Supplementary Material

Head and neck basal cell carcinoma excisions across specialties in hospital and practice settings.

Supplementary Methods

Study design, data source and data retrieval

Pathology records were extracted from the Danish Pathology Data Bank (Patobank), a nationwide pathology database containing all records of pathology specimens examined across Denmark. The registered demographic data from the database included the personal identification number of the patient (CPR), age, and sex. Basal cell carcinoma (BCC) excision data included a unique record ID, International Classification of Diseases (ICD) 10 codes, histological diagnoses including tumour subtypes, anatomical locations, procedure codes, histological conclusion on tumour-free margins (complete or incomplete BCC excision), and free text macro- and microscopic specimen descriptions including dimensions. Moreover, each BCC pathology record was linked to the executing practice or hospital unit. Specimens were examined by pathologists using the bread loaf technique (2D histology) followed by haematoxylin and eosin histochemical staining.

Anatomical location was extracted from SMOMED CT (Systematized Nomenclature of Medicine Clinical Terms) through a combined search string. Similarly, histology BCC subtype was from SNOMED CT. If unavailable, we used free text from macro- and microscopic specimen descriptions. An algorithm searched for terms and variations of "nodular" and excluded terms like *superficial*, *micronodular*, *infiltrative*, etc. (and all combinations of these). If the conditions were met, the subtype was recorded as nodular. If not, the subtype was recorded as not available (N/A). A manual review ensured the algorithm's accuracy. We extracted the specimen resection size from the largest noted specimen dimension (mm) using text search algorithms, since they were only available as unstructured text in the macroscopic description of pathology records. The size of the

actual tumour or operator safety margin was not available in Patobank and could therefore not be included in the analysis. Reporting of complete or incomplete BCC excision or unknown margins was retrieved from pathology records (SNOMED CT *free margins* M09400, *not free margins* M09401, or *margins not assessable* M09402).

Each practice or hospital department has a unique provider number, enabling us to extract and differentiate data by setting (practice vs. hospital) and medical specialty. These provider numbers are specified on a general list. Twenty-one of the practice provider numbers from the dataset were not on the general list and were therefore manually reviewed and accurately categorised.

BCC inclusion and exclusion criteria

The dataset included all standard excisions of primary BCCs (identified by SNOMED CT codes M809xx) on the head or neck (codes T015xx, T021xx-T023xx, T21xxx, TXxxxx, or TY01xx-TY06xx). We excluded BCCs that were described in free text or coded as recurring, assessed with use of intraoperative margin (e.g., frozen sections, repeat sections), biopsies (punch or incisional), or curettages. Skin closure methods, potential treatment complications, or recurrence rates were not assessed. All surgical specimens <5mm were excluded due to the high risk of such small sizes being curettage/biopsy samples that bypassed our search filter rather than being surgical excisions. Surgical specimens between 5-6mm were manually reviewed and excluded when relevant. To reduce the impact of erroneous records, we manually reviewed and removed all conspicuously large specimen sizes between 50-499mm. We marked specimen sizes >500mm as 'unknown' due to the high likelihood of error.

Data cleaning

Each pathology record could contain multiple tumours and an algorithm was developed to separate them. Inclusion and exclusion criteria were applied to each new tumour record.

