Grade 3	Grade 4	Any grade	Grade 3	Grade 4
<b>Common haematologic AEs of any cause, n (%)</b>						
Neutropenia	118 (33)	64 (18)	17 (5)	111 (31)	63 (18)	22 (6)
<b>Thrombocytopenia</b>	<b>112 (31)</b>	<b>43 (12)</b>	<b>26 (7)</b>	57 (16)	19 (5)	13 (4)
Anaemia	103 (29)	34 (9)	0	98 (27)	48 (13)	0
<b>Common non-haematologic AEs of any cause, n (%)</b>						
<b>Diarrhoea</b>	<b>164 (45)</b>	23 (6)	0	139 (39)	9 (3)	0
<b>Rash SMQ</b>	<b>131 (36)</b>	<b>18 (5)</b>	0	82 (23)	6 (2)	0
<b>Rash HLT</b>	<b>72 (20)</b>	9 (2)	0	45 (13)	6 (2)	0
<b>Constipation</b>	<b>126 (35)</b>	1 (<1)	0	94 (26)	1 (<1)	0
Fatigue	106 (29)	13 (4)	0	102 (28)	10 (3)	0
<b>Nausea</b>	<b>104 (29)</b>	6 (2)	0	79 (22)	0	0

**Red denotes differences of  $\geq 5\%$  between the 2 treatments**

# Common adverse events in TMM1 (second interim analysis)

	IXA+LEN+DEX (n=361)			LEN+DEX (n=359)		
	Any grade	Grade 3	Grade 4	Any grade	Grade 3	Grade 4
<b>Common non-haematologic AEs of any cause, n (%)</b>						
<b>Peripheral oedema</b>	<b>101 (28)</b>	<b>8 (2)</b>	0	73 (20)	4 (1)	0
<b>Peripheral neuropathy</b>	<b>97 (27)</b>	<b>9 (2)</b>	0	78 (22)	6 (2)	0
<b>Back pain</b>	<b>87 (24)</b>	<b>3 (&lt;1)</b>	0	62 (17)	9 (3)	0
<b>Vomiting</b>	<b>84 (23)</b>	4 (1)	0	42 (12)	2 (<1)	0
Upper respiratory tract infection	83 (23)	2 (<1)	0	70 (19)	3 (<1)	0
Nasopharyngitis	81 (22)	0	0	73 (20)	0	0
<b>Insomnia</b>	73 (20)	7 (2)	0	<b>98 (27)</b>	11 (3)	0
<b>Muscle spasms</b>	66 (18)	0	0	<b>95 (26)</b>	2 (<1)	0

**Red denotes differences of  $\geq 5\%$  between the 2 treatments**

# ERG alternative base case: summary of changes

Updated BORT+DEX costs	<ul style="list-style-type: none"> <li>• Removed assumption that duration of BORT+DEX treatments is the same as LEN+DEX (by applying the HR for PFS to the LEN+DEX ToT curve)</li> <li>• Limited to 8 cycles (as per SmPC)</li> <li>• Added outpatient cost for administration</li> </ul>
Updated BORT+DEX benefits	<ul style="list-style-type: none"> <li>• Applied ERG NMA</li> <li>• Updated distribution of best overall response</li> <li>• Removed 0.025 disutility for sc administration</li> </ul>
Updated IXA+LEN+DEX costs	<ul style="list-style-type: none"> <li>• Removed lenalidomide PAS from intervention arm in 1 prior therapy group</li> </ul>
Other	<ul style="list-style-type: none"> <li>• Applied costs for iv administration of concomitant treatments</li> <li>• Assumed 100% dosing intensity</li> </ul>

# End-of-life criteria: conclusions of other appraisals in multiple myeloma

Appraisal	EoL?	Life expectancy <24 months	OS benefit >3 months
<b>2-3 prior therapies (3<sup>rd</sup> and 4<sup>th</sup> line)</b>			
TA427 pomalidomide (4 <sup>th</sup> line)	Yes	Yes (model predicted 13, 9 & 6 months OS with panobinostat, bendamustine & chemo)	Yes (vs. chemo or bendamustine)
TA380 panobinostat (3 <sup>rd</sup> line)	No	No (expert statement: OS with LEN+DEX = 30 months)	No
TA171 lenalidomide (3 <sup>rd</sup> line)	Yes	Yes (~9 months with DEX according to clinical trials & MRC data)	Yes
Carfilzomib (3 <sup>rd</sup> line); preliminary guidance	No	No (HMRN data shows 1.3 years OS with 3 <sup>rd</sup> line LEN+DEX, model predicted 5 years but too uncertain)	Yes
<b>1 prior therapies (2<sup>nd</sup> line)</b>			
ID934 carfilzomib; preliminary guidance	No	No; didn't meet for 3 <sup>rd</sup> line so would not meet at 2 <sup>nd</sup> line	Yes
ID667 lenalidomide; preliminary guidance	No	No; model predicted OS >24 months with chemo	Not discussed
TA129 bortezomib	N/A: appraisal conducted before EoL criteria introduced		

# End-of-life criteria: comparison of trial and model outcomes for mean OS

	Mean OS, months		
	IXA+LEN+DEX	Comparator	Incremental
<b>1 prior therapy</b>			
Clinical trial result	21.0	N/A	-
Company base case model (contains error in NMA)	20.9	16.6	4.3
ERG base case model (analysis 4)	21.5	20.9	-0.6
<b>2-3 prior therapies</b>			
Clinical trial result	20.9	19.3	1.56
Company base case model	21.1	19.8	1.4
ERG base case model (analysis 2)	21.1	19.8	1.4
ERG scenario in 2 prior therapies only (analysis 5)	20.9	20.3	0.5

# End-of-life criteria: undiscounted life-year gains in the model

	Undiscounted life years gained		
	IXA+LEN+DEX	Comparator	Incremental
<b>1 prior therapy</b>			
Company base case model (contains error in NMA)	7.2	2.6	4.5
ERG base case model (analysis 4)	7.2	8.1	-0.9
<b>2-3 prior therapies</b>			
Company base case model	5.3	3.6	1.7
ERG base case model (analysis 2)	5.3	3.6	1.7
ERG scenario in 2 prior therapies only (analysis 5)	7.7	6.5	1.3