BCC categorisation

BCCs were categorised by anatomical location: scalp, forehead, temples, postauricular areas, ears, periorbital areas, nose, cheeks, lips, chin, neck, and other facial areas. The periorbital area included corners of the eye, eyelids and periorbital areas; the cheek encompassed the cheeks, mandibular borders, and preauricular areas; the neck covered both the neck and throat. Resection sizes were categorised as: >3.5 cm, >2.5 – ≤3.5 cm, >1.5 – ≤2.5 cm, >0.5 – ≤1.5 cm and not available. BCC subtypes were superficial, nodular, micronodular, infiltrating, morpheaform, and basosquamous. For specimens containing a combination of two or more histologic subtypes, we selected the most aggressive subtype in the following descending order: basosquamous, morpheaform, infiltrative, micronodular, nodular, or superficial. Fibroepithelial BCC was included as nodular BCC. Furthermore, histological BCC subtypes and anatomical locations were pooled together. Histologically aggressive BCC tumour subtypes included basosquamous, morpheaform, micronodular, and infiltrative BCCs, while non-aggressive tumours were classified as superficial and nodular BCCs. Anatomical locations were grouped into two officially defined risk areas: area H and area M.[1] Area H, a high-risk location of recurrence, includes the central face, eyelids, eyebrows, periorbital area, nose, lips, chin, ears, temples, genitalia, hand, and feet. Area M, a moderate-risk location, includes cheeks, forehead, scalp, neck, and pretibia.[1] As this study investigates BCCs of the head and neck region, the risk locations were defined as follows: area H: temples, ears, postauricular areas, periorbital areas, nose, lips, and chin; and area M: scalp, forehead, cheeks, and neck.

1. Cameron MC, Lee E, Hibler BP, et al. Basal cell carcinoma: Contemporary approaches to diagnosis, treatment, and prevention. *J Am Acad Dermatol*. 2019;80(2):321-339. doi:10.1016/j.jaad.2018.02.083

Supplementary Table 1. Estimated cost of a standard BCC excision across health care settings and medical specialties as of 2024.

General practice[1]

Service code		Rate DKK	Rate EUR
0101	Consultation	DKK 163.18	EUR 21.87
2133	Dispatch of biological material excluding blood samples	DKK 39.82	EUR 5.64
2121	Other significant operations	DKK 445.71	EUR 59.75
		DKK 648.71	**EUR 86.96**

Alternatively

0101	Consultation	DKK 163.18	EUR 21.87
2113	Biopsy with subsequent microscopic examination by a pathologist, including dispatch	DKK 222.86	EUR 29.87
		DKK 386.04	**EUR 51.75**

Dermatology practice[2]

Service code		Rate DKK	Rate EUR
0110	Initial consultation	DKK 588.78	EUR 78.92
3110	Surgical removal of tumour (NMSC)	DKK 765.53	EUR 102.62
		DKK 1,354.31	**EUR 181.54**

Plastic surgery practice[3]

Service code		Rate DKK	Rate EUR
0110	Initial consultation	DKK 517.41	EUR 69.45
3112	Surgery for skin changes of suspected malignant nature (NMSC)	DKK 1,815.32	EUR 243.67
		DKK 2,332.73	**EUR 313.12**

Dermatology and plastic surgery department, hospital[4]

Service code (DRG)		Rate DKK	Rate EUR
09PR03	Skin operation, uncomplicated	DKK 4,233.00	EUR 567.43
		DKK 4,233.00	**EUR 567.43**

Ophthalmology department, hospital[4]

Service code (DRG)		Rate DKK	Rate EUR
02MP18	Minor operations, eyelids, eye muscles, conjunctiva, retina and vitreous, without general anaesthesia	DKK 2,108.00	EUR 282.57
		DKK 2,108.00	**EUR 282.57**

NMSC=non melanoma skin cancer. EUR conversion pr 8.11.2024, 1 EUR = 7.46 DKK.

Sources (in Danish):

[1] https://laeger.dk/media/cjphv0gt/honorartabel-2024-oktober.pdf

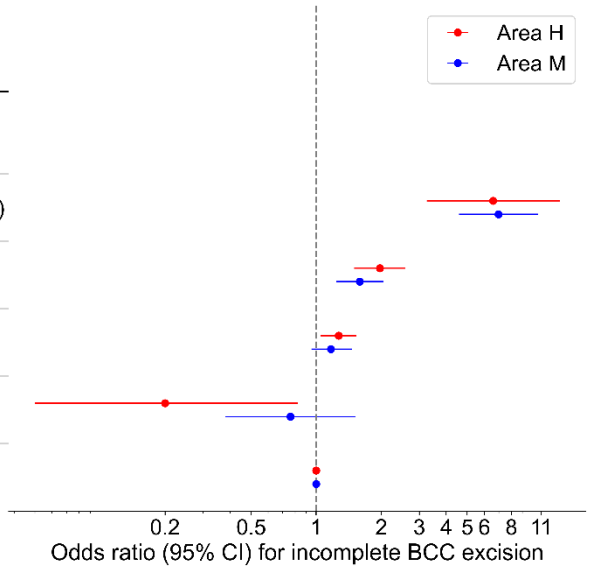
[2] https://laeger.dk/media/ss3otqwu/dermatologi-oktober-2024.pdf

[3] https://laeger.dk/media/khbdfzh3/plastikkirurgi-oktober-2024.pdf

[4] https://sundhedsdatastyrelsen.dk/-/media/sds/filer/finansiering-og-afregning/takster/2024/takstvejledning_2024.pdf

Supplementary Figure 1. Odds of incomplete BCC excision as a function of treatment setting stratified by anatomical location.

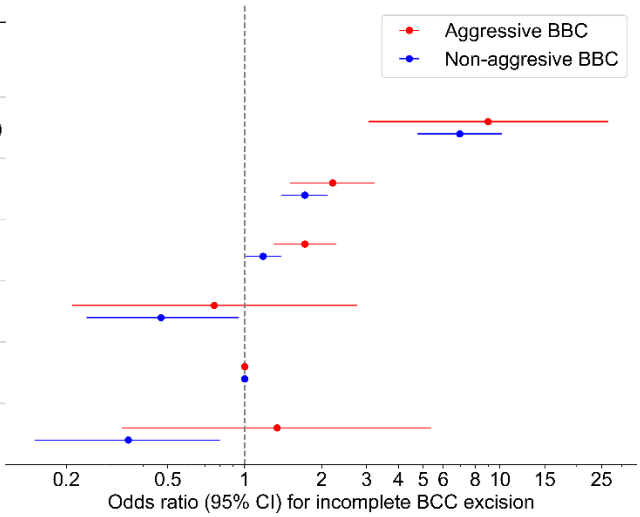
	Area H OR (95% CI)	Area M OR (95% CI)
Setting		
General practitioner Practice	6.59 (3.25-13.37)	6.98 (4.58-10.64)
Dermatology Practice	1.97 (1.50-2.58)	1.59 (1.24-2.05)
Plastic surgery Practice	1.27 (1.05-1.53)	1.17 (0.95-1.46)
Dermatology Hospital	0.20 (0.05-0.82)	0.76 (0.38-1.52)
Plastic surgery Hospital	1.00 (ref.)	1.00 (ref.)



Area M was moderate risk are of recurrence and included scalp, forehead, cheeks, and neck. Area H was high risk area of recurrence and included temples, ears, post auricular areas, periorbital areas, nose, lips, and chin. Odds ratios included multivariable adjustment with age, sex, histological BCC subtype, and surgical resection size. Hospital ophthalmologists were not included in the analyses as they only operated in area H. CI=confidence interval; OR=odds ratio.

Supplementary Figure 2. Odds of incomplete BCC excision as a function of treatment setting stratified by histological subtype.

Setting	Aggressive BBC OR (95% CI)	Non-aggressive BBC OR (95% CI)
General practitioner Practice	8.99 (3.05-26.49)	6.96 (4.75-10.21)
Dermatology Practice	2.21 (1.51-3.23)	1.72 (1.39-2.12)
Plastic surgery Practice	1.72 (1.30-2.28)	1.18 (1.00-1.39)
Dermatology Hospital	0.76 (0.21-2.76)	0.47 (0.24-0.95)
Plastic surgery Hospital	1.00 (ref.)	1.00 (ref.)
Ophthalmology Hospital	1.34 (0.33-5.38)	0.35 (0.15-0.80)



Non-aggressive histological subtypes included superficial and nodular BCCs. Aggressive subtypes included morpheaform, micronodular, infiltrative, and basosquamous BCCs. Odds ratios included multivariable adjustment with age, sex, anatomical tumour localisation, and surgical resection size. CI=confidence interval; OR=odds ratio.